
SCIENTIFIC MANAGEMENT OF NATURAL RESOURCES FOR SUSTAINABLE DEVELOPMENT

with special reference to

BUNDELKHAND
(THE SAGAR DIVISION)

SECTION - 1 STATUS OF RESOURCES

Dr. Bharatendu Prakash

M.Sc.,D.Phil.

Silver Jubilee Vikram Sarabhai Fellow

Madhya Pradesh Council of Science & Technology

Vigyan Bhavan, Nehru Nagar

BHOPAL 462003

M.P.

2013

PREFACE

Present document entitled “**SCIENTIFIC MANAGEMENT OF NATURAL RESOURCES FOR SUSTAINABLE DEVELOPMENT**” is the outcome of study and work which I did under Silver-Jubilee Vikram Sarabhai Fellowship awarded to me in the year 2008 by Madhya Pradesh Council of Science & Technology (MPCST Bhopal) for five years. Sagar division of *Bundelkhand* comprising five districts viz. Chhatarpur, Damoh, Panna, Sagar & Tikamgarh was taken up as the area of detailed study. Though initially water resources, soils (land use) and forest-resources comprising herbs / medicinal plants only were planned to be studied but while working it came to be clear that all aspects including regional background: history, geography, geology, topography, agricultural practices, climate and industry of the region must be looked at because these are interacting areas and must be kept in view for any suggestive plan towards sustainable development.

Thus this task gave me opportunity to understand region's geo-physical nature, drainage pattern, forests, rivers, hills, soils, Govt. policies & plans, industrial aspects, people's problems & ambitions, efforts and their culture. This also provided me time and resources to study several technology alternatives which could be successfully introduced to help the process of sustainable development. In regions such as *Bundelkhand*.

This study was planned to be completed in phases with three pronged strategy adopted as follows:

1. Observation of status related to remote locations & natural resources by visiting personally the forests, river projects, reservoirs, villages, block- and district- offices; interacting with scientists of nearby universities and institutions and organizing block-level meetings to understand realities and explore alternatives,
2. Documentation of views of common villagers as well as Panchayat-Heads regarding present situation, problems, obstacles, impact of climate change and seek their opinion through village-level surveys with help of volunteers preferably the local educated youth.
3. Exploring information from District Gazetteers, District level department-reports, reference books, dissertations and local newspapers etc.

This particular report comprises of two sections : Section (1), Section (2). Section (1) after introducing the region depicts status of resources and situation comprehensively and also the climatic indicators district wise while the Section (2) reflects over existing resources, presents potential of the region, people's perception of problems & their

opinion and desirable technologies & management-alternatives aiming at sustainable development of the region. The Appendix includes some articles which were prepared by me for presenting in some seminars and other relevant papers which relate to present area of study.

I am extremely grateful to Dr. Mahesh Sharma, former-Director General and Dr. Pramod Kumar Verma, present Director-General of Madhya Pradesh Council of Science & Technology, Bhopal for having provided me this opportunity and help in the process of studying major *Bundelkhand* region of Madhya Pradesh. My heart felt thanks are also due to Dr. Narendra Nath Mehrotra, ex-Executive Director (MPCST) who encouraged me to devote five years of my life in this important task. Cooperation of Dr. N.P.Shukla, ex-Project Director and Shri Ajit Kumar Shrivastava, present Executive Director of MPCST is being thankfully acknowledged.

Dr. G.S. Kaushal, Silver Jubilee Dr. Richharia Fellow (MPCST) working on sustainable farming systems helped me on several occasions and contributed a lot in my understanding of organic farming, an area overlapping my studies on sustainable technology- systems. I express my cordial gratitude to him at this occasion. Late Professor R.R.Das, the Silver Jubilee Sir C.V.Raman Fellow (MPCST) studying indigenous traditional knowledge systems was for me a friend and philosopher who cooperated in my work till last moment of his life. It was a great loss for all of us to have lost him during active period of the fellowship. I pay my deep regards to him.

I express my thanks to Professor Dr. L.P. Chaurasia and Dr. Satyendra Jain (Dr. HS Gaur Central University of Sagar), Dr. R.L.S. Sikarwar (Arogya Dham, Chitrakoot), Shri Chinmay Mishra (Sarvodaya Press Service, Indore), Shri Sachin Kumar Jain, Shri Gagan Nayar & friends (Vikas Samvad, Bhopal) and Dr. J.K.Bajaj (Centre for Policy Studies, New Delhi) for their help and valuable references. I am indebted to Shri Ajay Kumar and Dr. Upama Diwan for extending to us homely atmosphere and care. My special thanks are due to Late Dr. D.K.Sharma, Founder President of SIRD I for associating me to his organization. MPCST-scientist Dr. Manoj S. Rathore and Accounts Officer Shri VK Dubey deserve my cordial gratitude for continuous cooperation extended to me during entire duration of my fellowship and beyond.

I am particularly thankful to Scientists Dr. Subroto Khan (retd), Dr. Rajesh Saxena, Dr. R.K.Singh, Dr. Anil Khare, Dr. Sandeep Goyal, Dr. Dilip Soni, Dr. Somesh Pandey, Dr. Saroj Vokil, Dr. Reena Verma, Dr. Bhupendra Saxena, Dr. Ravi Bhardwaj, Dr. Rajesh Sharma and Dr. Bharat Singh for their friendly interaction and cooperation.

I must not forget to thank Mr. M.A. Thomas, assistant at D.G. 's office who always received us in Council with respectful smile.

I cordially thank friends Shri Anil Malaiya, Shri Vishal Prasad , Shri Santosh Chaturvedi , Shri Dayaram Namdeo , Shri Lal Singh Gaur , Shri Amit Bhatnagar , Shri Devidin, Shri Deepak Tewari, Shri Arvind Chhiroliya and Shri Ram Lakhan Tewari who contributed their time and energy in coordinating block level meetings and field surveys of nearly 2,900 villages in area of present study. I am highly thankful to volunteers who helped me by visiting various villages, interviewing villagers in all five districts .

Cooperation of Shri Durga Prasad Arya, Shri Sanjoy Singha, Shri Ravi Prakash Shukla and Smt. Damayanti Pani of M.P.Gandhi Smarak Nidhi has been of great help to me. The scientific and office staff of Bundelkhand Resources Study Centre (BRSC), Chhatarpur (past & present) viz. Shri Rajesh Sharma , Shri Narendra Saxena & Shri Vivek Goswami had been helpful in entire work including coordinating field surveys, accompany me to field visits , preparing summaries of findings and finally compilation of present report. My cordial thanks are due to all of them.

In course of this work I received cooperation from all the sectors concerned who not only appreciated such a study but also contributed their ideas & opinions towards practical approach to help future planning of the region.

It is not possible for me to express in words my gratitude to my wife Smt. Shobhana for working with me as real shadow extending her time, saving from domestic responsibilities, for helping in my study & tours , official dealings with the Council and elsewhere, preparing summaries of findings. and nursing me during my heart problems leading to an angioplasty in 2011, saving me from collapse of health through timely treatment & medication and encouraging me to devote to this work without other worries.

VIJAYA DASHMI
14th October 2013

-Bharatendu Prakash
Vikram Sarabhai Fellow (MPCST: 2008-2012)
Bundelkhand Resources' Study Centre
Chhatarpur 471001 M.P.

STATUS OF RESOURCES

CONTENTS

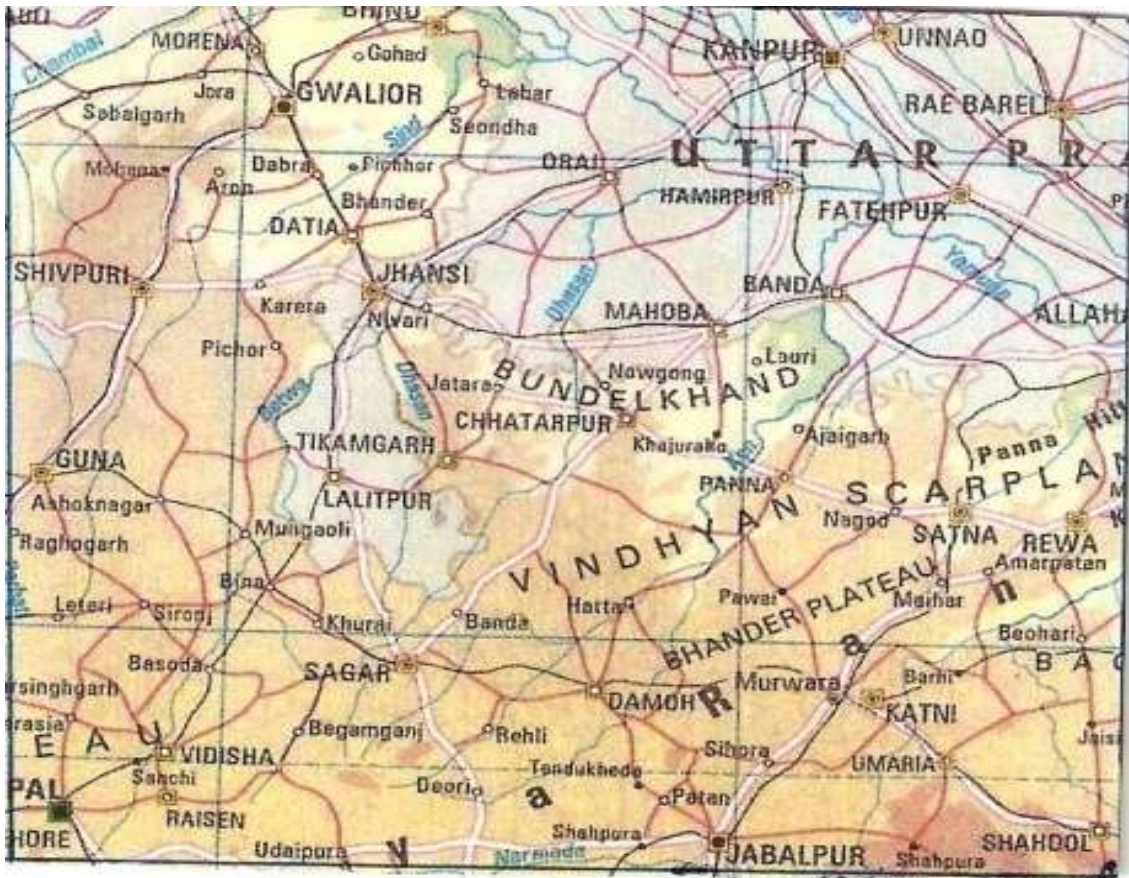
s.no.	what	Page Number
1	Background:	Chapter I 6- 51
2	<i>Bundelkhand</i> - The Sagar Division:	Chapter II 52- 133
3	Water Resources of Sagar Division:	Chapter III 134-194
4	Agriculture & Horticulture:	Chapter IV 195-240
5	The Forests:	Chapter V 241-270
6	Industriousness of People & Industries:	Chapter VI 271-299

Important References

BACKGROUND

INTRODUCTION

Map engulfing *Bundelkhand* Region



Present region of *Bundelkhand* lies between approximately $23^{\circ} 10'$ and $26^{\circ} 27'$ (north) Latitude and $78^{\circ} 4'$ and $81^{\circ} 34'$ (east) longitude, and comprises five districts of Sagar division (Chhatarpur, Damoh, Panna, Sagar & Tikamgarh) , one district of Gwalior division (Datia) , three districts of Jhansi division (Jalaun, Jhansi & Lalitpur) and four districts of Chitrakoot-dham division (Banda, Chitrakoot, Hamirpur & Mahoba). The cultural Bundelkhand , however, spreads beyond this region and touches partially some areas of the adjacent districts of Madhya Pradesh.

BASIC STATISTICS OF *BUNDELKHAND* REGION

Districts	Particulars						
	Area (km ²)	Population (2011)	Rural Population (%)	Villages	Gram-Panchayat	Janpad Panchayat / Development-Blocks	Population Density
Chhatarpur	8,616.82	17,62,275	13,63,359 (77.4)	1,080	558	08	205
Damoh	7,285.83	12,64,219	10,13,668 (80.2)	1,229	461	07	165
Panna	7,135.00	10,16,520	8,91,185 (87.7)	1,015	395	05	142
Sagar	10,252.00	23,78,458	16,69,662 (70.2)	2,059	753	12	197
Tikamgarh	5,048.00	14,45,166	11,95,293 (82.7)	865	459	06	286
Datia	2,959.00	7,86,754	6,04,772 (76.9)	583	280	03	266
Banda	4,114.20	17,99,410	15,23,655 (84.7)	681	463	08	437
Chitrakoot	3,452.91	9,91,730	8,95,398 (90.3)	536	317	05	287
Hamirpur	4,121.90	11,04,285	8,94,437 (81.0)	491	318	07	268
Mahoba	3,038.00	8,75,958	6,90,577 (78.8)	440	252	04	288
Jalaun	4,565.00	16,89,974	12,71,074 (75.2)	937	564	09	370
Jhansi	5024.00	19,98,603	11,65,119 (58.3)	755	449	08	398
Lalitpur	5,039.00	12,21,592	10,46,214 (85.6)	681	342	06	242
TOTAL:	70,651.66	1,83,34,944	1,42,24,413 (79.2)	11,352	5,611	88	-
Source: - Census Data (www.censusindia.gov.in) - District Profiles of M.P. Districts: Chhatarpur, Datia etc. - < www.uponline.in > & < www.indiawater.gov.in > (IMIS reports)							

COMPREHENDING *BUNDELKHAND*:

For understanding a region and its culture in depth basic knowledge of its history and geography is essential because both of these influence people's life-condition, culture, nature and their behaviour. *Bundelkhand's* history, however, has been so chequered that it never remained under one regime for a long period. Even its boundaries have been changing depending on the ruling dynasties and the political decisions..

A BRIEF HISTORY OF THE REGION :

Though geography of any region dates back to Earth's own creation but human history is taken to be initiating with advent of human beings in the area. In that respect early history of this region, presently known as *Bundelkhand*, starts with evidence of early man living here by rock paintings found at many places within Chitrakoot, Sagar, Chhatarpur, Panna and Datia districts.

During *ramayana*- era description of beautiful hills and forests is found around Chitrakoot where Lord Rama with Sita and Laxman stayed for major part of their exile. The region is also associated with *Maharshi Valmiki*, the author of epic *RAMAYANA* and *Maharshi Vyasa* who was born near confluence of Yamuna and Ken rivers (present Banda district) and lived at Kalpi (present Jalaun distrct.) . *Maharshi Vyasa* is known to have authored several *PURANAS* as well as the famous *MAHABHARATA* epic.

Within *MAHABHARATA* reference of this region is found as *CHEDI janapada* (kingdom), one of the 16 great *JANPADAS* of that time having its capital at *Shuktimati* which has been discovered to be located on the banks of KEN river (present Banda district). *CHEDI* - kingdom has been described as lying south of *Yamuna* river and between the *Chambal* and *Ken* rivers. . This is major area covered by *Bundelkhand* region even today. Around 324 BC *MAURYAS* seem to have extended their reign up to this region. Ashoka's inscription at Rupnath in Sihora (Jabalpur) , Gujarra-minor inscription in Datia, two *brahmi* inscriptions found at Budni (Hoshangabad district) and Sanchi (Raisen district) reveal close intimacy of the *Mauryans* with this region.

Around 184-185 BC *Sungas* seem to have succeeded *Mauryas* who ruled up to nearly 75 BC. Next follow in quick succession several dynasties e.g. *KANVAS*, *SATVAHANAS*, *KUSHANS*, *NAGAS*, *VAKATAKAS*, and *KALCHURIES* before *GUPTAS* succeeded to occupy large areas of Indian sub-continent including this region. Towards the end of *Gupta*-period towards end of 9th century AD, *HUNAS* led by Toramana appear on the scene for a short while. *KALCHURIES* are reported to be ruling over *Kalanjar* during early ninth century AD and were overpowered by *CHANDELLAS* , a dynasty which was to rule this tract for next four centuries. Just before *CHANDELLAS* ' arrival in the scene

there seem to be tussle amongst *PALAS*, *GURJARS*, and *RASHTRAKUTAS* too for a short while. Later *PRATI HARAS* of Kannauj are known to have proved their supremacy and *CHANDELLAS* began their rule first as their feudatories who later became powerful to declare themselves independent rulers of not only this region but of major north India.

Contribution of *CHANDELLAS* to this region has been immense. Not only on cultural front in terms of better art-forms, sculptures & temples of *KHAJURAHO* fame but also surface water management by building numerous notable lakes, ponds and water-reservoirs by themselves and also encouraging each village to have ponds and better rain water harvesting storages. *CHANDELLAS* ruling the region from *Kalinjar*, were challenged several times by Muslim invaders viz. Mahmud of Ghajni (11th century AD) and later Muhammed Ghori etc. Supremacy of *CHANDELLAS* was eclipsed with occupation of *Kalinjar* Fort by Kutubuddin Aibak fighting on behalf of Muhammed Ghori who established his rule over Delhi after defeating Prithviraj Chauhan towards end of thirteenth century AD.

KHANGARS are reported to appear on scene for a while before *BUNDELAS* took over from them and ruled this tract from fort of Kudar (popularly known as *GARH KUNDAR*, the Kunder Fort). Later *ORCHHA* was chosen to be main seat of *BUNDELA*- power by king Rudra Pratap in the year 1531 AD though his dream fulfilled only after 23 years when his younger son Madhukar Shah took charge of Orchha in the year 1554 AD. Orchha remained important kingdom of *BUNDELAS* before Maharaja Chhatrasal Bundela chose Panna to be his main seat of power. *BUNDELAS'* relation with Moghuls of Delhi had been constantly of love and hate. Maharaja Chhatrasal during his time carved *Bundelkhand* as an independent state and resisted all the attempts from Delhi to annex it. The present understanding of *Bundelkhand's* boundary is on the basis of a popular saying :

IT JAMUNA UT NARBADA, IT CHAMBAL UT TAUNS
CHHATRASAL SE LARAN KI RAHI NA KAHU HAUNS,

(BUNDELKHAND : South of Yamuna and North of Narmada; East of Chambal & West of Tons)

Maharaja Chhatrasal in his last days had to take help from Peshva Bajirao of Pune in his efforts to repulse Muhammed Khan Bangash who attacked *Bundelkhand* on behalf of Moghul rulers of Delhi. Bangash was defeated but in recognition of timely help of Peshvas Maharaja offered to them one third of his territory of *Bundelkhand*. The entry of Peshvas followed by other Marathas, however, was not of any benefit to *Bundelkhand*. People had to fight even the ruling Marathas. *BUNDELAS* though split in many states were still major rulers in this region.

The year 1762 AD seems to be the last to show combined strength of *BUNDELAS* when they repulsed the forces of Nawab of Lucknow led by Karamat Khan who attacked this region crossing Yamuna in the north. This fight occurred at the fields ca. 20 km north of Banda near present Tindwari town. But later on mindless infighting amongst *BUNDELA*-princes themselves, however, made them so weak that Ali Bahadur, an off-spring of Peshvas of Pune ruling as Banda-Nawab during the end of eighteenth century annexed some of their area including the Bijawar state.

The treaty of Bassein (1803) between Peshvas and British rulers, however ended Maratha dominance in this region. British entered the Maratha-region of *Bundelkhand* with authority although none of the local rulers including local Marathas, the leaders and common people liked this turn of the events. Later on when British started extending themselves, they were challenged by local rulers, land lords and the freedom-loving common people. The *BUNDELA*-revolt against British rule in 1842 and later the 1857 – uprising from all quarters have been important historical events which involved people of this region.

The resistance put forth by Queen of Jaitpur, Peshvas of Bithoor. Rani Laxmibai of Jhansi, Nawab of Banda, Raja Mardan Singh of Banpur, Maratha leader Tatya Tope etc. and several companies of Indian soldiers under British control, was of major significance. This could be termed as the first combined struggle of freedom against a foreign ruler. British, however, settled here firmly after 1862 AD. *Bundelkhand* –states under local kings were issued *SANADS* while a large area covering Jalaun, Jhansi, Hamirpur, Banda, Damoh and Sagar was brought under direct British rule. The *Bundelkhand* as a compact geographical region was thus split and enslaved for next nine decades.

The 20th century is known to have brought consciousness & political awareness throughout India under leadership of prominent persons like Gopal Krishna Gokhle, Bal Gangadhar Tilak, Neta ji Subhash Chandra Bose and Mahatma Gandhi etc. the sacrifices of several notable revolutionaries, non-cooperation and quit-India movements coupled by consequences of the 2nd World-war forced British to leave this country handing over its rule to Indian people on 15th August 1947. All the princely states of *Bundelkhand* which were tributaries to British rulers also achieved independence.

Meanwhile strong current of awareness amongst some of *BUNDELKHAND* – activists, intellectuals, and social thinkers influenced by Mahatma Gandhi and the martyrs started agitating for responsible governments in the erstwhile princely states. Simultaneous push from the newly independent India's strong Home-Minister Sardar Vallabh Bhai Patel ultimately forced these states to join Indian Union. In 1950 a state entitled *Vindhya*

Pradesh was formed comprising all of these states but before long a new state of *Madhya Pradesh* came into being in the year 1956 and most of the princely States were made part of the new province M.P. Some of the states were also merged with *Uttar Pradesh* which were located in Jalaun, Jhansi, Hamirpur , Banda and Chitrakoot districts.

The BUNDELKHAND under M.P. today as mentioned earlier constitutes districts. viz. Chhatarpur, Damoh, Panna, Sagar and Tikamgarh under Sagar Division and Datia under Gwalior Division.

PHYSICAL FEATURES

TOPOGRAPHY :

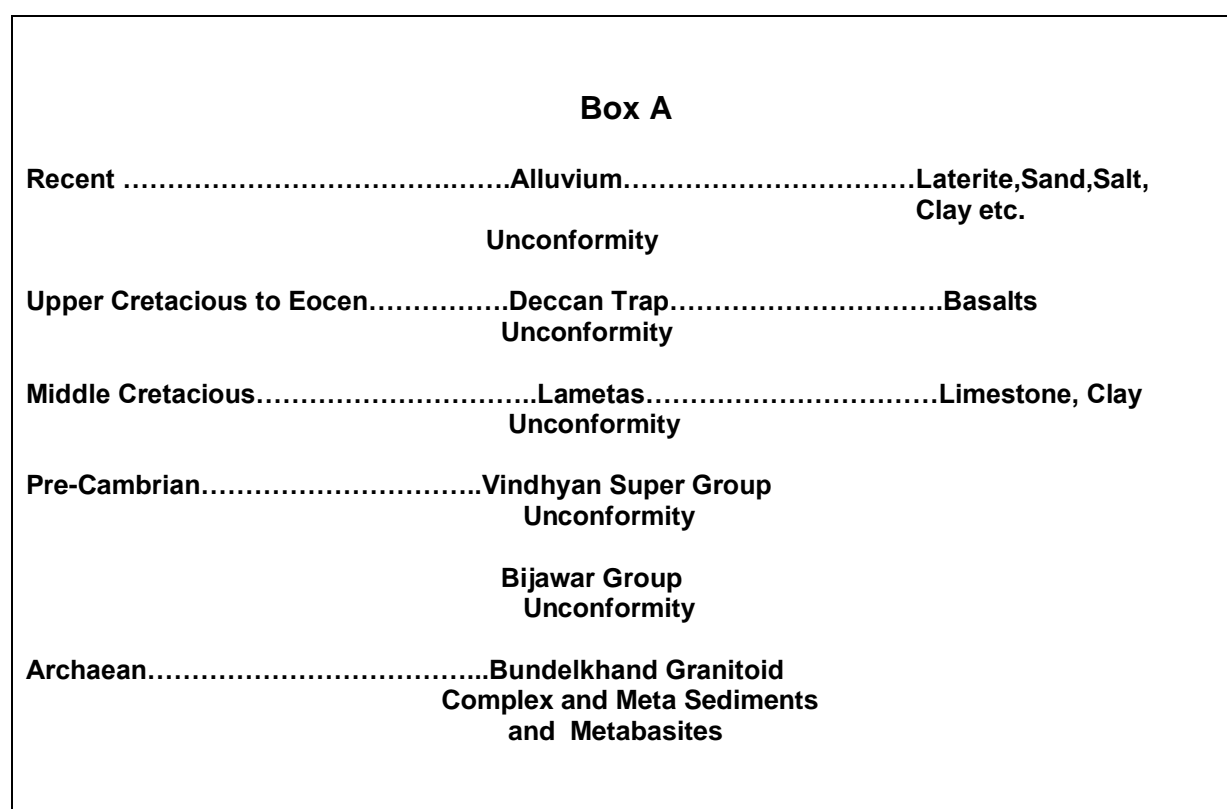
Bundelkhand has been endowed by Nature ,with beautiful mountains, good perennial rivers, fast flowing seasonal rivulets, large forest areas with valuable timber , fruit trees, numerous medicinal plants and herbs all over and rich alluvial plains with comprehensive agriculture activities mostly in the north . To the south of this region, *VINDHYACHAL* range is all along stretched while some part is also plane suitable for agriculture. Geographically present *Bundelkhand* is a part of the central zone of India with a group of north-bound perennial rivers flowing and paying tribute to river Yamuna . From west to east these are Sind, Pahuj, Betwa, Dhasan, Ken, Baghein, Paisuni and Tons. Along with Chambal and Yamuna there are ten rivers justifying one of its ancient name *DASHARNA* (Region of ten rivers). All the above rivers are also joined by large number of east and west flowing rivulets , many of them being seasonal in nature.

The region of *Bundelkhand* is homogeneous dissected upland, presenting an old eroded surface , carved out of granite ,with northern alluvial plains merging imperceptibly into the granite uplands. The frequent constriction of drainage by the dykes has resulted in the multiplicity of small tanks , practically in all parts of the region. To the south of the region's upland , stand out three massive sandstones with quite distinctive features . These are known as Kaimur sandstone, Rewa sandstone and Bhandar sandstone.

Some salient features of various districts of Sagar division could be seen later in next chapter when each district has been discussed separately.

GEOLOGY :

The general geological succession of entire region of Bundelkhand could be seen in Box A. The metasediments and metabasites, which occur as enclaves within the granite rocks, form good exposures in Mahroni tehsil of Lalitpur district. The metasedimentaries mainly comprise quartzite, quartzose-schist and quartz sericite schist. The metabasites are represented by peridotite, serpentinite, pyroxinite and amphibolites rocks. The scattered small exposures of these rocks are also found at many other places. These rocks occur in Jhansi, Lalitpur, Datia, Sagar, Chhatarpur, Tikamgarh, Panna, Banda and Chitrakoot districts of Bundelkhand region.



The granite gneisses and migmatite are closely associated with schistose rocks and exhibit minor folding. Medium-grained granite gneiss which is porphyroblastic at places form low mounds in the area. The leucocratic fine to medium grained granite represents intrusive phase and forms bold hills. The granite gneisses which are porphyroblastic at places exhibiting effects of metasomatism, are well exposed in the north of Jhansi. The diorite represents hot phase intrusive in the above rocks and is

widely exposed in the vicinity of Jhansi town. The leucocratic granite (intrusive of cold phase) generally forms rounded hillocks and is followed by various intrusive dykes of porphyry , aplite, pegmatite, quartz, dolerite and lampophyre. The granitic rocks carry enclaves of various dimensions of metasedimentaries such as quartzite, quartzose-schists , quartz amphibolites, sillimanite hornfels , banded hematites quartzite, impure marble etc., and metabasites such as amphibolites and pyroxynite. The metasediments and metabasites exhibit various grades of metamorphism ranging from low temperature gneiss schist facies to high temperature K-fields-par-cordierite-hornfels facies. Foliation is generally developed in the granitoid rocks and trends in ENE-WSW directions with steep to vertical dips.

Major shear planes in the area trend in N 60° E-S 60° W to N 30° E- S 30° W to N 30° E-S 30°W directions and are generally occupied by quartz reefs which are conspicuous features in the form of linear ridges, and often crossed at right angles by dolerite dykes. These rocks occur in Datia, Sagar, Chhatarpur , Tikamgarh & Panna in addition to Jhansi, Lalitpur, Chitrakoot and Banda districts of *Bundelkhand* region.

The granitic activities were followed by intrusions of aplite, pegmatite, diorite, granite porphyry, quartz reefs, dolerite and secondary veins of quartz and epidote. Aplite and pegmatite seen as minor veins are present in all the granitic rocks. The porphyries are particularly common in the northern part of Lalitpur district generally trends in ENE-WSW direction. These are cut by reefs of quartz which are trending in NE-SW direction, The dolerites are trending in NW-SE direction.

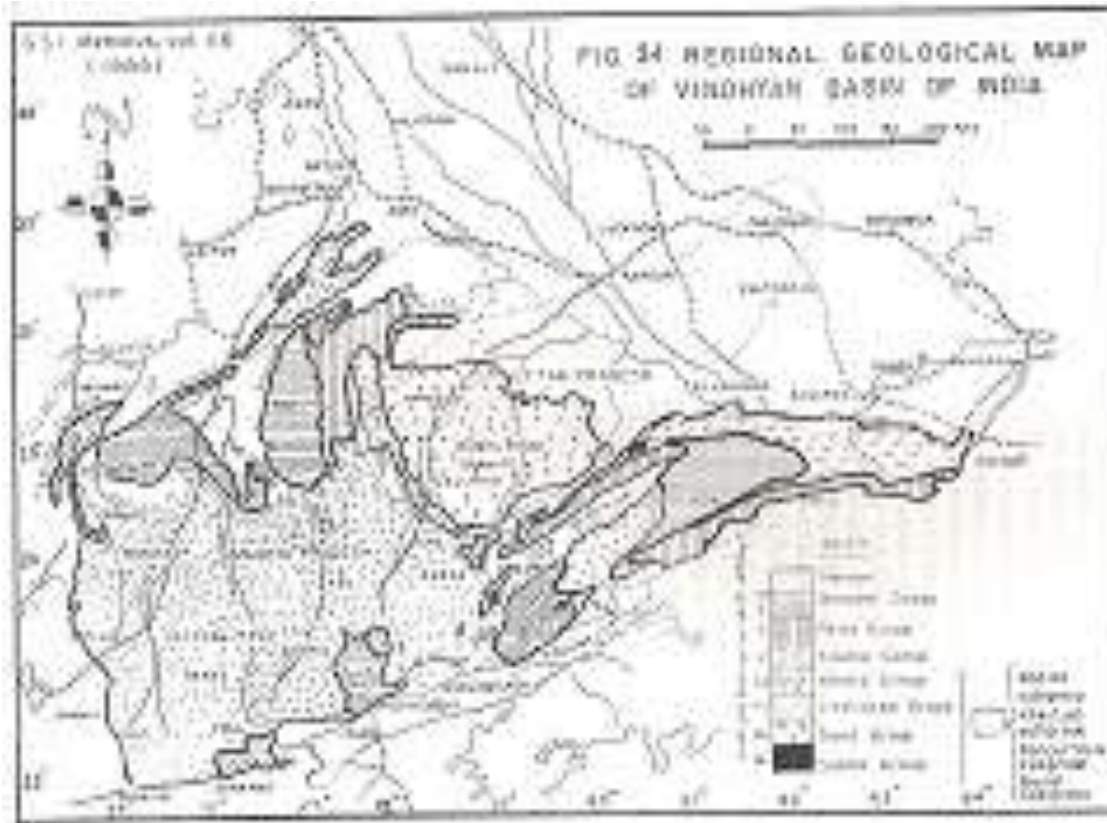
Bijawars consisting of limestone, dolomite, quartzite, shale, sand-stone, banded hematite quartzite, basic dykes and lavas belonging to Bijawar Group are exposed in a narrow zone in the south of granitoid complex. The Bijawars are folded to form a large W—S—W plunging synclinorium, the southern limb of which is concealed below the Vindhyan rocks. The northern limb is traversed by several strike and oblique faults. These rocks occur in Sagar, Chhatarpur, and Panna districts of *Bundelkhand* region.

Vindhyan comprising sandstone, limestone and quartzite are exposed at the southern fringe of the region and forms great Vindhyan scarps. These rocks occur in Sagar, Damoh and Panna districts of southern Bundelkhand. Deccan Trap consisting of basalt with intra- trappean beds occur in Sagar, Damoh and Panna districts in the form of flat topped hills, plateaus, and conical hills. Lametas consisting of limestone, granite, clays etc. , mostly fossiliferous and overlain by Deccan trap rocks, are found in Sagar and Damoh districts Alluvium occurs along the banks of the rivers of *Bundelkhand*

mostly in Datia and northern districts of Jalaun, Mahoba, Jhansi, Hamirpur and Banda districts. It consists of sand, silt, gravel and clay etc.

The geological formations are shown as under:

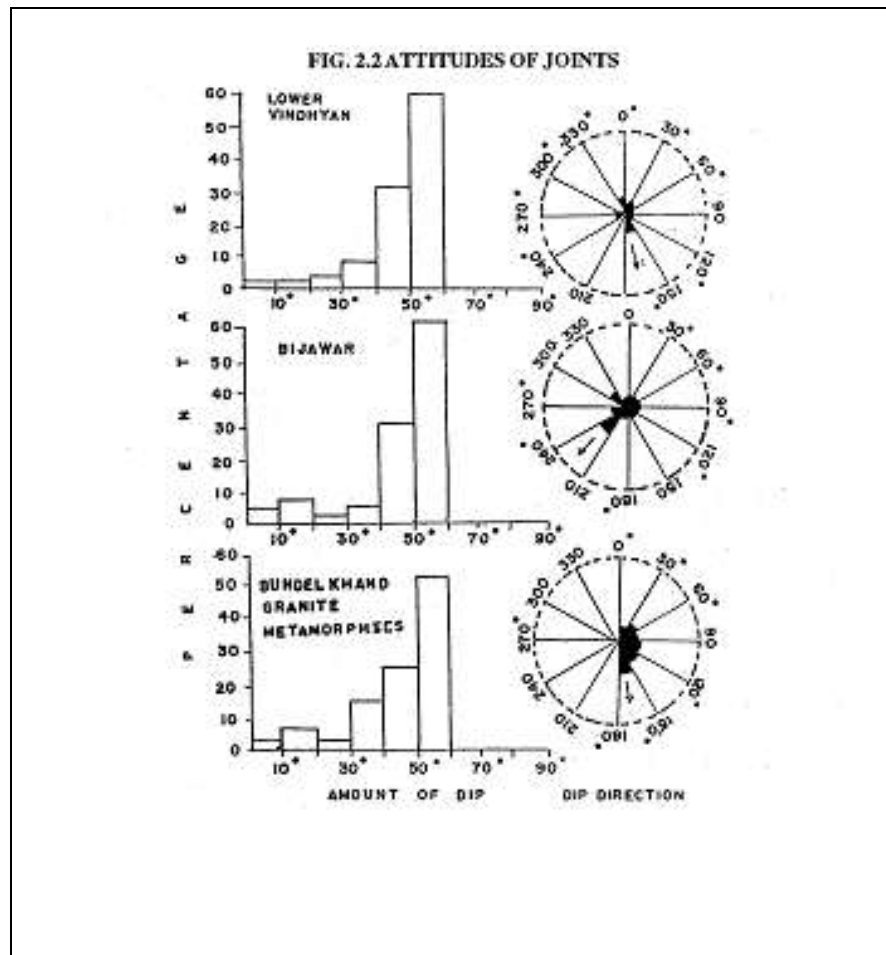
GEOLOGICAL FORMATIONS



JOINTS IN ROCKS:

Joints are the openings in rocks which play a very important role in the movement of groundwater. These joints are normally of two kinds: primary and secondary . Primary joints are those which formed during the formation of rocks whereas secondary joints are formed after the formation of the rocks. Generally in the hard rock, the joints are of secondary type. These are formed when the rocks are subjected to deformation which goes under stress and strain. The path of groundwater flow is controlled by the joints.

Therefore, the measurement of attitudes of joints is made in the field in different types of rocks. The amount of dip and the average direction of different rocks is shown in a figure which follows:



A glance of the diagram as above shows that the average direction of joints in Bundelkhand granite is nearly towards south; in Bijawar rocks, it is towards south-west and in Vindhyan, it is nearly in south direction. These directions show that the ground water flow takes place in these directions.

Source:

“ PROBLEMS AND POTENTIALS OF *BUNDELKHAND* WITH SPECIAL REFERENCE TO WATER RESOURCE BASE” by B.Prakash, Santosh Satya, S.N.Ghosh & L.P.Chaurasia (CRDT-I.I.T.Delhi & Vigyan Shiksha Kendra (Banda) published in 1998 , and references there-in.

THE SOILS :

The soils in *Bundelkhand* region have developed from Vindhyan rocks abounding in gneiss and granites of the Deccan Trap with highly ferruginous beds and often soft lime stone. Local names and kinds of soils found in each district vary according to the physical observation, experiences and traditional terms given to it. The soils, in general, can be divided into two broad groups, (1) red, and (2) black soils. Four soil associations have been recognized in the area which include (i) *Bundelkhand* – coarse grained- reddish brown soils, (ii) *Bundelkhand* –coarse grained- grey to grayish brown soils, (iii) *Bundelkhand* – clay loam-black soils and (iv) *Bundelkhand*-fine clayey black soils. Locally these soils are termed as *rakar*, *parua*, *kabar* and *mar*, respectively. The red soils *rakar* and *parua*, belong to the order Ultisols, Alfisols, and Inceptisols and the black soils *kabar* and *mar* are grouped under the great groups, Pellusterts, Chrosterts, and Ustochrepts.

The *rakar* soils are residual, slightly acidic, coarse grained, shallow and excessively permeable soils occupying higher elevations. The *parua* soils are alluvial, mildly alkaline, very deep soils with free CaCO_3 accumulation at lower depths. The black soils, *mar* and *kabar*, are very deep soils confined to low lying landscapes having fine texture and remarkable property of shrinkage on drying and swelling on wetting. These soils though known as having better water retention capacity are normally deficient in organic matter and difficult to be worked.

THE MINERALS:

Bundelkhand is quite rich in the natural resources including availability of several important minerals listed briefly as follows:

Diamond is extensively found around Panna. Other than Diamond, **Coal** is the most valuable deposit in the vicinity of *Bundelkhand*. **Copper** was at one time extensively worked in Shahnagar pargana of the erstwhile Panna state.

Lead in the form of galena was found at Bargoa village near Bardi (the Rewa State), and exists in rich veins in the hills near Datia and Seondha (District Datia), in the Par Sandstones and in the Quartzites of the Bijawars.

Iron is met with throughout the Vindhyan rocks, to which it gives its characteristic red and brown colours. Comparatively rich deposits of Iron ore were found near Hirapur village ca. 75 km from Chhatarpur on Chhatarpur- Sagar route. These, however, were

not up to mark and work on commercial iron smelting which was initiated there could not be sustained. Traditional Iron smelting has been popular here in whole of *Bundelkhand*, one can see large deposits of iron slag still spread out in many places in thick of the forests and around forts like Kalanjer etc. The local tribal community especially the KOLS were main iron-smelters. In addition to the above, **Agate** and **Jasper** also had been found in several places.

Bauxite is found at several places but the quantity is not economic. Building materials like **lime** is found in many places and the **sandstones** in the form of boulders and flag-stone are presently mined and marketed.

The stone gravel crushed of granites is an extremely popular product these days for RCC construction, exported throughout north India. Mining Granite, however, is at such vast scale that it has started affecting groundwater reserves, life of village people around mining sites and agricultural productivity of surrounding villages. It is largely because of water deficiency created by mining and the fine sand from huge stone-crushers adsorbing on crops as well as the soils. The sand of the rivers of *Bundelkhand* form another valuable building material for masonry and RCC work. Bundelkhand-granites, these days, are also being mined to be even exported for converting it to beautiful tiles.

NATURAL DRAINAGE :

The drainage of *Bundelkhand* region is through its large number of perennial rivers and their tributary rivulets and seasonal *Nallahs* which carry all the water including the rain water off to river Yamuna in the north. The main slope of entire region is towards north and north-east. The situation is that the drainage of Sagar district which is just 9 km from Narmada at one point, is towards river Yamuna which is hundreds of kilometers from this place.

The main water resources of Bundelkhand region have been the same perennial rivers and rivulets, numerous lakes formed through embanking the lower side of the valleys and the ponds spread almost in each village being over thousand years' tradition in this tract. This region has also been getting on an average about 1000 mm rains annually. almost 90% of it within three months of July to September. Yet it was sufficient to fill all the lakes, ponds, and reservoirs of *Bundelkhand*.

Even up to half a century back this region was full of deep forests which allowed good recharge of ground water except at few places in the plateaus of Chitrakoot and Panna

districts. The rivers and rivulets invariably were charged with water-streams from foot of the hill-forests.

At several places even the hilltops are even now seen giving perennial flow of water like those in *Hanumandhara* (Chitrakoot) , *Kalinjar* (Banda) and *Jatashankar* (Chhatarpur) etc. At several places including in Datia and Jalaun districts there used to be numerous artesian flows (*jhirnas*). Such flows have been major sources of water in Pahuj & Paisuni rivers and Gadra, Banganga & Bisahil rivulets etc.

THE RIVERS :

Boundaries of *Bundelkhand* region and of several districts within *Bundelkhand* are formed by rivers only. All such rivers are north- or north-east bound and ultimately pay tribute to river Yamuna. The table which follows gives information about the region's rivers and their tributary rivulets and local drains etc.

RIVERS & RIVULETS OF BUNDELKHAND

Principal River	s.n o.	Rivers of <i>Bundelkhand</i>	Tributaries to rivers	Sub-rivers- Rivulets joining the Tributaries (their contributories)	<i>Bundelkhand</i> -Districts being touched
YAMUNA	1	SINDH			Datia,Jhansi,Jalaun
			Mahuar		
	2		Pahuj		-do-
	3			Angoori	
	4			Marwaya	
	5			Setol	
	6			Parron	
	7			Oon	
	8			Somain	
	9	NON			Jalaun
	10		Malunga		-do-

	11	BETWA			Sagar, Tikamgarh, Jhansi Hamirpur, Jalaun
	12		Bina		Sagar
	13		Dhasan		Sagar, Tikamgarh, Chhatarpur, Hamirpur
	14			Bila	Sagar
	15			Mancrar	
	16			Tarper	
	17			Narkrar	
	18			Bharar	
	19			Ur	Chhatarpur, Tikamgarh
	20			(Dhunderi)	
	21			Sukhnai	Tikamgarh, Jhansi
	22			(Patrehi)	
	23			Lakheri	Jhansi
	24			(Chainch)	
	25		Narayan		Sagar
	26		Jamni		Lalitpur, Tikamgarh
	27			Shahzad	Lalitpur
	28			Sajanam	Lalitpur
	29	KEN			Damoh, Sagar, Panna, Chhatarpur, Mahoba, Banda ,Hamirpur
	30		Sonar		Sagar, Damoh ,Panna
	31			Bewas	Sagar, Damoh
	32			Vyarma	Sagar, Damoh
	33			(Goraiya)	
	34			(Soon)	
	35			(Pathari)	
	36		Mirhasan		Panna
	37		Patan		-do-
	38		Ranj		-do-
	39		Gurne		-do-
	40		Kilkila		-do-

	41		Chanda		-do-
	42		Chandrawal		Mahoba, Hamirpur ,Banda
	43			Sihu	
	44			Karonan	
	45			Shiam	
	46		Urmil		Mahoba, Chhatarpur
	47		Banne		Chhatarpur
	48		Khuraran		-do- -do-
	49		Kutni		-do-
	50		Lohruk		-do-
	51		Kusar		-do-
	52		Kail		-do-
	53		Bichhui		-do-
	54		Gawain		-do-
	55		Sihu		-do-
	56		Karoran		-do-
	57		Shiamri		-do-
	58			Barano	-do-
	59		Goraiya		Damoh
	60	BAGHEIN			Panna, Banda, Chitrakoot
	61		Ranj		-do-
	62		Madrar		
	63		Karehli		
	64		Barar		
	65		Banganga		Chitrakoot
	66		Barua		-do-
	67	PAISUNI			-do-
	68		Kuthar		-do-
	69		Sarbhang		-do-
	70		Kari Barar		-do-
	71		Hira Kotra		-do-
	72		Ohan		-do-
	73		Girwar		-do-
	74		Gunta		-do-
	75	GARARA			Banda
	76		Matiyara		-do-
	77		Usrah		-do-

NARMADA	78	FALKU			Damoh
	79	BIRANJ			Sagar
	80	SINDHAUR			-do-
<p>There are large number of smaller streams spread in the region , most of them seasonal, which drain out water to reach various tributaries of main rivers.</p>					
<p>Ref: --<i>Bundelkhand Ka Itihaas</i> Vol. 1, by Diwan Pratipal Singh (Chhatarpur) 1929</p> <p>--PROBLEMS AND POTENTIALS OF <i>BUNDELKHAND</i> WITH SPECIAL REFERENCE TO WATER RESOURCE BASE” by B.Prakash, Santosh Satya, S.N.Ghosh & L.P.Chaurasia (CRDT- I.I.T.Delhi & Vigyan Shiksha Kendra (Banda) published in 1998</p>					

CREATED WATER RESOURCES

(TRADITIONAL AND PLANNED)

As indicated earlier major reservoirs and ponds belong to the period of *chandella* – kings ruling this tract during 10th to the 13th century AD. and / or the *bundelas*- who governed the region from early 16th century to 18th century AD.

Major technology adopted during those days used to be embanking of the lower part of the valley formed by any river , rivulet or a seasonal *Nallah* surrounded by hills on three sides or a pond embanked on three sides leaving open the fourth i.e. upper side for intake of rain- water. Such structures are seen today in almost everywhere in *Bundelkhand* and even in deep of the forests and were not necessarily meant for irrigation . These reservoirs , however, contributed to enriching the underground water resources raising the level of water in wells and increasing soil moisture to allow healthy growth of vegetation . The hills looked greener and there were numerous streams from the foothills to add to the perennial rivers and rivulets. The forests with water reservoirs provided congenial atmosphere to the wild animals and whenever necessary shelter to native revolutionaries fighting imperial forces with guerilla-war tactics.

During last quarter of nineteenth century British administration of India did undertake surveys and construction of several weirs associated with canals for irrigation . Canals were dug and even joined to the earlier reservoirs in order to earn revenue from irrigation. This was quite opposite to people’s previous culture of using wells and tanks / ponds for limited irrigation without anycharges. That, on other hand, ensured village-participation in cleaning and digging the reservoirs. During British administration the forests were also acquired and in name of its scientific management , large scale commercial exploitation started taking place which continues even after 1947 in

independent India without bothering the environmental damage, destruction of hills, drying of rivers ,failure of rains and severe climatic change affecting agriculture, horticulture and overall life of people in villages / towns as well as tribal communities, the traditional natural protectors of forests.

Frequent famines and epidemics during the last quarter of the 19th century and the first few years of 20th century produced reserves of cheap labour which was employed in the construction of various weirs over Betwa, Dhasan and Ken rivers at Parichha (1881-85), Bariyarpur (1900-04), Dhukuwa (1905-09), Lahchura (1906-10), Pahadi (Deori) (1909-12) and Gangau (1915) . The technology of complete damming of the rivers which leads to death of rivers itself, was not employed till then which started only after 1950 under the western influence and the glamour which attracted our leaders.

THE CLIMATIC INDICATORS:

TEMPERATURE & SEASONAL VARIATION:

Bundelkhand is a hot and semi-humid region. Minimum temperature was found to vary normally from around 5 to 12⁰C and maximum temperature from around 38 to 45⁰ C. Sometime minimum as well as the maximum temperatures touch extremes. In recent years some days during winter may cool up to 1⁰C while during summers the daytime outside-temperature can rise to as high as around 50⁰ C at certain places.

Normally four distinct seasons are experienced here. The rainy season starts normally by mid-June continuing up to September followed by a transitional two months' period of October and November after which winter takes over to last up to February . The summers start in March to go up to mid- June. With change in environment the winter and rainy seasons are becoming shorter while the summer season extending comparatively longer. The Tropic of Cancer passes through two of Bundelkhand-districts namely Sagar and Damoh which influences the climate here . What happens in Himalayas also shows direct impact over this region. Normal winter season is mostly dry; the sky during this season remains clear and wind velocity keeps low. But , due to decrease of temperature during nights, there may be frost and fog during mornings in hilly as well as plateau regions. During beginning of the winter season or towards end i.e. during February there may occur rains associated with hails which affect severely the standing crops. By February end , normally, wind velocity boosts up and hot winds start blowing by March, some times drying crops prematurely..The wind slowly becomes hotter in later months to attain maximum temperature During May- June.

RAIN-FALL:

Bundelkhand gets moderate annual rainfall , ranging from around 750 mm in the north-west to 1250 mm in the south-east . Precipitation now-a-days has turned erratic and a deluge is followed by long stretches of no rain. The rainfall data available for *Bundelkhand* districts shows that 80 to 95 % of the rainfall normally happens during June to September and most of it within two months of July & August only. Even small amount of rains during winter season (locally called MAHUT) is very beneficial for RABI-crops but in recent days frost and hails do occur which considerably damage crops leading even to farmers committing suicides.

In order to understand the normal raining pattern of *Bundelkhand* following monthly rainfall data for past eight years (2004-2011) for most districts might give a helping direction.

TABLE- AVERAGE MONTHLY RAINFALL DATA

District	Average Rainfall Data (for the years 2004 to 2011) (mm)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Chhatarpur	4.59	10.65	15.59	4.93	13.06	124.66	273.98	244.79	125.16	34.23	10.86	1.69
Damoh	8.91	3.30	5.38	7.23	4.36	207.01	395.51	293.09	153.38	8.83	13.94	4.11
Datia	1.00	9.44	9.18	1.96	2.84	116.65	205.94	178.00	117.29	9.43	8.88	2.01
Panna	7.33	8.40	4.66	3.90	8.44	106.54	284.68	297.09	119.30	27.75	9.33	0.66
Sagar	5.51	3.84	15.40	4.75	15.04	202.66	387.50	272.73	140.40	20.40	19.29	2.39
Tikamgarh	3.51	7.65	4.28	0.31	7.15	184.16	231.01	208.83	73.99	26.15	8.34	0.63
Banda	2.84	20.66	10.87	0.07	18.50	160.39	249.49	217.49	127.05	22.61	6.45	2.98
Hamirpur	6.34	12.12	5.04	1.31	8.93	103.99	193.83	168.89	123.13	17.94	7.18	1.33
Jalaun	3.54	3.90	2.99	0.91	1.91	63.01	198.78	159.25	116.56	25.55	9.86	0.83
Jhansi	4.26	7.96	12.40	1.94	13.14	146.88	192.34	154.65	90.99	24.80	8.01	1.03
Lalitpur	5.80	10.43	19.92	0.20	6.94	198.84	270.09	190.64	99.74	20.31	19.40	2.60
Average	4.88	8.94	9.61	2.50	9.12	146.80	262.10	216.85	117.00.	21.63	11.04	1.84
Source: Calculated from the data from Indian Meteorological Department (GOI) Pune, & India Water Portal. (<u>No separate data for Chitrakoot & Mahoba districts which separated from Banda and Hamirpur respectively could be available.</u>)												

The average annual rainfall and amount of rains precipitating between June to September of an year compared with the total rains received here are presented in the table which follows:

**TABLE – AVERAGE ANNUAL RAINFALL
(2004-2011)**

s.no.	District	Average Annual Rainfall	The rainfall – fraction during June-September	Percentage of rainfall received within three months (Jun-Sep)
1	Chhatarpur	864.20	768.59	88.94
2	Damoh	1105.04	1048.99	94.93
3	Datia	693.60	617.88	89.08
4	Panna	916.19	807.61	88.15
5	Sagar	1089.90	1003.29	92.05
6	Tikamgarh	756.61	697.99	92.25
7	Banda	823.72	754.42	91.59
8	Hamirpur	602.01	589.84	98.00
9	Jalaun	672.95	537.60	79.90
10	Jhansi	672.77	584.86	86.93
11	Lalitpur	933.10	759.31	81.37
Source: Calculated from recorded data of Indian Meteorological Department (GOI) Pune				

The pattern of rainfall changing on time scale for the region is presented in following table covering total rainfall received by these districts year wise from 2004 to 2011.

TABLE – RECENT RAINFALL DATA

District	Average Annual Rainfall –year wise (2004 to 2011) (mm)							
	2004	2005	2006	2007	2008	2009	2010	2011
Chhatarpur	940.7	1006.6	648.9	575.2	938.3	809.8	915.8	1078.1
Damoh	1048.7	1666.8	806.0	888.9	1259.4	793.1	1028.1	1349.3
Datia	567.7	483.2	NA	568.4	1044.0	654.8	785.1	751.7
Panna	1284.6	1494.4	N.A.	405.7	584.8	832.5	741.3	1070.0
Sagar	1070.7	1644.6	1040.1	746.5	1026.3	1115.3	783.5	1292.2
Tikamgarh	567.3	713.4	593.7	388.0	1316.5	778.1	574.5	1121.4
Banda	837.9	1131.8	698.0	596.2	NA	NA	669.5	1008.9
Hamirpur	559	614.8	454.0	458.3	NA	683.0	539.9	905.1
Jalaun	629.4	674.7	NA	NA	NA	NA	700.5	687.2
Jhansi	693.3	619.0	388.8	352.8	1169.6	NA	602.0	883.9
Lalitpur	NA	NA	724.3	NA	NA	NA	754.0	1321.0
Source: Recorded data of Indian Meteorological Department (GOI) Pune & India Water Portal								

The above data indicates towards some facts as follows:

1. Amount of falling rains goes down systematically from south to north possibly due to diminishing forest-cover as one moves to north in districts located in north of Madhya Pradesh and south of Uttar Pradesh.
2. During years 2006, 2007 and again in 2009 and 2010 , total annual rainfall had been deficient i.e. below the average and that coupled with untimely and erratic precipitation created drought conditions here in this tract.
3. More than the quantity of rainfall , the bothering fact has been most of the rains occurring just in two-three months that too within few days of the months thus causing flash floods followed by a long spell of drought condition. The total number of rain-days are becoming less and less in each passing year. .

The undulating topography of this region and severe deforestation during past one and half century has led to very minimum ground water recharge affecting perennial nature of the rivers and rivulets of *Bundelkhand* . Recently the problem has become much more serious because of indiscriminate and unmindful mining promoted by the governments in name of industrialization. In most parts of this region, an impermeable rocky layer is found at fairly shallow depths . The sloping topography of this region helps sharp run-off of both rain water and the soils. The problem is aggravated by erratic rainfall and extremely poor forest cover in several districts. That triggers drought or floods in some part or other , sometimes in entire region and also in some years both happening simultaneously. The uncertainty of weather does influence the productivity of various crops and creates large scale starvation and migration.

Consequences are faced by common people . Farmers and farm-workers are forced to migrate to urban locations and also to other states for meeting their livelihood expenses. That created also a condition resulting in loss of hundreds of lives of farmers who opted even to commit suicide .

OTHER FACTORS:

Wind Velocity , **Humidity** and **Evapo-transpiration Losses** etc. are another important factors which influence the climate of a particular place. Although this aspect has been covered later for individual districts in detail , the indicative information for the region which follows is worth looking at in order to understand the situation in general.

WIND VELOCITY:

The horizontal component of the air movement parallel to the earth's surface is generally known as the Air Current. Measurement of these air currents by anemometer is called the wind velocity in terms of km. per hour (km/ hr). The wind velocity indirectly affects the intensity of the rainfall . The low wind- velocity triggers more chances of rainfall .

The mean Wind Velocity of all the districts of Bundelkhand region are as follows:

TABLE- MEAN WIND-VELOCITY

s.no .	month	CPR	DAM	PAN	SGR	TKG	BND,CKT HPR	MBA, ORAI (Jalaun)	JHS	LPR
1	Jan	3.37	3.67	3.46	3.35	3.04	2.93	2.95	2.84	3.04
2	Feb	3.48	3.74	3.56	3.53	3.24	3.22	3.22	3.14	3.24
3	March	3.71	3.95	3.86	3.65	3.37	3.37	3.34	3.21	3.37
4	April	3.99	4.04	4.03	3.92	3.82	3.81	3.82	3.76	3.82
5	May	4.22	4.10	4.08	4.27	4.33	4.26	4.37	4.40	4.33
6	June	4.14	3.88	3.86	4.26	4.51	4.37	4.58	4.71	4.51
7	July	3.68	3.54	3.45	3.85	3.98	3.81	4.01	4.12	3.98
8	Aug	3.20	3.20	3.11	3.34	3.33	3.24	3.35	3.39	3.33
9	Sept	3.01	2.99	2.94	3.07	3.08	3.00	3.09	3.12	3.08
10	Oct	2.52	2.72	2.54	2.59	2.39	2.37	2.38	2.34	2.39
11	Nov	2.64	2.93	2.73	2.70	2.39	2.37	2.35	2.26	2.39
12	Dec	2.95	3.22	3.03	2.99	2.68	2.61	2.61	2.52	2.68

Source: [www.synergyenviron.com/ tools / wind_data.asp](http://www.synergyenviron.com/tools/wind_data.asp)

The wind velocity (Wind-Speed) for the region as shown above, has almost identical trend which indicates the uniformity of weather in this region including the rainfall occurring during same months (July to September) . The wind-velocity during winter months also is on lower side indicating that rains may occur any time during these months. Probability of rainfall during October and later during January has been a common phenomena in the past years too.

HUMIDITY:

Humidity plays a complimentary role in total climatic pattern of an area along with its rainfall and temperature. Humidity is amount of water- vapour in the air (the invisible

gas phase of water) and indicates likelihood of precipitation, dew or fog. Higher the humidity ,more are chances of rains. Thus Humidity is one of the factors which directly influences weather of particular place or the region. Humidity also affects the energy budget and thereby influences temperatures in two major ways:

1. Water vapour in the atmosphere contains **latent** energy. During transpiration or evaporation , this latent heat is removed from surface liquid, cooling the earth's surface. This is the biggest non-radiative cooling effect at the surface. It compensates for roughly 70% of the average net radiative warming at the surface.
2. Water vapour is the most important of all greenhouse gases (GHG) . Water vapour , like a green lens, that allows green light to pass through it but absorbs red light , is a **selective absorber**. The selective absorption causes the greenhouse effect . It raises the surface temperature substantially above its theoretical radiative equilibrium temperature with the sun, and water vapour is the cause of more of this warming than any other greenhouse gas.

Humans are sensitive to humid air because the human body uses evaporative cooling as the primary mechanism to regulate temperature. Under humid conditions , the rate at which perspiration evaporates on the skin is lower than it would be under arid conditions. While humidity itself is a climate variable, it also interacts strongly with other climate variables. This is normally affected by winds and rainfall.

There are three main measurement-modes of humidity : **Absolute, Relative and Specific** Absolute Humidity is the water content of air, Relative Humidity expressed as a percent , measures the current absolute humidity relative to the maximum for that air pressure and temperature. Specific Humidity is a ratio of the water vapour content of the mixture to the total air content on a mass basis.

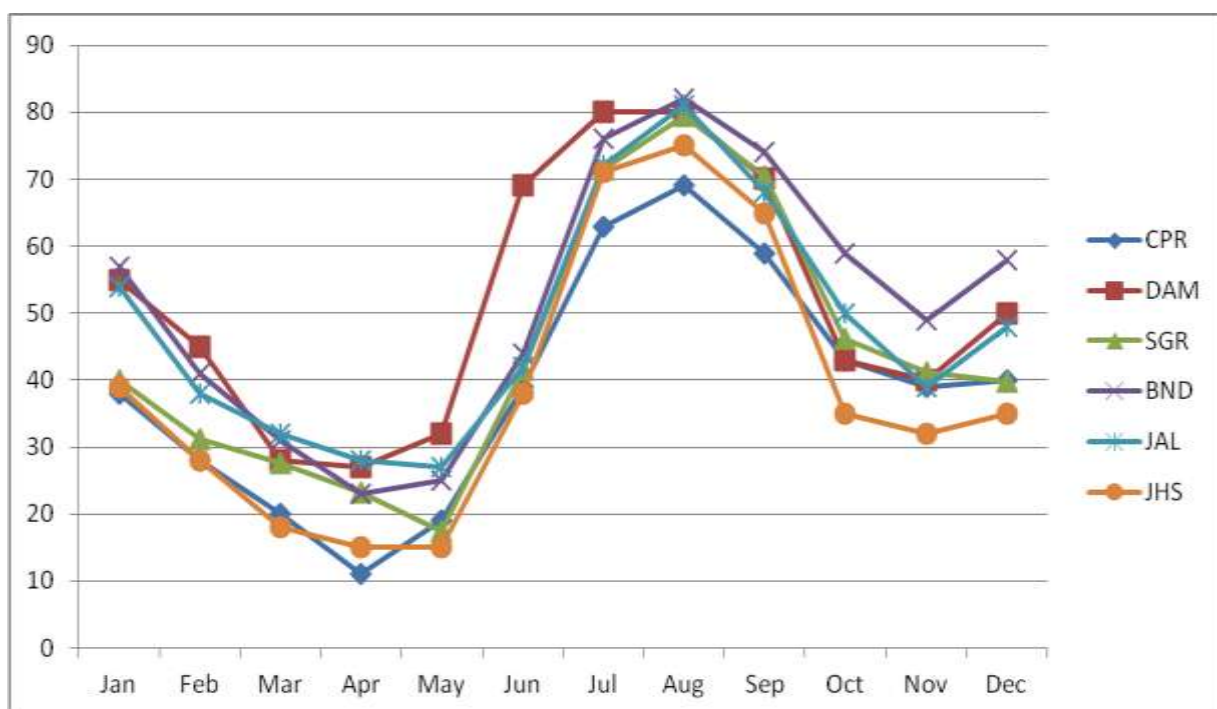
For understanding the pattern let us see the afternoon data available for the years after 1962 (for different year groups) related to some of the districts of the region and its graphical view which follows:

TABLE – RELATIVE HUMIDITY

Month	CPR	DAM	SGR	BND	JAL	JHS
Jan	38	55	40	57	54	39
Feb	28	45	31	41	38	28
Mar	20	28	28	31	32	18
Apr	11	27	23	23	28	15

May	19	32	18	25	27	15
Jun	39	69	42	44	42	38
Jul	63	80	72	76	72	71
Aug	69	80	79	82	81	75
Sep	59	70	71	74	68	65
Oct	43	43	46	59	50	35
Nov	39	40	41	49	39	32
Dec	40	50	40	58	48	35

Source: Problems and Potentials of Bundelkhand with special reference to Water-Resource Base- edited by: B.Prakash, S.Satya, SN Ghosh & LP Chaurasia (CRDT-IITD-VSK-Banda) 1998 and the references therein.



Above graphical presentation of relative humidity as observed for several districts of the region records uniformity showing high values during monsoon months i.e. July to September and also slightly more during January and December months of the year.

These are the usual months and days of rainfall in *Bundelkhand* region.

POTENTIAL EVAPO-TRANSPIRATION:

This is one of the important factors which helps in study of climate of a particular place. Evapo-Transpiration (ET) is literally the sum of [evaporation](#) and [plant transpiration](#) from

the Earth's land surface to [atmosphere](#). Potential Evapo-Transpiration (PET) or Potential Evaporation is defined as the amount of evaporation that would occur if a

sufficient water source were available. Potential evapo-transpiration (PET) is the representation of environmental demand for evapo-transpiration and represents the evapo-transpiration rate of a short green crop, completely shading the ground, of uniform height and with adequate water status in the soil profile. It is a reflection of the [energy](#) available to evaporate water, and of the [wind](#) available to transport the water vapour from the ground up into the lower [atmosphere](#).

Actual evapo-transpiration is said to equal potential evapo-transpiration when there is ample water. If the [actual evapo-transpiration](#) is considered the net result of atmospheric demand for moisture from a surface and the ability of the surface to supply moisture, then PET is a measure of the demand side.

This is affected by surface and air temperatures, solar insolation, and the winds. Dryland can be defined as a place where annual potential evaporation exceeds annual precipitation. PET is expressed in terms of depth of water and its unit of measurement is mm / month . PET is higher in the summer, on less cloudy days, and closer to the equator, because of the higher levels of solar radiation that provides the energy for evaporation. PET is also higher on windy days because the evaporated moisture can be quickly moved from the ground or plant surface, allowing more evaporation to fill its place. Average annual PET is often compared to average annual precipitation. If potential evapo-transpiration is greater than actual precipitation, then soil will dry out, unless it is irrigated.

The Potential Evapo-transpiration (PET) is not very popular aspect of measurement , yet some data recorded by IMD is available for the districts which has been discussed in next chapter dealing with individual districts of Sagar division.

SOLAR IRRADIATION:

Solar Irradiance is a measure of how much solar power a location gets . This is the amount of energy transmitted from the sun to Earth's outer atmosphere. The irradiance varies throughout the year depending on the seasons. It also varies throughout the day, depending on the position of the sun in the sky, and the weather. The measure of solar irradiation at any place can help in planning solar based power plants and devices using direct solar energy. This is an important factor in understanding over all weather of a place . Solar irradiation is measured normally in square units per units of time.

Average solar irradiation per day on monthly basis available for most of the *Bundelkhand* districts has been presented in the table as follows:

TABLE- SOLAR RADIATION (in kWh/ m²/day)

DIST.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
CPR	4.23	5.09	5.92	6.60	6.51	5.45	4.32	3.93	4.51	5.04	4.51	4.00
DAM	4.45	5.27	6.05	6.75	6.58	5.25	4.12	3.64	4.48	5.12	4.67	4.21
PAN	4.14	5.00	5.87	6.50	6.53	5.36	4.35	3.94	4.38	5.00	4.40	3.99
SGR	4.61	5.60	6.51	7.18	7.28	5.94	4.82	4.40	5.40	5.73	4.92	4.42
TKG	4.37	5.50	6.50	7.13	7.36	6.27	5.09	4.79	5.54	5.72	4.84	4.24
BND	3.87	4.77	5.83	6.35	6.58	5.67	4.60	4.28	4.39	4.85	4.31	3.74
CKT	3.87	4.77	5.83	6.35	6.58	5.67	4.60	4.28	4.39	4.86	4.31	3.74
HPR	3.87	4.77	5.83	6.35	6.58	5.67	4.60	4.28	4.39	4.86	4.31	3.74
MAH	4.00	4.88	5.81	6.32	6.43	5.70	4.60	4.24	4.55	4.89	4.30	3.82
JHS	4.17	5.35	6.45	7.03	7.17	6.27	5.23	4.96	5.50	5.56	4.66	4.02
LPR	4.40	5.30	6.15	6.89	7.04	6.24	5.18	4.54	5.33	5.63	4.71	4.18
Reference: www.synergysenvirom.com												

IMPORTANT BASIN-WISE INFORMATION

Bundelkhand region is part of the hydro-meteorological subzone 1 (c) which comprises basins of *SIND*, *BETWA* & *KEN* rivers and Free Catchment Areas of other southern tributaries of the river *YAMUNA*. The subzone is located between Latitudes 23⁰ 0 ' and 26⁰ 52' (North) and Longitudes 77⁰ 20' and 81⁰ 30' (East). That includes entire *Bundelkhand* i.e. the thirteen districts spread in M.P. and U.P. and also 10 other districts of Madhya Pradesh surrounding Bundelkhand.

The hydro-meteorological subzone 1 (c) is bounded by :
Subzone 1 (e) the upper Indo-Ganga Plains to the north,
Subzone 3 (c) , Narmada basin to the south,
Subzone 1 (b) , Chambal basin to the west, and
Subzone 1 (d) , Son basin to the east.

The basin-wise detailed information within subzone 1 (c) is as follows:

THE SIND-BASIN

The *SIND*-basin lies between the North Latitude $24^{\circ} 00'$ and $26^{\circ} 45'$ & East Longitude $77^{\circ} 15'$ and $78^{\circ} 10'$. The maximum length of the basin from north to south is 300 km and the width from east to west is 170 km . The total catchment area of the basin is $27,742 \text{ km}^2$ of which $26,050 \text{ km}^2$ lies in M.P. and the rest $1,692 \text{ km}^2$ in U.P. covering the areas of *Bundelkhand* uplands.

Physical Features:

The *SIND* river flows through Vindhya and *Bundelkhand*- granites in the form of narrow stream in the upper stretches and the gradient is steep. In the lower reaches ,it passes through undulating ravines with gradual slope. The general elevations of the basin vary from 198 m to 203 m above the mean sea level.

The three distinct regions are apparent:

1. Medium Land
2. Plains
3. Deep Ravines

Geology & Hydrogeology:

The basin is covered initially by Deccan Traps followed by granites and gneisses and later by Vindhyan Sand- stones , then passing on to the alluvial plains.

The ground water occurs in granite and gneisses in the fractures , fissures, joints and weathered zone. In the Vindhya also it occurs in jointed and fractured sand stones and cavernous lime stones. In the Deccan Traps , weathered, fractured and vesicular basalts form the aquifers. Alluvium with sand forms good groundwater-reservoirs.

The Soils : The soils of this region consists of mainly hilly fine loamy to coarse loamy in texture and shallow in depth. These are low in organic matter contents and possess poor water retention capacity.

- a. **Hilly Soils:** These are fine loamy to coarse loamy in texture and shallow in depth. These are prone to severe erosion. Hilly soils are low in organic matter content and have poor water retention capacity.

-
- b. **Plateau Soils:** These are mixed red black soils , and are coarse to medium in texture and low in nutrient status. These are shallow to deep moderately eroded
 - c. and the water retention capacity varies with the texture and organic matter content.
 - d. **Pediment Soils:** These are also like Plateau soils , coarse to medium in texture and moderately eroded,
 - e. **Alluvial Soils:** These are deep to very deep , fine loamy and well to moderately drained . These are low in organic matter content but are fairly rich in nutrient status.

The Climate:

The *SIND*-basin is characterized by tropical climate . Normally there are four distinct seasons. Summer from March to June, Rainy season from mid-June to September, the post monsoon transition season between October and November while Winter extends from November to February.

This is a medium rainfall zone varying from 867mm to 1220 mm. The normal temperatures have been recorded at the Gwalior station as varying from 7.2° (min) to 42.6° (max) . The wind velocity has been found to be ranging from 2.8 km / hr. to 13.0 km / hr recorded at Gwalior and Guna respectively.

THE BETWA - BASIN

The *BETWA* basin lies between the North Latitude $22^{\circ} 51'$ & $26^{\circ} 0'$ and East Longitude $77^{\circ} 10'$ & $80^{\circ} 20'$. Maximum length from south to north is ca. 431 km ,while the maximum width from east to west is ca. 155 km. It consists of a number of districts of *Bundelkhand* region like Sagar, Tikamgarh and Chhatarpur in M.P. and Lalitpur Jhansi, Jalaun and Hamirpur in U.P. . The catchment area of this basin is 43,895 km² of which 30,217 km² lies in M.P. and the rest 13,678 km² in U.P. state.

Physical Features:

Physiography:

Bundelkhand granites , Vindhyan Sandstones and Deccan Trap lava flows form the basic physiography of this region. The alluvium deposits also have been important in developing the present central valley plains of the basin. The elevation of the basin

ranges from 106 m to 680 m above mean sea level. Physiographically the basin can be divided into three main units :

- 1) Uplands
- 2) Medium land
- 3) River banks

The overall drainage pattern is sub-dendritic and the drainage segments are controlled by joints.

Geology & Hydrology:

The *BETWA* basin is occupied by Bundelkhand granites , upper Vindhyan Sandstone, Deccan Traps , Alluvium and Laterites. The Bundelkhand granites in the northern parts are traversed by numerous quartz reefs and basic dykes. They have water bearing zones within joints , fissures and fractures and along the contacts with quartz reefs and dykes. The weathered zones also form shallow aquifers within the granites.

Major central parts are overlain by basaltic lava flows with isolated outcrops of sandstone forming inliers. Isolated Deccan Trap exposures can also been seen in Vindhyan valleys in southern parts of the basin. Shallow groundwater occurs in the weathered vasicular jointed and fractured basalts. The sandy and gravelley alluvium in the north also forms good aquifers.

The Soils:

Based on the studies of National Bureau of Soil Surveys and Land use Planning , Nagpur and the State Soil Survey Deptt. (M.P.) , the soils of Betwa Basin could be classified into five broad groups as follows:

- a. **Soils on Hills and Ridges:** These are fine loamy to coarse in texture, prone to severe erosion , and low in organic matter contents, having very poor water - retention capacity.
- b. **Plateau Soils:** These are coarse to medium in texture and low in nutrient status. These are shallow to deep and are moderately eroded and possess water – retention capacity varying with soil texture and organic matter content.
- c. **Pediment Soils;** These are shallow to very deep , coarse to medium in texture and poor in nutrient status.
- d. **Soils on Basalt Landscapes:** These soils are deep to very deep, fine in texture, rich in base and nutrient status with swelling and shrinking properties.
- e. **Alluvial Soils :** These are deep to very deep , fine to fine loamy and well to moderately drained. They are neutral to slightly alkaline , low in organic content, fairly rich in nutrient status and are moderately eroded.

The Climate:

This is also a region with hot summers to moderately cold winters, like in *SIND* basin and exhibits four distinct seasons . The rainfall varies within the basin from 870 mm to 1394 mm . The maximum and minimum temperature in this region have been reported to be ranging from 39.9⁰ C to 42.6⁰ C and 5.3⁰ C to 10.6⁰ C respectively. The hottest month is June while the coldest month is January. The wind velocity of the region under the present study has been found to vary from 3.5 km/ hr at Bina to 11.0 km/hr at Sagar.

THE KEN - BASIN

The *KEN* river basin lies between North Latitudes 23⁰ 20' & 25⁰ 20' and east Longitudes 78⁰ 30' & 80⁰ 36'. The KEN basin covers mainly the areas of Jabalpur, Sagar, Damoh, Panna, and Chhatarpur districts of M.P. and Mahoba, Hamirpur and Banda districts of U.P. It is bounded by Vindhyan ranges in south, *Betwa* basin in the west, free catchment area of Yamuna in east and the river Yamuna towards the north.

Physical Features:

Topography and Physiography:

In the upper reaches , the KEN basin is characterized by very undulating terrain with isolated steeply sloping hills and ridges. Except for a large patch on the right bank , the basin is occupied by dissected plateau in the central part. The gently undulating terrain next to the plateau can roughly be marked up to Banda associated with the preponderance of surface boulders. The flat plain which , with imperfect sub-surface drainage extended to the southern banks of Yamuna , is also characterized by ravines. Besides a few locally radial and annular drainage , a coarse dendritic drainage dominates the area.

Geology and Hydrology:

The rock formations encountered in the southern part of the basin is comprised of Deccan Traps , Lameta bed and Vindhyan. A few outcrops of dark grey porphyritic basalts are also found in the region. The inter-trappean beds are met with between the flows of basalts and consist of lime-stones, cherts and clays. The rocks of Vindhyan system consist of a succession of sand –stones and shales with horizons of lime-stones and cover a large part of Sonar sub-basin . In the North, the basin is mainly occupied by Bundelkhand-granite and alluvium. Some Palaeo-channels have also been

demarcated around Banda. While the Vindhya's form poor aquifers, ground water occurs in vesicular, jointed, fractured and weathered basalts. Weathered and fractured granites also form water bearing zones. The Palaeo- channels and sandy zones within alluvium yield copious supplies of ground-water.

The Soils:

Based on the preliminary studies by the National Bureau of Soil Survey and Land-use Planning (ICAR) Nagpur the soils of this region can be classified as follows:

- a. **Soils on Hills and Ridges:** There are fine to coarse loamy, grayish brown to dark reddish brown, highly eroded, well drained, slightly acidic to neutral, stony and gravelly shallow soils with low organic matter content and poor water retention capacity.
- b. **Plateau Soils:** These soils occupy eroded levels to gently undulating terrains. These are locally known as *parua* and could be sub divided into three types:

Subgroup 1 :

- Loamy to fine
- Shallow to moderately deep
- Yellowish to reddish brown
- Slightly acidic to neutral with somewhat high base status,

Subgroup 2 :

- Fine Loamy to fine
- Moderately eroded, moderately deep to deep,
- Yellowish brown to reddish brown,
- Base rich; slightly acidic to neutral,
- Containing low organic matter,
- Low water retention capacity

Subgroup 3 :

- Occur in gently undulating landscapes,
- Fine loamy to fine deep,
- Brown to grayish brown,
- Slight acidic to neutral,
- Low in organic matter,
- Moderately water retention capacity.

-
- c. **Pediment Soils** : These soils are shallow to deep, coarse to medium in texture and poor in nutrient status.
 - d. **Soils of Inter-Plateau Basin** : These are deep to very deep , fine loamy to fine, brown to dark brown , well drained to moderately well drained, Neutral to slightly alkaline, base rich, having low organic matter , having high bulk density and possess poor and somewhat high water retention capacity.
 - e. **Piedmont Plain Soils**: These are very deep , moderately well drained, normally calcareous, yellowish brown , brownish to dark , grayish brown , fine loamy to clayey soils . These are base rich , neutrally to moderately alkaline, of low organic matter content , high bulk density and possess high water retention capacity . These soils are locally known as *kabar & mar*.
 - f. **Soils of alluvial plains and undulating old flood plains**. These are deep to very deep, undulating , fine to fine loamy, well to moderately well drained, yellow brown to dark yellowish-greyish brown calcareous soils. These are neutral to slightly alkaline , base rich and low in organic matter and have moderately high water retention capacity.
 - g. **Soils of dissected flood plain**: These are fine loamy yellowish , dark brown soils, with low organic matter , possess moderate water retention capacity and are susceptible to erosion.

The Climate:

The climate of the basin area is mainly semi-arid to dry sub-humid with hot summer and fairly cold winter.

FREE CATCHMENT AREA

Besides the three main basins of the Sind, the Betwa and the Ken forming the hydrometeorological sub zone : 1-C , there are three free catchments of Yamuna:

- (i) **Between Sind and Betwa basins,**
- (ii) **Between Betwa and Ken basins and**
- (iii) **East of Ken basin and north of Tons sub-basin.**

These catchments comprise mainly parts of Jhansi, Jalaun, Mahoba , Hamirpur , Banda and Chitrakoot districts and are overlain by alluvium . These areas are similar to adjoining basins and thus separate discussion is not needed.

THE VEGETATION:

1 Agriculture

2 Horticulture

3 Forests

AGRICULTURE

Although *Bundelkhand* region had been gifted by nature with dense forests and hills almost in entire length and breadth of the tract, Yet, the northern part of Bundelkhand consisting of almost all districts of U.P. except the southern parts of Banda, Chitrakoot and Lalitpur and most of the northern parts of Tikamgarh, Panna and Chhatarpur are comparatively flat with alluvial soils which is productive and suitable for all agricultural operations.

The state of agriculture during pre-British days is not well documented but the Gazetteer of Eastern States vol. IV –A (compiled by Captain CE Luard) published in 1907 comprising of several erstwhile Princely States which comprise present districts of Chhatarpur, Panna, Tikamgarh and also some publications covering Damoh and Sagar are available which give a glimpse of agricultural activities, soils, crops, cropping patterns of the area with certain minute details . The district gazetteers published after 1947 for most of the districts of *Bundelkhand* which form part of U.P. and M.P. states today have also been consulted for relevant information on traditions of farming in this tract.

Agriculture in *Bundelkhand* had always been guided by local weather conditions, soil-types, availability of water and the location of fields. Selection of the crops for particular cropping seasons , variety of the seeds, and the farming operations were decided by above factors. With large varying soil types it was natural to have many different varieties of grains / crops being grown here. An important observation on the cropping pattern has been the presence of all such seeds indigenously within this region. The editor of 1907-Gazetteer comments ; “Farmers based on their experience say that seeds from other regions do not flourish here”.

TABLE-LIST OF FOOD-GRAINS / OILSEEDS GROWN BY FARMERS:

s.no.	Grains/ Plants	Botanical name
1	MAKKA	Zea mays
2	JOWAR	Sorghum vulgare
3	URAD	Phaseolus radiates

4	ARHAR	Cajanus indicus
5	MOONG	Phseolus mungo
6	BAJRA	Pencillaria spicata
7	KODON	Panicum scrobiculatum Paspalum stoboniferum
8	KUTKI	P. milliare
9	KAKUN	Solaria italic
10	SAMAN	Panicum frumentaceum
11	Dhan (paddy)	Oryza sativa
12	GEHUN (Wheat)	Triticum asticum
13	CHANA(Gram)	Cicer artinum
14	MASUR	Erecuna lens
15	JAVA (Barley)	Hordeum vulgare
16	RALI	Panicum miliaceum
17	TIL	Sesamum indicum
18	ALSI (Linseed)	Linum uisitatissimum
19	SARSON	Brassica compestris
20	SEHUA	Eruca sativa
21	KAPAS (Cotton)	Gossypium indicum
22	AMBADI	Hibiscus cannabinus
23	SAN	Crotolaria junecea

Classification of Soils: Major soil groups identified by people on the basis of physical properties, its crop-preference as well as the location ,later classified in four groups by British administration during their land- settlement process in some of the districts under their direct rule are as follows:

TABLE- SOIL-CLASSIFICATION

Particulars	Major Soil-types			
	MAR	KABAR	PANRUA	RAANKAR
Major Characteristics	- A rich and fertile black loamy soil with close grains, - very fertile and retentive of moisture,	- Darkish brown/ light black loamy soils which cracks on drying and may contain lime,	-Light grayish yellow soil common wherever the gneiss is covered by	-Poor rocky soil formed chiefly on hill-slopes -Refuse soil composed of rocky matter.

	-Formed by the disintegration of the dykes of the Trap.	-Second to <i>Mar</i> in productivity, - More of a clay than loam,	alluvium. -Soft texture, -A sandy loam, -Often very fertile and of alluvial origin.	
Other Soil Types having similar character	<i>Mar (Mota or Mauta)</i> <i>Mund</i> <i>Dumat</i> <i>Khadari</i> <i>Chikni</i>	<i>Kabar</i> <i>Hadkabar</i> <i>Rathia</i> <i>Rainya</i> <i>Sihara</i> <i>Binva</i>	<i>Panrua</i> <i>Patrua</i> (Barra ,Mutbarra) <i>Duparua</i>	<i>Raankar</i> <i>Bhatua</i> <i>Bhatan,</i> <i>Chhapra</i> <i>Retili</i> <i>Pathrili</i> <i>Pahadi</i> <i>Sihara</i>
Crop-preference	<u>KHARIF:</u> <i>jowar,maize,</i> <u>RABI:</u> Wheat, Gram, Linseed	<u>KHARIF:</u> <i>Kodo, jowar, Dhan</i> <u>RABI:</u> Wheat, Gram, Linseed, Peas	<u>KHARIF:</u> <i>Jowar, Urad, Moth, Cotton</i> <u>RABI:</u> Wheat (under irrigation)	<u>KHARIF:</u> <i>Kodo. Kutki, til and other small millets</i> <u>RABI:</u> Wheat (under irrigation)
Irrigation Status	Irrigation not essential		Responds more to irrigation	

People's classification of Soils depending upon its location / usage:

The properties of Soils also vary according to its location in the village. Farmers of *Bundelkhand* had classified soils and used its properties in selection of the crops to give better yields . Such classification follows:

TABLE- PEOPLE's CLASSIFICATION OF SOILS

s.no.	Description of location	Name of the soils/ Fields	Remarks
1	Soils / Fields which lie close to villages (human habitations)	<i>GOIND, GEUNRA, BINVA,GONHARI</i>	Very productive soil because of richness of humus/organic matter/ natural manures
2	Fields which lie far away / at a distance from villages	<i>HAAR</i>	It may contain many soil types.Not much productive
3	The soils found near rivers, tanks and <i>Nallas</i> where silt is left behind after occasional floods followed by rains	<i>KACHHAR</i>	Suitable for all crops but preferably the garden crops i.e. vegetables and spices etc.

4	Embanked depressions through which a stream runs	<i>TARI</i>	Moist soil
5	Rice-terraces of the hilly tracts	<i>BANDHIA</i>	Embanked fields where water could be stored/retained
6	The soils at height on slope	<i>TAGAR</i>	
7	Low-lying , water logged	<i>SASIRA</i>	
8	The soils which lies in ditches	<i>BHARKILA</i>	
9	ABADI-land under cultivation	<i>MAZRUA</i>	
10	Soil lying fallow	<i>PARANTHA / PARTI</i>	
11	Local name of grazing land	<i>RUND</i>	
12	The land which has never been cultivated although is good enough to be cultivated	<i>BHATO</i>	
13	Newly broken and cultivated for 3-4 years and then left fallow for 1-2 years.	<i>UGAR</i>	
14	Garden land	<i>BAGH</i>	
15	Land reserved for cultivation of wheat near the village habitation	<i>GUHABAGHNI</i>	
16	Land reserved for RABI crops only	<i>SAIYA</i>	
17	Low lying land which is allowed to remain fallow during KHARIF crop-season	<i>NAGARWAR</i>	
18	The Irrigated land	<i>THARO</i>	
19	Rocky or boulder strewn soil	<i>PATHALA</i>	
20	Double cropped soil : both KHARIF and RABI	<i>DUSAIYA</i> <i>DOFASLI</i>	
21	The soil and the fields which suitable for paddy production.	<i>DHANHAI</i> further classified in 3 categories:	

	:	<i>JHILAN (low lying)</i> <i>SAMAN (flat land)</i> <i>TIKRA (high lying)</i>	
<p style="text-align: center;">Reference: Gazetteers of India Vol. VI-A (Eastern States-<i>Bundelkhand</i>) Ed. Capt. CE Luard (1907)</p>			

CROPPING CYCLES:

Two major cropping seasons, as indicated above , the KHARIF (called *SIYARI*) and the RABI (called *UNHARI*) are prevalent in entire *Bundelkhand*. The garden crops like fruits, vegetables, spices , betel leaves and sugar cane etc. do cover the summer months, possible only with assured irrigation normally managed by farmer himself through his own dug wells . Water normally used to be drawn by *RAHAT* (or Persian wheel) and *TARSA* (leather bucket) powered by humans and bullocks.

The crops generally taken in major two cropping seasons are listed below:

TABLE- SEASON WISE CROPS

s.no.	Cropping Season	Crops
1	<u>KHARIF</u> (<i>SIYARI</i>) (May to October)	<i>JOWAR, BAJRA, KODO, KUTKI, SAMAN, KAKUN, ARHAR, MOONG, URAD, COTTON, TIL , DHAN</i> (paddy), <i>MAKKA</i> (maize) , <i>PHIKAR</i> (<i>Lathara</i>), <i>RAMTILI</i> , <i>SAN-HEMP & AMBADI</i> etc.
2	<u>RABI</u> (<i>UNHARI</i>) (October to March / April)	<i>WHEAT, PISSI, GRAM, BARLEY, LINSEED, MUSTARD, MASUR, MATAR</i> (peas),
3	In both cropping Seasons	<i>MOONG, URAD, DHAN</i> (paddy) (reported only for Orchha State- present Tikamgarh Dist.)
4	Garden Crops	All kinds of fruits like mango, guava, <i>jamun</i> , custard apple, oranges, pomegranate and plantains etc. and vegetables & spices like potato, brinjals, onions, garlic , ginger, carrots, radish, melons and several varieties of gourds; Spices: <i>HALDI</i> (turmeric) , <i>DHANIA</i> (coriander) <i>ZIRA</i> (cumin) and others.

In addition to above references of growing *TERVA*, *BATRA*, *PAAN* (betel) and Sweet Potato are also found in some areas. Certain areas had been famous for its specific production e.g. Mahoba and Damoh for cultivation of *PAAN* (betel leaves) & *parval*, and Hatta (Damoh) for its brinjals . Sugarcane was cultivated almost everywhere mainly to be sold direct as canes during festivals and / or *GUR* (the jaggery) made by farmer himself in his farm.

AGRICULTURE- THE TRADITIONAL & CULTURAL ASPECTS:

There are few auspicious days and very pinpointed *nakshatras* which were normally followed for different farming activities by *Bundelkhand* farmers.

THE AUSPICIOUS DAYS:

1. **AKSHAY TRITIYA** (*Baisakh Sudi 3*) : falling mostly in the month of May is the first day for initiating farm-activities. The first operation *BAKHARANI* starts on this day . Cultivators used to worship *JEURA* – some grains which have been sown in earthen pots, and also *BIJARA* or pot used to hold seeds in when sowing.
2. **BARGAD AMAVASYA** (*Jeth badi 30*) :falling normally in the month of June .
3. **GANGA DASHARA** : (*Jeth sudi 10*) also falling mostly in June, was observed as an important day for deciding the year long arrangement of farming by cultivators.
4. **ASHADHI** (the first day of *Ashadh* month) :was observed as a festival day. Farmer's family used to give dinner to all concerned with his farming . This signified that the associates of farmers/ cultivators will remain bound with them for next one year.
5. On the commencement of the rains in the **ARDRA** *nakshatra* , the day is celebrated and a preparation of wheat & *Gur* (**kohri**) is prepared and offered to all.
6. **THE FIRST DAY OF SOWING**: When seeds were first taken to the field its little amount used to be put into two very small cow-dung pots to be placed at the two corners of main entrance of the house before departure.

OTHER IMPORTANT EVENTS RELATED TO AGRI-OPERATION:

In Orchha state (present major Tikamgarh district) *BIJARA* used to be again worshipped on the first day of sowing . *Doorva* (*DOOB*- grass) used to be planted round the pot , a silver ornament was to be fixed on its neck and then it was worshipped together with the plough and plough- bullocks. In some places sweetmeats used to be distributed on that day while in some other places sweet dish prepared from wheat was distributed on the day when sowing operations completed.

IMPORTANCE OF NAKSHATRAS:

Farmers traditionally followed astrological directions usually in consultation with the village astrologers. For all agricultural operations suitable days were followed. *NAKSHATRAS* played very important role in these operations especially during sowing of certain crops. There is some information available in the Gazetteer under reference as follows:

TABLE: RELATIONSHIP BETWEEN NAKSHATRAS AND CROPS

s.no.	<i>Nakshatra</i>	Suitable for the crops to be sown/ field preparation
1	<i>ARDRA</i>	<i>Kodo, Kakun, Moong</i>
2	<i>PUNARVASU</i>	<i>Dhan, Urad</i>
3.	<i>ASHLESHA & MAGHA</i>	<i>Til, Kutki</i>
3	<i>PUSHYA</i>	<u>Fields prepared for sowing the <i>RABI</i>-crops.</u>
4	<i>CHITRA</i>	<i>Gram (chana)</i>
5	<i>SWATI</i>	Wheat
6	<i>VISHAKHA</i>	<i>Barley, Batra, Pissi</i>
Note: <i>nakshatras</i> are the asterisms of which 27 fall in the twelve months of an year		

At this point it is worth noting that modern biodynamic calendar based on observation of Rudolf Steiner (1861-1925) of Austria , which emphasizes that timing in agriculture for sowing, weeding, and harvesting etc. should consider the influences of [moon](#) and [planets](#) on plant growth, becoming popular these days , reminds that traditional practices and operations of farming adopted by *Bundelkhand* farmers from ancient times was in right direction.

MONTH WISE SOWING SCHEDULE OF SOME CROPS :

An average situation is presented below . There might, however, be some shift from district to district depending upon commencement of the rains which was and even now likely to be on different days.

TABLE- MONTH WISE SOWING PRACTICE

S.No.	Month	Crops to be sown
1	CHAITRA (March-April)	Betel
2	BAISAKH (April-May)	<i>china</i>
3	JETH (May-June)	Dry farming- sugar cane
4	ASHADH (June-July)	Maize, <i>Jowar</i> , cotton, <i>saman</i> , <i>bajra</i>
5	SHRAVAN (July-August)	<i>Urad</i> , <i>Moong</i> , <i>kodo</i> , <i>kakun</i> & Kutki
6	BHADO(August- September)	-
7	KUNWAR (September-October)	Wheat, Gram, Barley, <i>Pissi</i> , <i>Batra</i>
8	KARTIK (October-November)	-
9	AGAHAN (November –December)	-
10	PAUSH (December – January)	-
11	MAGH (January- February)	<i>Zeera</i> (cumin) and other spices
12	FAGUN (February- March)	Sugarcane

THE PLOUGHING/ SOWING AND OTHER OPERATIONS:

PLOUGHING:

With the first rains fields used to be roughly ploughed to break the surface and admit the absorption of rains. This was usually done by *BAKKHAR*. When the rains had set in, the fields were thoroughly ploughed several times. Number of such ploughing depended upon soil, the proposed crops and other circumstances. For *KHARIF* crops 2-3 ploughings were taken to be sufficient but for preparation of *RABI*-crops fields were ploughed number of times till soil became soft and sufficient moisture had been absorbed.

A traditional saying popular amongst farmers was *NAU-TERA (9-13.)*. This indicated need of nine times ploughings during the last days of *ASHADH* and 13 days of beginning of *SHRAVAN* month. Explaining the same, another belief was that during raining months (i.e. July-August) nine ploughings are essential while thirteen ploughings were to be done during post rains (i.e. October –November) before sowing wheat or other *RABI*-crops.

In some other places a popular saying used to be *TERA KATIK TEEN ASHADH* (13 times in *Kartik* and 3 times in *Ashadh*). That meant three ploughings were sufficient for *KHARIF*-crops while for *RABI*-crops there could be as many as 13 ploughings before sowing.

SOWING:

These operations did not differ much in all districts of *Bundelkhand* except for some minor changes here and there.

THE TECHNIQUES OF SOWING:

1. *Saman, Bajra, Kakun, Urad, Til, Kutki, San, Jowar, and Dhan* were to be scattered broadcast by hands after suitable ploughing and preparation of the field.
2. *Barley, Pissi, Masur, & Sarson* were sown by hand by a person following the plough.
3. *Wheat, Gram and Alsi (linseed)* were sown through a hollow bamboo tube fixed with the plough through which seed is dropped into the furrows by a person moving by the side of plough.

WEEDING:

Ordinarily *kodo, Dhan (paddy) & Urad* etc. were weeded twice; cotton three times, and *saman, bajra, kutki, kakun, and til* only once; in the field of *jowar* the plough used to be passed down the standing crop two or three times, so as to loosen the soil at the roots. Weeding was not common for *RABI* crops.

REAPING :

Reaping of almost all crops used to be done by means of a sickle (***hansia***). The crops which were cut were packed as sheaves and were taken to threshing platform (i.e. ***khalihan***) for threshing to be carried out. The time of ripening of different crops is listed in table which follows:

TABLE- RIPENING PERIOD

Crops	Ripening period
KHARIF crops <i>Saman, Bajra, Kakun, and Kutki</i> <i>Urad , Til , Kodon, Moong & Dhan (paddy):</i> <i>Jowar:</i>	From second half of BHADO (i.e. first fifteen days of September) till the end of AGHAN (i.e. first half of December) By the end of KUNWAR (first fortnight of October) By the end of KARTIK (i.e. end of October) By the end of AGHAN (i.e. first half of December)
RABI crops	Between the months of PHAGUN and CHAITRA (i.e. February to April)

MIXED CROPPING AND CROP- ROTATION:

MIXED CROPPING:

Farmers regularly used technique of sowing a few of the grains together. This saved them labour and other operations like irrigation of two different crops separately. The grains being mixed were to be of similar characteristics and inputs.

The commonest form of mixed sowings in southern part of *Bundelkhand* during KHARIF season were : *ARHAR* with *MOONG*; *KODON* with *TIL*; *URAD* with *TIL*, and *JOWAR* with *ARHAR* while in northern part Paddy was mixed with *JOWAR* and *URAD*. Cotton with *URAD* and in some places *JOWAR* was mixed with *URAD*, *ARHAR* and / or *MOONG* . During RABI season the combination were Wheat with Gram and Linseed, Wheat with Gram and *MATAR* and Wheat with Gram & Barley. Above combination were basically decided by farmers on the basis of soil-types where the crop were to be taken.

CROP ROTATION:

Farmers normally were aware of benefits of crop-rotation. Gazetteer under reference comments on tendency of crop-cycling of *Bundelkhand* farmers as “*The cultivators well understand the value of recuperating their wheat or jowar bearing lands by an occasional leguminous crops , like gram or MOONG, by means of which Nitrogen is kept under soils*”.

Crop-rotation normally depended upon the types of land /soils . *EK-FASLI* (allowing only one crop in a year) and *DO-FASLI* (capable of taking both KHARIF as well as the RABI crops) had different combinations to follow one after other.

Some relevant information follows:

In ***EK-FASLI*** (ONE-CROP)- land the rotation was as follows:

KHARIF> KHARIF > KHARIF----:

1. TIL + KUTKI in the first year ; Kodon in the second year followed by JOWAR or RALI in the third year.
2. TIL + KODON in the first year; KODON with JOWAR or KUTKI in the second year ; JOWAR or KUTKI with URAD and sometimes with cotton. After three years this soil , usually *raankar*, was given rest for 3 to 5 years before repeating the above cycle.
3. JOWAR with ARHAR or URAD followed by Cotton with ARHAR or JOWAR alone.

RABI > RABI > RABI ----:

Usually in the MAR / KABAR soils Wheat with Gram followed by Wheat with Linseed during next year.

In ***DO-FASLI*** (TWO CROP) - land the rotation is KHARIF > RABI > KHARIF and so on and the crops are:

1. JOWAR with ARHAR or URAD or Cotton with JOWAR followed by Wheat with Gram or Wheat with Linseed or Gram with Linseed or Wheat with Gram & Barley.
2. SAMAN with PHIKAR (*lathara*) , KUTKI and TIL being followed by Wheat with Gram and Linseed.

A report related to Orchha State (present Tikamgarh district) mentions people taking MOONG / URAD & Paddy in both KHARIF as well as RABI seasons.

IRRIGATION – THE TRADITIONAL SOURCES:

Throughout the length and breadth of *Bundelkhand* major irrigation sources traditionally had been dug-wells situated mostly in the vicinity of farmers' fields. Irrigation from tanks despite their remarkable presence was not very popular. Many of the existing tanks built in past by kings belonging to *Chandella* and *Bundela* dynasties and also later by British rulers, were joined with channels through sluice gates for the purpose of irrigation. British administration also built some weirs on rivers like *BETVA*, *DHASAN* and *KEN* and in some districts canals were constructed for the purpose of irrigation. These inspired certain areas to change their traditional farming pattern introducing cultivation of irrigated paddy and other RABI-crops.

The dug-wells were simple, built with villages' own resources and almost sufficient for essential watering of the garden crops, limited sugar cane and Betel crop and, if possible, the RABI crops on *PARUA* soils. Tanks were always ready at hand in each village if extra irrigation was demanded by selected crops. Most of the grains and the varieties of seeds were suitable for dry land farming as these needed almost no watering beyond what was available through rains. The *MAR* and *KABAR* soils never needed any irrigation because of their water retention property. Drawing of water from wells used to be by *RAHAT* (Persian Wheel) or *TARSA* (a leather bucket) drawn by bullocks. Water from tank was available through channels thru' sluice gates and when its water receded, canoes or basket-lifts were operated by farmers.

STAPLE DIET OF PEOPLE:

In normal years villages used to produce sufficient for their essential needs of food-grains. The artisans and the farm-labourers were paid wages in kind which used to meet their family food needs. Farmers always grew different varieties of grains which suited their soils and the local weather. Thus staple diet of people also contained varieties and the practice was guided by the seasons as follows:

STAPLE DIETS – SEASON WISE	
Season	Staple Diet
1. Rainy Season	Maize, <i>KODON</i> , <i>RALI</i> , <i>SAMAN</i> & <i>PHIKAR</i> (<i>lathara</i>)
2. Winter Season	<i>JOWAR</i> & Pulses grown during <i>KHARIF</i> cropping season,
3. Summer Season	Wheat, <i>PISSI</i> , Gram and Barley

HORTICULTURE:

Forests being rich and heterogeneous wild fruits used to be freely/ readily available to people. Yet, those who could afford loved to plant fruit trees like mango, guava, Tamarind, Lime, Orange, and such others in their gardens, within farms and in their house campuses. Apart from fruit-trees other popular trees have been those of religious and medicinal value like *PEEPAL*, *BARGAD* & *NEEM*. These were planted at any free space in the village, around tanks / ponds and near the Temples.

On roadside also people used to plant shade bearing trees to facilitate pedestrians and bullock carts transporting goods from one place to other. This practice was approved and followed by British rulers under their plan of arboriculture.

THE FORESTS :

Ancient literature like Valmiki's *ramayana*. mentions Chitrakoot, the *vindhyatavi* (Vindhyan Forests), the river *mandakini* (Paisuni) etc. and the dense forest around it. This region now known as *Bundelkhand* was extremely rich in the resource of forests even up to 19th century. Useful timber trees, fruit trees and innumerable medicinal plants were in abundance. The rich forests and plentiful rains had rendered this region rich and supportive for human- as well as the wild life from very ancient times.

Publications related to *Bundelkhand*- region viz. "**EASTERN STATES - BUNDELKHAND GAZETTEER (1907)**" as well as the District Gazetteers published after 1947 report large number of plant-species present up to that time in this region. The "**Flora of Bundelkhand**" listed by E.T. Atkinson (published 1874) has been extremely helpful in our studies of forest-wealth here. In addition we consulted various other reference books also for knowing the facts. During our field-trips we came across hundreds of plants in forests of this region and on the basis of all above information a comprehensive report on **Potentials : Plant Wealth of Bundelkhand** has been prepared which appears in chapter II (volume -2) of this document.

In Madhya Pradesh seven out of 21 forest circles namely Bhopal, Jabalpur, Sagar, Seoni, Hoshangabad, Shivpuri, and Gwalior are in the vicinity of *Bundelkhand* region. These forests, like other adjacent forest-circles of M.P. have been mixed in nature comprising large number- and of many different species of valuable timber, fruit-trees, medicinal plants and herbs etc. In addition, quite a large part of these forests had been rich in bamboos too. The environment of forest was such that there was hardly any impact of thousands of people living within or millions of village-cattle grazing regularly during rainy season. The hills along with its slopes were fully covered by vegetation. The thorny trees like *kardhai*, *babul*, *karaunda*, *makor* and *reonjha* etc. were the

protectors of bigger trees in forest because these did not allow grazing cattle to reach near such trees even during their early growth-period. Occasional fires also helped forests towards its denser growth.

It was like a developing process in a family with presence of people, cattle, wild life, big and small trees, thorny, bushy shrubs, herbs and the rivers / rivulets providing sufficient moisture and also shelter to wild life. Wild life's role had been important in protection of the forests. Dense forests used to give them safe shelter while the beasts were responsible for protecting vegetation because their presence prohibited and limited visit of unwanted people in the forests.

FORESTS UNDER BRITISH ADMINISTRATION:

The forests were divided under broadly three categories:

Class 1 : Forests of bigger valuable mature trees marked as Reserved Forest.

Class 2: Smaller less valuable trees marked as Protected Forest

Class 3 : The forests near villages as ABADI BAN allowed for essential use (NISTAR) by village-people.

During British administration of forests, however, people's right of *NISTAR* and local *sahariya (saunr)* tribes as forest-guards were maintained. These forest-guards were paid for their services and were allowed to collect and sell the minor forest produce. British administrators as well as Indians trained under them for similar forest – governance unfortunately never gave any importance to medicinal plants. The herbs were just weeds for them.

Since British knowledge of health & medicines had different foundation, their purpose of governance here was for income-generation and also because of cultural difference they just avoided to mix with traditional healers or *Vaidyas* to understand the importance of medicinal plants and herbs. Either they could not understand or perhaps avoided to accept that rains as well as the surface or ground water is controlled by forests and in this region forests are the only means which provide water to inland-rivers along with restricting severity of floods during rainy season and also the hot winds during summers.

The Forest Department used to plan and control the felling of trees and grazing of animals. Wood was available to villagers but after paying its price. Only during famine like conditions people were allowed to freely collect fruits and fodder from forests. The village-cattle could enter some forests for grazing but sheep and goats were totally prohibited.

THE WILD LIFE :

The wild life in this tract has been so rich that during the times of Moghul rule at Delhi , forests around Panna and Narvar (Shivpuri Dist) have been reported as catchment of elephants . Like the vegetative diversity, wild life also was quite diverse and rich. Tiger, Panther , Leopard , Wild dog, Hyaena , Wild boar , Bear, Kotri , Antelopes of several types, *Nilgai* , Ravine deer , Spotted deer, *Shambhar*, Fox and Jackals etc. used to be found all over these forests .

The rivers particularly *KEN* and *DHASAN* used to be full of crocodiles . Some of these rivers just few decades back were full of alligators, porpoises, and tortoises. A large number of fish-varieties were found in ponds/ lakes and the rivers. All the common birds such as duck, geese, teal, snipe, partridge, quail and plover etc. and many domestic and wild birds have been reported to be found here. That included florien and even the great bustard seen in the plains of central and western *Bundelkhand*.

The present situation, however is, extremely alarming ; forests as well as the wild life including that in the rivers , all are on the verge of extinction.

.....

Chapter - II

BUNDELKHAND : THE SAGAR DIVISION :

Present study is aimed to cover districts of the Sagar (*Bundelkhand*) division viz. Chhatarpur, Damoh, Panna, Sagar and Tikamgarh which lie in the same watershed, draining towards north / north-east towards Yamuna river. The map below presents area of focus in our detailed study. Datia being a part of different water-shed was not included in present study.

Area covered by present study is shown below:



GENERAL STATISTICS: **(on the basis of 2011 Census)**

Following table gives general statistics regarding the districts under study viz. Chhatarpur, Damoh, Panna , Sagar and Tikamgarh under Sagar (*Bundelkhand*) division :

GENERAL STATISTICS

District (Janpada- Panchayats)	Particulars					
	Area (km²)	Villages	Population CENSUS- 2011	Rural Population (%)	Gram- Panchayats	Population Density per km²
Chhatarpur (8)	8616.82	1080	17,62,275	77.4	558	205
Damoh (7)	7285.83	1229	12,64,219	80.2	461	165
Panna (5)	7135.00	1015	10,16,520	87.7	395	142
Sagar (12)	10252.00	2059	23,78,458	70.2	753	197
Tikamgarh (6)	5048.00	865	14,45,166	82.7	459	286
Some more information regarding these districts has been given while discussing the individual districts later in this chapter.						

DISTRICT- ADMINISTRATION:

The administrative pattern of all these districts is the same as in other districts of Madhya Pradesh. Normally district forms the basic unit of administration which is governed by an officer belonging to IAS cadre (a version of ICS cadre during British rule) entitled the **Collector (District Magistrate)** selected normally by centrally managed Union Public Service Commission , New Delhi or a promoted senior officer of Provincial Civil Service (PCS). Collector is the chief functionary on behalf of the State Government and is chief coordinating authority at the district level.

For purpose of efficient administration , each district has been divided into Sub-Divisions and *Tehsils*. These are governed by Sub-Divisional Magistrates (SDM's) and *Tehsildars* respectively who mostly are stationed at their head-quarters. Most *Tehsil*-headquarters have also been made Community Development Blocks (known as *JANPADAs* in M.P.) for purpose of better implementation of the development-programs and schemes of Central- as well as the State Government. These Blocks are managed by respective CEO's.

Coordinating development programs within district is also a responsibility of Zila-Panchayats whose members and heads are publically elected . The municipal management of towns / cities is done through various Nagar-Panchayat –Parishads (Nagar Panchayats) managed by elected team of members and its head . Apart from it there are various state government- as well as central government- offices looking after responsibility and functions of respective departments/ schemes.

GENERAL INFORMATION DISTRICT-WISE:

General information concerning five districts under the Sagar Division of Madhya Pradesh viz. Chhatarpur, Damoh, Panna, Sagar and Tikamgarh is presented district wise , as follows:

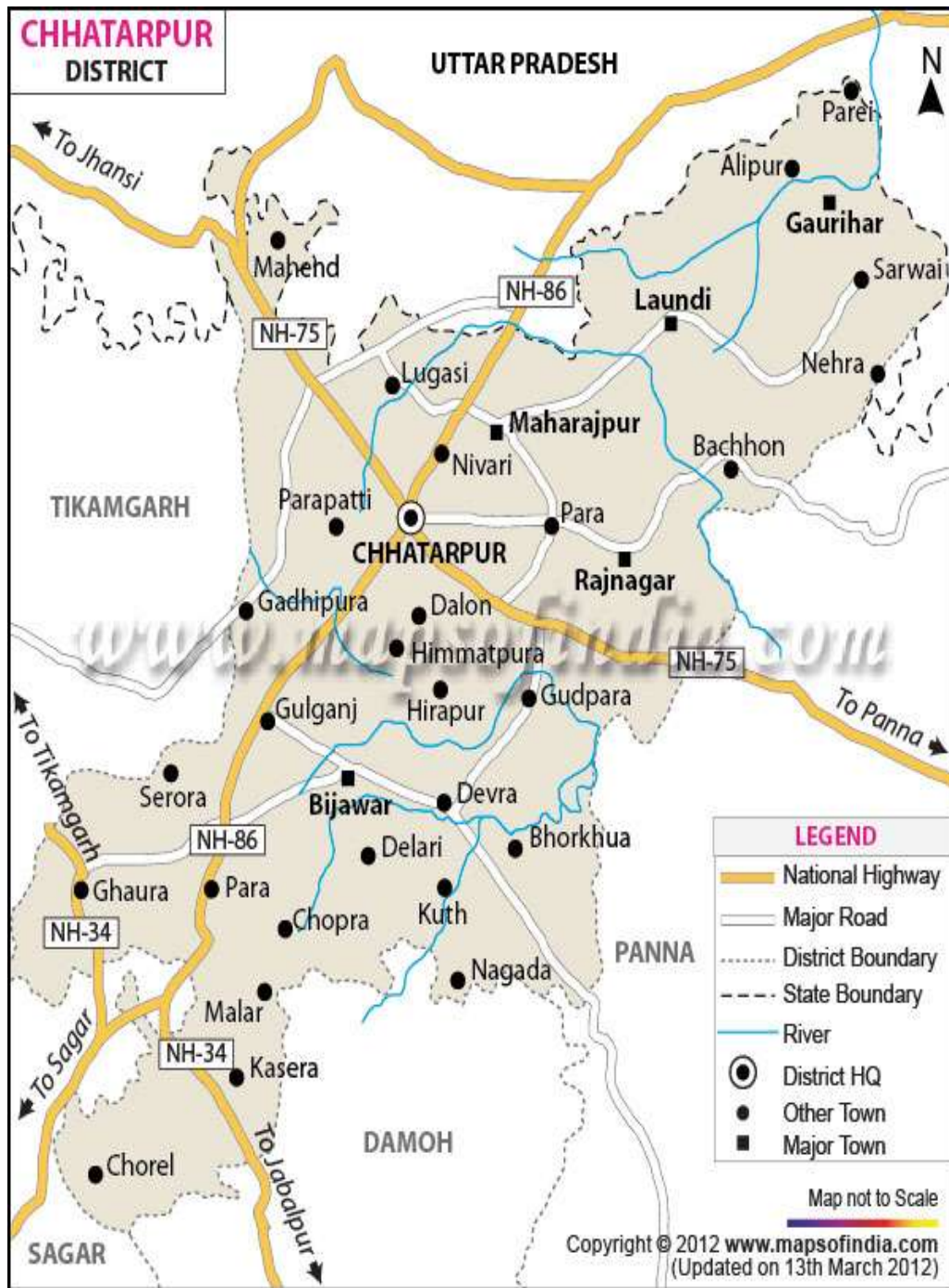
1. CHHATARPUR

A . INTRODUCTION:

The district is named after the headquarters' town , Chhatarpur. As per history this town was founded by Maharaja Chhatrasal Bundela in the year 1707 AD. Chhatarpur district lies between Latitude 24⁰ 6' & 25⁰ 20' (north) and longitude 78⁰ 59' & 80⁰ 26' (east).

The district is elongated from south-west to north-east. The maximum length of the district is 185 km and the width around 121 km. The rivers *DHASAN* and *KEN* form the physical boundaries on the west separating Tikamgarh district and on the east , Panna district respectively. The district is bounded on the north by Mahoba district (U.P.) and on the south by Damoh district/ Banda district (U.P) .occupies a north-easterly while Sagar and Lalitpur (U.P.) south westerly position across the boundaries. Small section of the district boundary also touches Jhansi district of U.P. in the north-west direction across *DHASAN* river.

MAP OF CHHATARPUR DISTRICT



DISTRICT AT A GLANCE:

S.No.	Particulars	Statistics
1	GENERAL INFORMATION	
	Geographical Area	8616.82 km ²
	No, of <i>Tehsils</i>	08
	No. of Development Blocks	08
	No. of Gram Panchayats	558
	No. of villages	1080
	Population (2011)	17,62,275
	Average Annual Rainfall	1060.42 mm On the basis of 110 years' average
2	GEOMORPHOLOGY	
	Major Physiographic Units	Panna Range, Central Plateau, & Northern Plains
	Major Drainages	Yamuna sub-basin of the Ganga basin
3	LAND USE	
	Total Area	8633.60 km ²
	Forest Area	1808.00 km ²
	Net Area Cultivated	4038.63 km ²
	Rest Cultivable	651.67 km ²
4	Major Soil Types	Alluvial, Red & Yellow, Mixed Red & Black, & Medium black soils.
5	Predominant Geological formations	Recent Alluvium Deccan Traps , Vindhyaans, Bijawars & Granite
6	GROUND WATER SITUATION	
	- Annual Replenishable Ground - Water-Resource: - Net Annual Ground Water Draft: - Stage of Ground-Water Development:	948.41 MCM 536.10 MCM 57%
Reference: <ol style="list-style-type: none"> 1.District Statistics of Chhatarpur (2010) 2.Central Ground Water Board – Report of Chhatarpur district (2009) 3. Report of MSME : Chhatarpur (2012) 4. IMD-India Water Portal 		

B .PHYSICAL FEATURES:

TOPOGRAPHY:

The district as a whole lies on the lower part of *Bundelkhand* plateau. The general height of the district is about 400 m. However, most prominent parts are those traversed by the Panna hill- range through southern parts of the district. The range stands about 100 m from the surroundings and 500 m from above the mean sea level. From here the plateau gradually lowers down and converges into the alluvial plains in the north , particularly along the *KEN* and the *DHASAN* rivers.

The three distinct physical divisions of the district are as follows :

1. The Panna range,
2. The Central plateau,
3. The Northern plains.

1. THE PANNA RANGE:

This is a branch of the Vindhyan mountains traversing Sagar, Chhatarpur, and Panna districts from south-west to north-east. It separates upper Bundelkhand from the lower *Bundelkhand* plateau. Overlying Archaeans it is formed by the Bijawar- and Vindhyan beds which have folded variously , and have also been much cut up by superimposed drainage system of this area.

A few hill tops now capped by the Deccan Trap rocks stand evidence of their being covered by extensive lava flows. Since then, the drainage developed on the slopes of the original lava bed has eroded the surface deeper to the present level. On account of this and by the cutting back of the up- streams , main rivers of the district flow across the Panna range.

The Panna range had developed several mild folds , each sloping to the south and scarping to the north, notably coinciding with the change of geological formations. The central syncline is drained by two small streams of the same name SAIMRI, flowing in opposite directions to the east and the west , respectively. This separates anticlinal hill ranges of Binjh and the local Panna ridge. The highest peak in the district (606 m) lies at $24^{\circ} 37'$ (N) by $79^{\circ} 45'$ (E). KUSMAR hill on Buxwaha Plateau is 551 m and MADANWA 564.2 m above the mean sea level.

2. THE CENTRAL PLATEAU:

This runs to the north as if an offshoot of the Panna range and lies mainly on the *Bundelkhand* granites and forms the central sub-water divide. This results in presence of small hills and ridges everywhere at intervals, standing between the tributary streams. They give way to lower plains along the *KEN* and *DHASAN* in the east and west respectively.

3. THE NORTHERN PLAINS :

The plain lies between 150 to 300 m above the mean sea level and is covered by varying thicknesses of alluvium. The rains and the drainage of this area results also in ravine – formation as in other parts of *Bundelkhand* region.

GEOLOGY:

Nearly three-fourths of the district is occupied by Archaean rocks, while the terraced hilly area in southern part is formed mainly of the rocks of Bijawar and Vindhyan formations. The edges Bijawar – Semri- and Kaimur – groups and Rewa-groups form a succession of scraps tending in direction from the east-north-east to the west-south-west.

A few isolated areas covered with basalts and associated rocks are also found in this part. Extensive areas of the Archaean rocks are covered with alluvium especially in the northern and western parts of the district. The extent of the alluvial capping progressively increases towards north, particularly in Laundi (Lavkush Nagar) *Tehsil*.

ROCK- SYSTEMS FOUND IN THIS DISTRICT :

ARCHAEANS: The Archaean rocks in the district are formed mainly of coarse and medium grained pink granites and granitic gneisses. These are known as Bundelkhand-granites. Inclusions of amphibolites and schistose rocks are

sometimes observed in the rocks. Granitic rocks are traversed by numerous quartz reefs (locally called *DHAULA PATTHAR*) . These form many of the prominent north-east to south-west trending ridges in this area. Granites are also traversed by a number of dolerite (*TELIA PATTHAR*) –dykes which usually run in a general north-west to south-east direction.

BIJAWAR GROUP:

The town of Bijawar and the scarps immediately to the south are formed of Bijawar group of rocks, comprising mainly of chert breccias, lime-stone, quartzite, ferruginous breccias and basalt.

VINDHYAN FORMATION:

The second terrace , comprising the area from near Jatashankar southwards , is formed of rocks of lower Vindhyan formation (Semri and Kaimur groups) and comprise mainly of sand-stones, quartzite, lime-stone, porcellanitic shale, black carbonaceous shale, yellowish green shale and conglomerates.

The third terrace further southwards is formed mainly of quartzites, green to chocolate shales and conglomerates in Rewa-group of rocks.

DECCAN TRAP:

Vesicular basalt occurs in four isolated areas in the southern hilly terrain of the district overlying the shales and quartzite of Rewa group of rocks and sometimes over a calcareous sandstone.

ALLUVIUM:

A small area in Laundi (Lavkush Nagar) tehsil and narrow strips along the KEN and DHASAN rivers lie covered under the alluvium of varying thicknesses .

THE SOILS :

The soils of Chhatarpur represent all types of soils present in other districts of this region. The only difference is of the its percentage of availability. There are also regions of mixture of black and red and also of alluvium which makes this tract to be able to produce all the crops .

The presence of good forests in the past had been enriching the soils here with enormous humus. The deforestation and ill-management of village pastures has resulted into worsening quality of the soils.

C .THE MINERAL WEALTH

The mineral wealth of this district comprises of

1. Building Materials like sand-stone & flagstone, quartzite, slates, *kankar* , granite, reef-rock, dolerite , sand and muram etc.,

-
2. Clays (china-clay associated with granite, inferior quality of fire-clay, red, white and yellow ochres),
 3. Copper (in traces) ,
 4. Impure lime-stones and Dolomite, Diaspore & Pyrrophyllite at several places,
 5. A peculiar Iron ore in small quantities within Bijawar rocks. Iron Ores have also been sensed to be in the north-eastern part of the district, and
 6. A belt of Diamond has been discovered and being worked in Buxwaha and some part of Bijawar blocks of Chhatarpur district.

D . NATURAL DRAINAGE ;

The general slope of the district is diverted to the north through the *KEN* and *DHASAN* rivers which also form the boundaries of Chhatarpur district on east and west respectively. The drainage of this district is divided into two parts : on each side of the central sub-water divide which runs from south to the north past Buxwaha, Ragauli, Chhatarpur and Lugasi. The streams east of this dividing line flow to the east and join *KEN* , while the west bound streams join *DHASAN*.

The district as a whole lies in the Ganga drainage system. The nature of drainage is seasonal and the pattern mostly dendritic.

Important streams are described as follows:

THE RIVERS:

THE KEN: Rising in Jabalpur district , river KEN flows through Panna district and marks the eastern boundary of Chhatarpur with Panna and Banda districts of *Bundelkhand*. The course of this river is towards north. Between the two anticlines of the Panna range (the Vindhyachal- and the Panna –range proper) flows a small tributary stream called **siamri** . The **siamri** joins river *KEN* whose confluence has been merged under the reservoir created due to the GANGAU weir on river *KEN* itself. A tributary of *KEN* , **banne** has been dammed at Rangawa, giving water to a canal irrigating some of Panna villages and rest of its water feeds the Bariarpur wier providing irrigation to Chhatarpur, Panna and Banda districts. As the river proceeds towards alluvium tract, it has a tendency of forming ravines on both the banks.

The tributaries of *KEN* within Chhatarpur district are **Siamri, Banne, Khuraran, Kutni, Urmil, Lohruk, Kusar** and **Kail** besides many of its small seasonal tributary streams which drain off the district from the western direction.

THE DHASAN: This river rises from Raisen district and flows to the north across Sagar district. It then follows towards Sagar, Lalitpur, Jhansi, Chhatarpur, Tikamgarh and Hamirpur districts. Total length of the river is 365 km, out of which 240 km lies in Madhya Pradesh, 54 km common boundary between Madhya Pradesh and Uttar Pradesh and 71 km in Uttar Pradesh. This river was called **DASHARNA** in ancient period.

In its early course, *DHASAN* flows through the Trap-rocks but like the *KEN*, crosses the Vindhya, Bijawars and Bundelkhand-gneisses before entering the alluvial plains. The tributaries of *DHASAN* within this district are mainly **Kathne** or **Bila**, **Mancrar**, **Tarper**, **Narkrer**, **Bharar** and several seasonal draining streams, all joining river from the eastern direction. There are several islands and rocky portions in course of *DHASAN* and the lower course as usual is cut up by ravines.

E. CLIMATE OF THE DISTRICT:

The climate of Chhatarpur district is characterized by general dryness except during the south-west monsoon season and a very hot summer. Within twelve months of an year one observes four marked seasons : the summer months are from March to mid-June followed by rainy season between mid-June and September. The post monsoon months i.e. October to mid-November are transitional to the winter which starts from mid-November and lasts up to February. January being the coldest while May is normally the hottest month.

July-August (*ashadh* & *shravan* by Indian calendar) are the heaviest raining months in this tract.

TEMPERATURE:

As indicated above January is normally the coldest month. February is unpredictable as the atmospheric temperature may turn on any side, but heat takes over definitely from March onwards. The atmosphere cools only with the south-western monsoons coming to rain from mid-June, though humid summer is strongly felt for next few weeks. During rainy season temperature shows a drop but increases slightly in October (especially during Indian *kwanr* or *aswin* month). Sky remaining clear allows sun-rays to be more piercing and unbearable for farmers and farm-workers working open on the fields.

In Chhatarpur district the climatological indicators like temperature and rainfall etc. are being recorded at Nowgong station. The information documented for the average maximum and minimum temperatures by Indian Meteorological Department for 1901-1961 and that provided by India Water Portal based on records of India Meteorological Department for 1962 to 2002 are given in the table as follows :

TABLE – MAXIMUM AND MINIMUM TEMPERATURE

Month	Maximum Temperature (°C)		Minimum Temperature (°C)	
	1901-1961 Highest: 47.2 (1947)	1962-2002 * Highest: 43.5(1978)	1901-1961 Lowest: 0.6 (1905)	1962-2002 * Lowest: 7.2(1963)
January	23.8	24.2	8.1	9.2
February	26.7	27.4	10.3	11.4
March	33.2	33.0	15.3	16.4
April	38.8	39.0	21.2	21.7
May	42.1	41.2	26.4	25.9
June	39.4	38.5	28.2	26.3
July	32.7	32.0	25.8	24.3
August	31.2	29.9	24.9	23.2
September	32.4	31.3	23.8	22.5
October	32.6	32.8	18.2	19.2
November	28.3	29.4	11.4	13.7
December	23.8	25.3	7.9	10.1
Source: India Water Portal & IMD Climatological Tables of observatories in India				

RAINFALL:

The average annual rainfall as computed from the records available up to 2011 for Chhatarpur district is of the order of 1050 mm. The maximum in these 110 years has been recorded as 1589.4 mm in 1982 while the minimum rainfall amounting 368.8 mm in the year 1905.

Annual average of the rainfall on the basis of data recorded for Chhatarpur district from 1901-1960 and 1961-2011 give following figures:

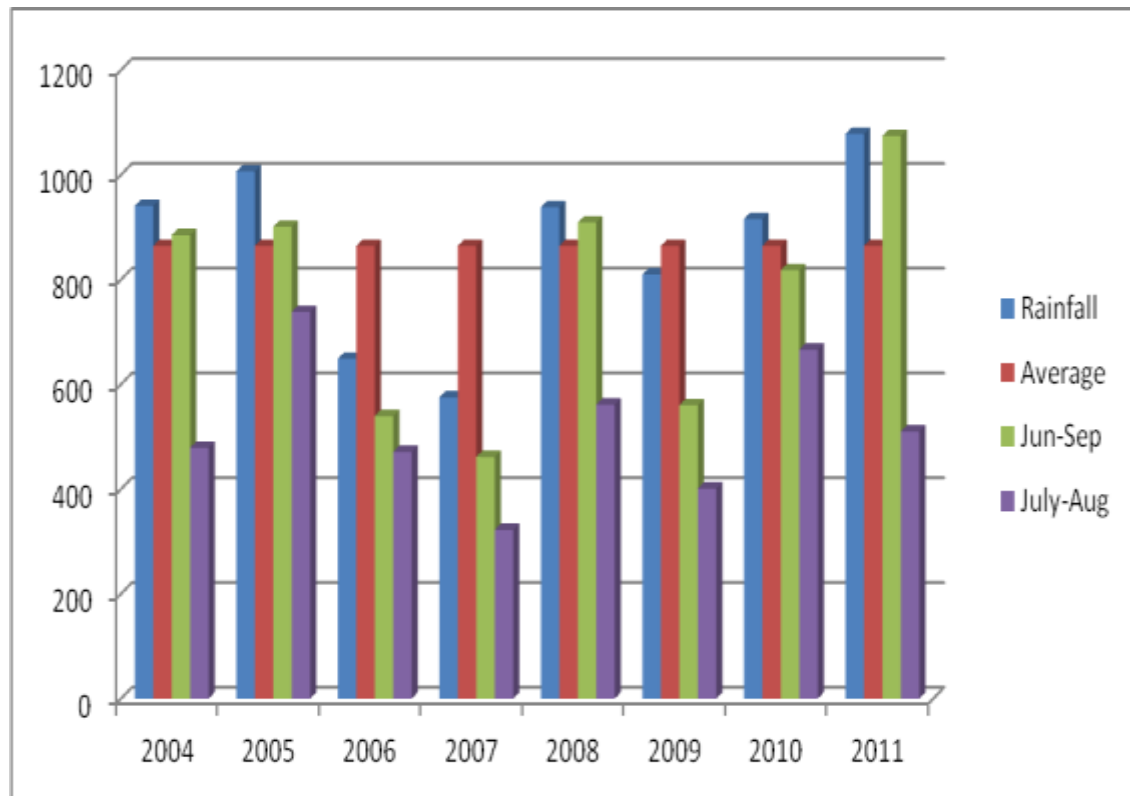
TABLE- AVERAGE RAINFALL RECORD

Mean Monthly Rainfall	Average Rainfall (mm)	Average Rainfall (mm)
Month	1901-1960	1961-2011
January	19.38	15.83
February	13.88	12.10
March	8.19	6.35
April	4.19	3.49
May	6.87	5.90
June	94.31	100.78
July	371.43	297.81
August	344.07	349.79
September	172.62	191.58
October	33.21	30.94
November	13.19	10.89
December	6.89	7.14
TOTAL ANNUAL AVERAGE	1088.23	1032.60
Average Annual Rainfall (110 years) 1060.42 mm		
The rains during June-September:	982.43 (90%)	939.96 (91%)
Maximum Rainfall:	1534.30 (1942)	1589.4 (1982)
Minimum Rainfall :	368.80 (1905)	574.2 (2007)
Source: India Meteorological Department Data & India Water Portal		

RAINFALL DATA OF CHHATARPUR (2004 - 2011)
COMPARED WITH AVERAGE AND PARTIAL RAINFALL (Jun-Sep & Jul-Aug)

Year>>	2004	2005	2006	2007	2008	2009	2010	2011
Rainfall (mm)	940.7	1006.6	648.9	575.5	938.3	809.8	915.8	1078.1
Average for these 8 years	864.2	864.2	864.2	864.2	864.2	864.2	864.2	864.2
Rainfall: June-Sept.	885.1	900.8	539.6	461.6	909.0	560.2	818.1	1074.3
Rainfall July-August	479.1	738.5	471.2	322.2	561.4	401.2	666.4	510.1
Source: IMD-INDIA WATER PORTAL								

**RAINFALL DATA GRAPH OF CHHATARPUR
(2004 - 2011)**



Aiming at analyzing situation of Chhatarpur which had been facing drought / flood-condition in recent years, one must look at the rainfall which occurred during these years. The graph given above covers the period from 2004 to 2011, the eight years which were problem-years for this region. The erratic rains occurring at improper time and leaving a long spell of no rains within rainy season has been one of the major causes of the crisis.

For understanding the general rain-pattern rainfall-data and graph shown above are important which clearly show that most of the rainfall up to extent of 90- 91% falls between months of June to September of the year while 63 to 65 % of total annual rainfall occurs in just two months i.e. July and August only.

Not only that most precipitation occurs within two months but also in just few days of the month creating thereby flash-floods damaging crops and villages resulting into loss of many lives: human as well as cattle. Long interval between two sets of rains also contributes to drought conditions.

CONTRIBUTION OF RAINS TO GROUND-WATER :

Since summer months are quite hot and May being the hottest, rains coming during June are normally lost in evaporation giving slight relief to the top soils . The later rains during July and specially August do contribute to the ground water at appropriate places where there are still some forests or the surface is rock-free allowing rain water to stand and penetrate into soils. During September rains contribute to the ground water increment possibly due to infiltration to the upper aquifer bodies but rains in other months are scanty and hardly enough to meet the soil-moisture zone requirements.

THE HUMIDITY:

Humidity plays a complementary role in the total climatic pattern of an area along with its rainfall and temperature. We could manage to get the mean monthly relative humidity percentages for 30 years (1962-1992) for Nowgong station which is presented in the following table . The data of relative humidity recorded earlier between 1901 and 1961 at the same station are also given in the table which follows:

TABLE- RELATIVE HUMIDITY

month	Relative Humidity			
	1901-61		1962-92	
	8-30 AM	5-30 PM	8-30 AM	5-30 PM
January	76	41	79	38
February	67	30	66	28
March	46	23	57	20
April	34	24	30	11
May	34	27	31	19
June	54	46	74	39
July	50	76	74	63
August	83	76	77	69
September	81	67	75	59
October	69	44	66	43
November	73	39	61	39
December	77	40	72	40
Source: IMD Govt. of India Nagpur				

THE WINDS:

The mean wind velocity as reported recently by India Water Portal possibly from IMD data from Nowgong (Chhatarpur) station is presented in a table below.

TABLE- WIND-VELOCITY

Month	Wind Velocity Km/hour
January	3.37
February	3.48
March	3.71
April	3.99
May	4.22
June	4.14
July	3.68
August	3.20
September	3.01
October	2.52
November	2.64
December	2.95
Source: (www.synergyenviron.com) through INDIA WATER PORTAL	

Wind Velocity is an important indicator as it is the horizontal component of the air movement parallel to earth's surface (generally known as the air current). Measurement of these air currents by anemometer is called the Wind Velocity in terms of km. per hour. Wind Velocity directly affects intensity of the rainfall. It has been observed that lower the velocity , chances of rainfall are more.

From the data as shown above it is quite apparent that during winter months winds are slower while there is an increase in velocity from February onwards up to June after which it comes down. August-wind becomes quite slower . The winds during May-June are hotter and are sometimes associated with severe dust-storms.

SOLAR IRRADIATION:

Solar irradiance is a measure of how much total solar power a location receives. The irradiance varies throughout the year depending on seasons. It also varies throughout the day, depending on position of the sun in sky, and the weather. The information regarding average solar irradiation per day on Chhatarpur district is as follows:

TABLE- SOLAR IRRADIATION

Month	Solar Irradiation (kWh/m ² /day)
January	4.23
February	5.09
March	5.92
April	6.60
May	6.51
June	5.45
July	4.32
August	3.93
September	4.51
October	5.04
November	4.51
December	4.00
Source: IINDIA WATER PORTAL (Ref. from www.synergyenviron.com)	

EVAPORATION LOSSES :

Evaporation and Evapo-Transpiration (ET) is one aspect of the hydrological cycle. Evaporation of water into vapours is an ongoing process and is affected by several environmental factors itself . Following table presents the average monthly evaporation losses recorded at Chhatarpur :

TABLE- EVAPORATION LOSSES

Month	Evaporation Losses (cm)
January	7.62
February	8.89
March	16.51
April	20.32
May	25.40
June	20.32
July	17.78
August	16.51
September	14.60
October	9.52
November	6.35
December	6.35
Average Annual : 14.18 cm	
Source: IMD-GOI, Nagpur as referred in an earlier publication (Problems and Potentials of Bundelkhand with special reference to water Resource Base (1998)	

POTENTIAL EVAPOTRANSPIRATION:

The Potential Evapo-Transpiration (PET) as mentioned elsewhere is defined as the amount of evaporation that would occur if a sufficient water source were available. It is a reflection of the [energy](#) available to evaporate water, and of the [wind](#) available to transport the water vapour from the ground up into the lower [atmosphere](#) and in this way it serves as an important factor in climatological study of a region. Following table gives values of PET as recorded from 1960 to 2002 for Chhatarpur district :

TABLE- POTENTIAL EVAPO-TRANSPIRATION

Month	Potential Evapo-Transpiration (mm / day)
January	5.07
February	6.01
March	7.16
April	8.41
May	8.93
June	8.00
July	5.94
August	5.17
September	5.69
October	6.51
November	6.01
December	5.18
Average Annual : 6.51 mm / day	
Source: India Water Portal & IMD-GOI, Pune	

CLOUD- COVER OVER THE DISTRICT:

During the south-west monsoon season (normally from June to September) sky is mostly heavily clouded or overcast. In the rest of the year it is generally clear or sometimes lightly clouded. The averaged cloud cover data recorded in oktas or percentage of the sky covered each month at different time periods is presented as follows:

TABLE- CLOUD COVER

month	Coverage (%)
January	21.8
February	17.2
March	27.5
April	24.8
May	30.7
June	55.9
July	73.7
August	73.3
September	53.9
October	26.8
November	15.1
December	18.4
Source: IMD thru' India Water Portal	

SPECIAL WEATHER PHENOMENA:

Depressions from Bay of Bengal in the south-west monsoon season which move in westerly direction , reach this district or its neighborhood and cause wide-spread heavy rains and gusty winds. An occasional storm or depression from the Bay of Bengal during winter season also had been noticed to affect weather of the district.

Dust storms occur occasionally during summer season. Thunder storms generally occur during rainy season and up to October but the highest incidence is between the months of June , July and August . Occasional fog also hits the district during December and January months of the year. Precipitation in form of hails do occur sometimes between October and February. Frosts also have become common these days during winter months . Frosts and hails are major causes of standing crop-losses and these occasionally lead farmers to deep depression ; some events of farmers' committing suicides due to adverse climate , has also been noticed.

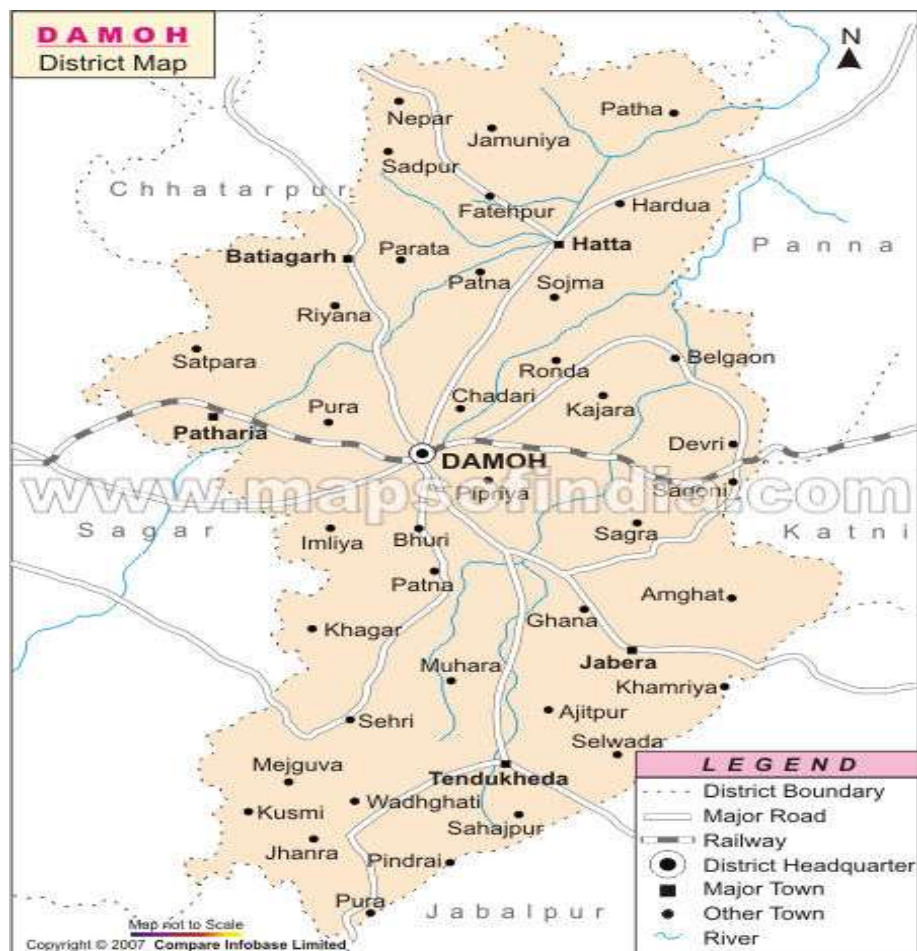


A FROST-HIT FIELD

2. DAMOH

A. INTRODUCTION:

One of the constituent districts of Sagar division, Damoh lies in between Latitude $23^{\circ} 9'$ & $24^{\circ} 27'$ (north) and Longitude $79^{\circ} 3'$ & $79^{\circ} 57'$ (east) and its geographical area is ca. 7,306 sq.km. The district is bounded on the north by Chhatarpur district, on the east by Panna, Katni and Jabalpur districts, on the south by Jabalpur and Narsinghpur districts and on the west by Sagar district. It comprises of seven Tehsils namely Batiagarh, Damoh, Hatta, Jabera, Patera, Pathariya and Tendukheda. The Development Blocks (*janpada- panchayats*) are also located at the same places.



DISTRICT AT A GLANCE:

S.No.	Particulars	Statistics
1	GENERAL INFORMATION	
	Geographical Area	7,285.83 km ²
	No, of Tehsils	07
	No. of Development Blocks	07
	No. of Gram Panchayats	461
	No. of villages	1,229
	Population (2011)	12,64,219
	Average Annual Rainfall	1,164.73 mm Based on 110 years' annual average)
2	GEOMORPHOLOGY	
	Major Physiographic Units	1 Southern Plateau, 2 Sonar Valley, 3 North western mountain range
	Major Drainages	River Sonar River Vyarma
3	LAND USE	
	Total Area	3,352.14 km ²
	Forest Cover	2,020.72 km ²
	Net Area Cultivated	-
	Rest Cultivable	-
4	MAJOR SOIL TYPES	Alluvium, Mixed red & black sandy
5	PREDOMINANT GEOLOGICAL FORMATIONS	Alluvium, Laterite, Conglomerates Aranaceous lime-stone, Upper Bhandar Sandstone
6	GROUND WATER SITUATION	Could not be available
Reference: Census of India 2011 District Statistics from Damoh office (Statistics Department) 2010 Report of MSME (Indore) 2012		

B. PHYSICAL FEATURES:

TOPOGRAPHY:

Damoh district is situated in south-east of the great Vindhyan plateau, which runs parallel to river *NARMADA*. The Vindhyachal hills, which stretch for a considerable distance along the western boundary, though of no great height, had been forming the most picturesque feature of the district. Damoh extends in a vast table land, sloping gradually towards the north, till an abrupt dip in the surface occurs, beyond which the plains are seen stretching far away into the distant horizon. The district has three distinct physical divisions as follows:

- Southern Plateau,
- Sonar Valley,
- North-western mountain range.

1. Southern Plateau:

The southern plateau is situated at a height of approximately 450 m of which the southern and south-eastern frontiers run with parallel mountain range. This mountain is like a vertical wall from where *Narmada*- and *Hiran* – valleys are quite visible. The *Vindhyachal* range here extends from the north of Sun-valley *Bhander*- and *Kaimur* ranges. In fact this range is the last corner of Vindhyan Plateau.

A large plateau having slope towards the north-east is situated to north and north-west of *Bhander*- mountain range and north-west of *Kaimur*- mountain range. In north it is spread up to Panna district. Certain peaks of these mountains ranging from 417 m to 479 m within this district are worth mentioning. These are:

1. **Fatehpur** : 450 m
2. **Satiriya** : 479 m
3. **Hindoriya** > 457 m &
4. **Jamuniya** 447 m (triangle), on the north –western border of the southern plateau,

and

1. **Lodhi-kheda** 463.6 m ,
2. **Gubra** 417 m &
3. **Pateria** 429.9 m , on the southern border of the district branching off the *Bhander* range running from south to the north.

2. **SONAR Valley :**

Sonar valley is spread like a belt across entire north-central portion of the district nearly 80 km long and 32 to 40.3 km wide. The height of this tract is 335 m above the mean sea level. The soil of this tract is formed from the volcanic lava and is black in colour and very fertile. This area also known as *haveli* , is plain and possesses better soils. As a result this tract is considered to be of great agricultural potential. Thus it has come also to be main centre of industrial, commercial and administrative activities of this district.

3.The North- western Mountain Range:

The north-western plateau rises like a 120 m high wall over the *Sonar* valley. The mountain range is spread from south-west to north-eastern direction. The highest peak of this range is known as Furtal hill which is 525 m above the mean sea level. Forest around this plateau had been the reserved forest.

GEOLOGY:

Damoh district has a distinction of possessing the oldest rock systems like Precambrian and Deccan Trap . The Vindhyan super group which is spread over most of this district comprises of lime-stone, sandstone and shale. Geologically four rock formations viz. Alluvium, Deccan Trap, Lameta and Vindhyan are found in the district.

Predominant Vindhyan rocks consist of a succession of sand-stones and shales with a horizon of lime-stones and occupy a large part of the district. The system is subdivided into Bhandar group , Rewah group, and Kaimur group. Lameta rocks consist of conglomerate, cherts, sand-stones , clays and lime-stones. Towards west of the district, Deccan Trap area and *Sonar* valley are entirely composed of the black cotton soils.

Bijawars seem to be basement for the younger formations, though these are not clearly defined .The galena mineralization seems to be within it. Semris are restricted to the north-eastern parts of the district and can be seen in Chouraiya area comprising Porcellanite, Semri shales, dolomite and quartzite. Kaimurs are in the northern part of the district . Rewas are exposed in Kerbana-Sonrai area. Jhiri shales are soft ; less regularly bedded and contain arenaceous layers. The quartzite is white and massive form of the upper Rewas. Ganurgarh shales are purplish red and contain calcareous layers and are exposed near Jagthar, Semra and Dondha. Bhandar lime-stone is generally earthy, compact and grey to dark grey in colour.

The Geological Succession of district Damoh

Age	Formation	Rocks
Recent to Sub-recent	-	Soil/ Alluvium/Laterite
	Unconformity	
Cretaceous to Eocene	Deccan Trap	Basaltic flows
Late Cretaceous	Lametas	Conglomerates Arenaceous limestone
	Unconformity	
	Bhander Group	Upper Bhander Sand- Stone, Sirbu shales
Neo Proterozoic		Lower Bhander Sand –stone, Bhander lime-stone and shales Ganurgarh shales
	Rewa group	Jhiri shales, Orthoquartzites Conglomerates
	Unconformity	
	Kaimur Group	Quartzites , Conglomerates
	Unconformity	
Meso Proterozoic	Semri Group	Quartzites, Shales, Porcellanite beds
Meso Proterozoic	Bijawar Group	Conglomerate, chert breccias, cherty-dolomite, dolomite
<p style="text-align: center;">Reference: GEOLOGY & MINERAL RESOURCES-District Damoh- Directorate of Geology and Mining , Mineral Resources department, Govt. of Madhya Pradesh (2004)</p>		

The lower Bhander sand–stone is usually reddish brown and medium grained . Sirbu shales are *khaki* and thinly laminated. The exposure can be seen around Damoh , south of Hatta and Sakor areas. The upper Bhander sandstone is flaggy, thinly bedded, fine grained and dirty white , dark red and greenish white in colour. It can be seen in Hinoti, Hatibhar, and Magra areas. Lametas consist of conglomerates , cherts, sandstones, clays and lime-stone. The outcrop is in Singrampur reserve forest area. The trap basalt is fine to coarse grained rock and shows columnar jointing at places. It can be seen in the west-south-west of Pathariya, Intertrapean beds are mostly siliceous limestone, cherts and clays.

THE SOILS :

The soils of *Sonar*-valley are fertile and are mostly black cotton soils which contribute towards major productivity of the area. The valley of *VYARMA* although very narrow, has most fertile soils , sometimes better than the *SONAR*- valley soils. The north-western and north-eastern hilly tracts of the district , although plain, have inferior soils yielding lower productivity. The local names of soils are *kabar*, *mund*, *rathia*, *patrua*, *bhatua*, *sihar* and *kachhar* and percentage of their availability in Damoh district and other related information is presented as follows:

TABLE- SOIL-TYPES

SOIL-TYPE	AVAILABILITY	Related Information
Kabar (found of two kinds : <i>kabar-1</i> and <i>kabar-2</i>)	01 %	The <i>KABAR</i> is good fertile black soil; <u>Found mostly Batiagarh area</u>
Mund (found of two kinds:) <div><i>mund-1</i> <i>mund-2</i></div>	09% 39%	<i>KABAR</i> , where found with <i>domat</i> , it was classified as <i>mund</i> . This is the main soil-types in <i>haveli</i> area.
Rathia	10 %	The inferior <i>KABAR</i> was termed as <i>rathia</i> found in the southern tract of this district near <i>vyarma</i> river.
Patrua (two kinds) <div><i>mutcharra</i> : <i>barra</i>:</div>	21% 16%	An inferior soil , mostly found in hilly tract, <i>patrua</i> (meaning light or weaker soils)soil is suitable for coarse grains as well as paddy and is found second in abundance.
Bhatua	03 %	Soils found in slopes and hill sides
Sihar	01 %	<i>Sihar</i> is the sandy fine soil which is normally preferred for paddy cultivation
Kachhar		<i>Kachhar</i> is the alluvial soil usually by the side of the rivers which is preferred by the vegetable-growers.
<div>Source</div> <div>Gazetteer of India: Damoh District (1906)</div> <div>Madhya Pradesh District-Gazetteer (Hindi) (Damoh) 1980</div> <div>(information relates to the settlement by British Admn. During 1908-1913</div>		

C. THE MINERALS:

Damoh district does not have any valuable mineral deposit. The sand-stones and limestones of Kaimur, Rewah- and Bhandar- group of the Vindhyan super group, however, furnish excellent construction materials. Some galena - deposit is also reported in this district. Iron ore in very small quantities had been found in north near boundaries of Panna and Chhatarpur districts but that had no significant commercial value. A good quality of clay for pottery also used to be found near Damoh. Some stones of lithographic value are found in the river bed of SONAR which have never been exploited.

A 2004 report of Directorate of Geology & Mining (Mineral resources Deptt.) of Govt. of Madhya Pradesh citing the situation of their investigation some time in past gives following information regarding the mineral resources of Damoh district:

1. LIME-STONE:

Limestone was found located in and around Boutra, Sujanpura, Keolari, Naigawan, Satpura, Mirjapur, Bansoli, Sukha, Narsinghgarh, Kishanganj, Mahuna, Mainwar, Kabirpur, and Mangola in Pathariya Tehsil, Kanaktala, Sunkua, Nimurmunda in Hatta Tehsil and Ramsalaiya, Danababa, in Jabera Tehsils. The important localities are briefly described as follows:

- **PATHARIYA AREA:** This limestone is generally grey, bedded, compact and invariably associated with shale in the form of intercalations. It was found to be of cement grade and the reserves were estimated in tune of 37 million tons.
- **NARSINGHGARH AREA:** Here the limestone was seen exposed on the banks of river Sonar and around Narsinghgarh, mahuna, Kishanganj, and Barkhera. It is fine grained, grey and frequently inter-bedded with shales and is of cement grade.
- **HATTA AREA:** It was found exposed mainly around Nimarmunda and extends in the NE direction. The quality of limestone seemed good on surface but deteriorates vertically due to intercalations and interbedding of shales. The average analysis revealed CaO : 47.52%, MgO: 1.42%, and SiO₂ : 11.35%. The reserve was estimated of the order of 3.00 million tons.
- **JABERA AREA:** Limestone in Ramsalaiya & Danibaba area was found generally grey in colour and at places stromatolitic in nature. The grade of the lime-stone in the area seemed of cement grade with reserves of the order of 2.76 million tons.

2. DOLOMITE :

Around Chouraiya the dolomite was seen white to grey. The exposed thickness looked ca 25 metres whereas drilling in the area confirmed its continuity up to 95 metres. The average analysis of the mineral showed : CaO : 30.59%, MgO: 19.10%, SiO₂ : 4.92% , Al₂O₃ : 1.93% and Fe₂O₃ : 0.56%. The reserve of Dolomite here was estimated to be of the order of 140 million ton.

3. BUILDING MATERIALS:

Good quality Flagstone and sands had been located around Hindoria, Balakot, Baheria, Imaliaghar, and Khamaria areas in Jabera Tehsil. Besides above deposits of Galena, Iron ore, Barytes, and Laterites had been reported in the district. Details follow:

- **GALENA:** Locations are: Chouraiya (Hatta Tehsil) and Kua-Karaundi (Jabera Tehsil),
- **IRON-ORE:** Locations near Sadpur and Rajpur.(in Hatta Tehsil).
- **BARYTES:** Locations are Kua-Karaundi (Jabera Tehsil).
- **LATERITES:** The laterite boulders and pebbles found scattered over slopes of hillocks and valleys.

D. NATURAL DRAINAGE :

Except for some streams which join *HIRAN* , the only tributary to river **NARMADA** , all rivers and streams of this district , flowing into river *KEN*, form the drainage system of river **YAMUNA** and thus of river **GANGA** towards north. The main river systems of this district are of *SONAR* and *VYARMA*, which follow normal slope of the district towards north-east. Though these rivers have been perennial and used to carry enormous volume of water during rainy season , yet turn lean for rest of the year . Water then is located in *KUNDS* (stored in deeper bed locations of the river) only. The river- flow remains for smaller distances, that too with very limited water quantity. The situation is that during rains, flash floods cause enormous destruction but during summer season there is scarcity of even necessary amount of water.

RIVER SONAR :

Rising from the hills situated south-west of Sagar district (23⁰ 22' N – 78⁰37' E) SONAR flows in north-east direction in these districts. In Damoh it flows through a tract known as **haveli** , a rich, fertile and productive area. After traversing a distance of 102.4 km within Damoh district SONAR meets river *KEN* beyond the north-eastern boundary. SONAR is not a very wide river and flows in a deep channel on a rocky bed. Except near the place where this is joined by *VYARMA* , width of this river is never more than 320 metres. Major tributaries of this river are *KOPRA* and *VYARMA* on right bank and the *BEWAS* on the left bank.

RIVER VYARMA:

Rising from Rehli Tehsil of Sagar district , this river forms a serpentine flow from south–west to north-east. Towards the end of its course , it forms the boundary between Damoh and Panna districts and joins SONAR on the north-eastern border. VYARMA within this district flows through a well defined channel flanked by vertical rocky bank on both the sides. Valley of VYARMA is nowhere wide. In the course of its total length of 193 km its gradient is 1.1 m per km. The result is that the flood waters off-flow with enormous velocity. At the confluence with SONAR the river has widest course as mentioned earlier. Rivers GORAIYA , SUN & PADARI and JABERA nallah are the main tributaries of VYARMA on the right bank while on the left bank it is joined by BAMNER & KATHERA nallah.

THE STREAMS OF SINGRAMPUR:

The small valley of Singrampur which has separated itself from the open tract of Jabalpur by the Kaimur–range has its own drainage system. Smaller streams of this region meet HIRAN which, flowing southwards makes its way into river **NARMADA**.

THE WATER FALLS:

A few waterfalls have been worth noting in this district though environmental imbalance created by deforestation has affected these falls quite badly.

These are :

1. *Bagdari* and *Jhapan*
(in Tendukheda forest range)
2. *Rampura*
(in Taradehi forest range)
3. *Deotara*, *Dayont*, *Jamunia*, and *Bhawarpani* (in Singrampur forest range.)

E. CLIMATE OF THE DISTRICT:

The climate of Damoh district is generally pleasant . Except for the rainy months which are visited by south-western monsoon, winds are generally dry. As in other districts of *Bundelkhand* four distinct seasons in a year are felt here too. The summer being from March to mid-June followed by rainy season from mid-june to September . Before winter season visits from mid-November to February there is a transition period which covers from October to mid-November mostly. Mid-September to October months, if there is no rain , show increase in temperature with piercing heat , unbearable to farm-workers open on the fields. Various indicators of climate for Damoh district are described below:

TEMPERATURE:

Following table clearly shows the increase of temperature March onwards up to June until it rains. May has been recorded as the hottest month. The rains bring down the temperature which rises again in October. From November onwards temperature falls to record the lowest in January. Western disturbances during winter season bring cold waves affecting the temperature which may go further down. Frost may occur during the cold wave period.

TABLE : MAXIMUM & MINIMUM TEMPERATURE

Month	Maximum Temperature (⁰ C)	Minimum Temperature (⁰ C)
January	17.96	10.70
February	20.58	12.87
March	25.59	17.66
April	30.33	22.45
May	33.59	26.26
June	31.52	25.62
July	27.24	23.70
August	25.93	22.86
September	26.50	22.36
October	25.73	19.29
November	21.92	14.66
December	18.49	11.19
Highest : 35.59 ⁰ C (1988) : Lowest : 7.18 ⁰ C (1963)		
Reference: India Water portal & IMD Climatological Tables		

The temperature record of recent years clearly shows May to be the hottest month and January, the coldest. Reports from newspapers and daily forecasts from Meteorological Departments, however, announce higher temperatures during summers and much lower temperatures during winter season. Reasons are quite obvious. The tract having been severely deforested resulting into thinning of rivers and gradual decrease in rainfall as will be clear from the information below:

RAINFALL:

The rainfall pattern of Damoh is identical to nearby districts of *Bundelkhand*. Average annual rainfall as computed from recent records covering the years 2004 to 2011 is of the order of 1105.04 mm as compared to 1212.95 mm & 1126.09 mm for the year-groups 1901-1960 and 1961-2000. Rainfall generally decreases from south-west towards the north- east direction. More than 90% precipitation is between June and September only. Mean monthly rainfall data recorded for Damoh from 1901 to 1960 and 1961 to 2011 is presented below:

TABLE: AVERAGE MONTHLY RAINFALL

Month	Average Rainfall (mm)	Average Rainfall (mm)
	Year (1901-1960)	Year (1961-2011)
January	20.26	13.02
February	13.76	13.35
March	12.39	7.12
April	5.45	12.64
May	7.91	4.87
June	119.40	139.90
July	394.81	334.71
August	387.89	368.72
September	194.43	181.52
October	35.16	21.85
November	14.56	11.35
December	6.96	7.44
TOTAL ANNUAL AVERAGE	1,212.98	1,116.49
-do-	1,164.73 mm (past 110 years' average)	
Rains during June-Sept	1096.53 (90.4%)	1024.85 (91.8%)
Maximum Rainfall	1832.1 mm (1926)	1720.5 mm (1990)
Minimum Rainfall	651.1 mm (1913)	569.2 mm (1979)
Reference: Indian Meteorological Department & India Water Portal		

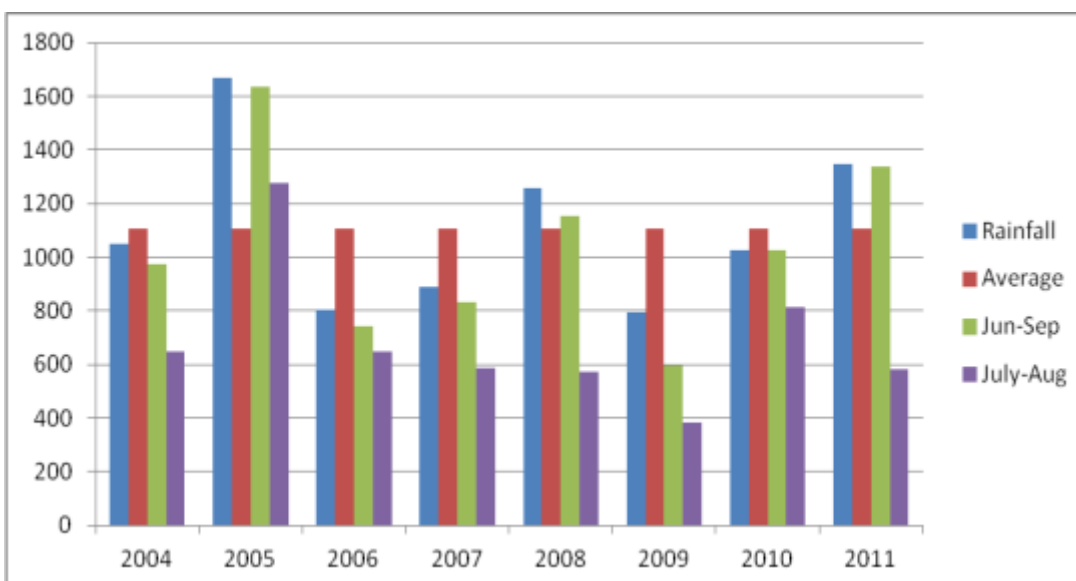
Two inferences are quite apparent from above table :

1. The average annual rainfall during earlier 60 years(1901-1960) was more than the same during later 50 years' period (1961 – 2011) .
2. Rains received during four months' period i.e. from June to September is gradually increasing thereby rendering other months drier than before.

RECENT RAINFALL DATA OF DAMOH (2004-2011)

Compared with average and partial (Jun-Sep & July-Aug)

Rainfall	2004	2005	2006	2007	2008	2009	2010	2011
Rainfall	1048.7	1666.8	806.0	888.9	1259.4	793.1	1028.1	1349.3
Average	1105.04	1105.04	1105.04	1105.04	1105.04	1105.04	1105.04	1105.04
Jun-Sep	972.7	1634.3	743.0	834.5	1155.3	594.7	1025.2	1337.1
July-Aug	645.9	1274.6	650.0	585.8	571.8	383.1	815.1	582.5
Reference: Indian Meteorological Department & India Water Portal								



Above graph on the basis of rainfall data for 2004 to 2011 (being problem years for this region) clearly shows precipitation below average for the years 2004, 2006, 2007, 2009 and 2010 . The fact is that most of the rains occur during four months from June to September and leave rest of the months drier. Major portion of the rains within those four months also has occurred during July and August . Not only that the rains have reduced or become uncertain but actual rainy-days have also reduced.

The extra deficient rainfall in the district during 2006, 2007 and then in 2009 indicates the cause of drought condition as was faced by entire *Bundelkhand*.. In fact when we deeply analyze the rainfall situation , we find rains occurring within fewer number of days followed by a long spell of dry period. Such a situation benefits neither the storages, ground water recharge nor the agricultural productivity.

THE HUMIDITY:

Humidity plays an important role in the total climatic pattern of an area along with its rainfall & temperature. The pattern of relative humidity of this district can be understood by following data recorded from 1985 to 1995. The trend of variation in relative humidity corroborates with other indicators that summer months are extremely dry while August is the most humid month. The Relative Humidity is generally found lower in afternoon than during morning hours.

TABLE- RELATIVE HUMIDITY

Month	Relative Humidity	
	8-30 AM	5-30 PM
January	75	55
February	65	45
March	48	28
April	33	27
May	36	32
June	75	69
July	85	80
August	87	80
September	81	70
October	66	43
November	58	40
December	68	50
Source: India Meteorological Department, Govt. of India Nagpur		

THE WINDS:

The horizontal component of the air movement parallel to Earth's surface (i.e. the wind) influences the climate. Winds have almost identical nature as found in other nearby districts of *Bundelkhand*. Following table gives common trend of the wind velocity recorded in this district :

TABLE- WIND VELOCITY

Month	Wind Velocity Km/hour
January	3.67
February	3.74
March	3.95
April	4.04
May	4.10
June	3.88
July	3.54
August	3.20
September	2.99
October	2.72
November	2.93
December	3.22
Annual Average of the Wind Velocity = 3.50 km/ hour	
Source: (www.synergyenviron.com) through INDIA WATER PORTAL	

Above data shows winds being slower during winter season, increase by February. The velocity goes on increasing till the arrival of south-west monsoon. By August the winds get again slower which continues for next few months.

SOLAR IRRADIATION:

Solar Irradiance is a measure of how much solar power a location gets . This irradiance varies throughout the year depending on the seasons. It also varies throughout the day, depending on the position of the sun in the sky, and the weather. Average solar irradiation per day on Damoh district has been presented in the table as follows:

TABLE - SOLAR IRRADIATION

Month	Solar Irradiation (kWh/m ² /day)
January	4.45
February	5.27
March	6.05
April	6.75
May	6.58
June	5.25

July	4.12
August	3.64
September	4.48
October	5.12
November	4.67
December	4.71
Source: www.synergyenviron.com through INDIA WATER PORTAL)	

EVAPORATION LOSSES:

As mentioned earlier Evaporation and evapo-transpiration (ET) is one aspect of the hydrological cycle . Evaporation of water into vapours is an ongoing process and is affected by several environmental factors itself. The monthly evaporation losses recorded for district Damoh are as follows:

TABLE: EVAPORATION LOSSES

Month	Evaporation Losses (cm)
January	7.6
February	10.2
March	17.8
April	26.7
May	38.1
June	23.5
July	9.5
August	8.3
September	10.2
October	8.9
November	7.0
December	7.0
Average Annual : 14.57 cm	
Source: IMD-GOI, Nagpur as referred in an earlier publication (Problems and Potentials of Bundelkhand with special reference to water Resource Base (1998)	

POTENTIAL EVAPO-TRASPIRATION (PET) :

The Potential Evapo-Transpiration (PET) as mentioned earlier is defined as the amount of evaporation that would occur if a sufficient water source were available. It is a reflection of the [energy](#) available to evaporate water, and of the [wind](#) available to transport the water vapour from ground up into the lower [atmosphere](#) and in this way it serves as an important factor in study of climatology of a region. Following table gives values of PET as recorded from 1960 to 2002 for Damoh district :

TABLE : POTENTIAL EVAPO-TRANSPIRATION:

Month	Potential Evapo-Transpiration (mm / day)
January	5.20
February	6.11
March	7.18
April	8.33
May	8.93
June	7.79
July	5.66
August	4.90
September	5.49
October	6.41
November	5.98
December	5.24
Average Annual : 6.44 mm/ day	
Source: India Water Portal & Indian Meteorological Department –Govt. of India , Pune	

CLOUD COVER OVER THE DISTRICT:

During south-west monsoon season (from June to September), sky remains generally heavily clouded and sometimes during winter season associated with western disturbances . In rest of the year it remains generally clear. But in recent years this is the most uncertain indicator of climate , yet it may be of some help in understanding the region. Data recorded for the years 1960 to 2002 have been averaged to present in the following table:

TABLE: CLOUD- COVER OVER THE DISTRICT

Month	Coverage (%)
January	17.955
February	20.583
March	25.588
April	30.331
May	33.591
June	31.516
July	27.241
August	25.927
September	26.504
October	25.730
November	21.398
December	18.489
Source: Indian Meteorological Department , Govt. of India Pune through India Water Portal	

SPECIAL WEATHER PHENOMENA :

The south western monsoon associated with storms and depression , causes heavy rains in this district. Now-a- days such storms can occur any time in the year. During winters frosts are common and sometimes there are hailstorms too.



.....

3. PANNA

A. INTRODUCTION:

Panna is an important town of *Bundelkhand* region. This district was created in 1950, shortly after Indian independence, from the territory of several former princely states of British India, including the states of Panna, Jaso, most of Ajaigarh and a portion of Paldeo state. Panna district became part of new Indian state of Vindhya Pradesh which was merged into Madhya Pradesh on November 1, 1956. The district lies between Latitude $23^{\circ} 45'$ & $25^{\circ} 15'$ (north) and Longitude $79^{\circ} 45'$ & $80^{\circ} 45'$ (east) and its geographical area is ca. 7,135 sq. km. Panna district is bounded on the north by Banda district, on east by Satna district, on the south by Katni & Jabalpur districts and on the west by Damoh and Chhatarpur districts.



DISTRICT AT A GLANCE:

S.No.	Particulars	Statistics
1	GENERAL INFORMATION	
	Geographical Area	7135 km ²
	No, of Tehsils	08
	No. of Development Blocks	05
	No. of Gram- Panchayats	395
	No. of Revenue- Villages	1,015
	Population (2011)	10,16,520
	Average Annual Rainfall	1,142.70 (past 110 years' average)
2	GEOMORPHOLOGY	
	Major Physiographic Units	Panna Range Southern Plateau
	Major Drainages	KEN river Along with its tributaries
3	LAND USE	
	Total Area	5,405.80 km ²
	Forest Area	2,480.60 km ²
	Net Area Cultivated	-
	Rest Cultivable	-
4	MAJOR SOIL TYPES	Soft black , Darkish black Red soils (stony-sandy) Red-black mixed Soft yellow-grey.
5	PREDOMINANT GEOLOGICAL FORMATIONS	Soft Rock -Alluvium Hard Rock – Bundelkhand Grantitoid Complex, Bijawars, Vindhyaans, Lametas & deccan trap.
6	GROUND WATER SITUATION :	
	Annual Replenishable Ground Water Resource:	487 MCM /Year
	Net Annual Ground Water Draft:	110 MCM / Year
	Stage of Ground Water Development:	23 % - SAFE
Reference: Present Studies , District Statistics (2012), Central Ground Water Board report on Panna district (2009) Report of MSME (2012)		

B. PHYSICAL FEATURES:

TOPOGRAPHY:

The district is mostly hilly and traversed by hills and valleys. The greater part of its area lies on the branch of Vindhya, known as Panna-range, which traverses *Bundelkhand* from the south-west to the north-east. Panna – range forms a watershed in itself. The southern Panna district forms a plateau which is formed by cascade-type rocks of Vindhyan series. The height of this district over the mean sea level ranges from 400 metres to 900 metres.

The terrain of the reserve is characterized by extensive plateaus and gorges. The topography in Panna district can broadly be divided into three distinct table lands :

- The Upper Talgaon plateau ,
- The middle Hinauta plateau,
- The *KEN*-valley

while there are series of undulating hills and plateaus on the other side of *KEN* river in Chhatarpur district.

Main drainage of this district is through river *KEN* and its numerous tributaries. River *BAGHEIN* originates from here. The district is adorned with beautiful falls such as *Vrihaspati Kund*, *Pandav Prapat* and *Chanda* falls etc. on different streams. *Raneh* fall is on *KEN* river bordering with Chhatarpur district.

GEOLOGY:

Geology of this district is unusually interesting, owing to the valuable mineral deposits which exist within its boundaries. Panna-range consists principally of the upper Rewah-sandstones of the Vindhyan rocks and has long been famous for its Diamond mines. These mines are found scattered over an area of about 75 km lying east and west of the town of Panna. The diamonds occur as pebbles in a conglomerate, and also in pebbly clay derived from it by disintegration. Diamonds are mined from the kimberlite pipe near Majhguan in Panna district.

Lower Rewah group is composed of three strata , the upper being Jhiri shales, the second lower Rewah-sandstone and the third a narrow shale band known as Panna shales. Lameta outcrops occur near Panna , and are overlaid by some of the

easternmost remnants of the Deccan Trap known to exist on the Vindhyan table land. Bundelkhand- granite rocks are found in Ajaigarh tehsil of Panna district.

General geological succession of the district is given in the box below:

GENERAL GEOLOGICAL SUCCESSION OF THE DISTRICT

Age	Formation	Rocks
Recent	-----	Laterite / Alluvium
-----,	Unconformity	-----,
Deccan Trap	-----,	Basalt (Lava Flows)
-----,	Unconformity	-----,
Vindhyan	-----,	Rewah group
Super Group	-----,	Kaimur Group
-----,	Unconformity	-----,
-----,	Unconformity	-----,
Bijawar Group	-----,	Ferruginous Quartzite shale
-----,	Unconformity	-----,
	Bundelkhand granite Gneisses	

C. THE MINERALS:

Panna has been known for its diamonds for many centuries*. Present situation of availability of minerals in this district is summarized below:

TABLE- MAJOR MINERALS

S.No.	Mineral	Areas from where extracted	Addl Information
1	Diamond	<u>Panna:</u> Kamalabai Tank, Rakseha Krishna-Kalyanpur Sikariya Chopra Itwa, Badgadi, Sirswaha, Brijpur etc.	Total area covered by Diamond mining presently is ca. 7,523 Hectares.
2	Flagstone ((Slab-Stone)	Gunnor , Panna, Pawai & Shah Nagar blocks	
3	Boulders	Panna, Pawai & Shah Nagar blocks.	
4	Boulders of Granite	Ajaigarh block	
5	Other Stones	Ajaygarh, Gunnaur & Pawai blocks	
6	River-Sand	From several rivers including the main river : KEN	
7	MURAM	Many places in all the blocks of Panna district.	
In addition to above Coloured Sand-stone has been found here in abundance. Limestone has been located in Panna district although it has not been exploited yet.			
Reference: Report from Deptt. of Mines –Minerals , Distt. Panna (2012)			

.....

**There is an ancient reference of the diamonds being found here for past several thousand years. The mythology of this tract connects it to Maharshi Dadhichi who was responsible for creation of BAJRA with which DAITYAS (demons) were killed by INDRA (King of Heaven) . BAJRA in ancient literature and Sanskrit language means diamond only.*

In Ajaygarh region as well as in other parts of Panna district & surroundings **IRON MINES** were extensive; extraction was done locally by mostly KOL tribes but arrival of British in this country creating competition with imported stuff killed this local industry .

D. THE NATURAL DRAINAGE :

Natural drainage of this district is towards north & north-east and the major river is *KEN* whose tributaries are other rivers of the district , namely *SONAR* and *VYARMA* flowing north and east –wards and *MIRHASAN*, *PATAN*, *RANJ*, *GURNE*, and *KILKILA* flowing westerly or south-westerly. River *BAGHEIN* originates from here and flows along the drainage line to enter into adjacent Banda district forming boundary of Banda with Chitrakoot district. Some details about major rivers of the district as mentioned above are as follows:

RIVER KEN : Rising from the north-west slopes of Kaimur hills in Jabalpur district at an elevation of about 500 metres above the mean sea level , river *KEN* flows initially north-ward and is joined by a river *ALONI* . Then it flows west-wards and turns at right angle to north where it is met with other tributaries like *SONAR*, other rivers & rivulets as described earlier. *KEN* borders with Chhatarpur district before entering in to Banda district where it meets river *YAMUNA* near Chilla-ghat.

RIVER VYARMA : Flowing from Damoh district ,*VYARMA* forms Panna district's south-west boundary for certain distance. It joins *SONAR* on Panna's boundary which flowing north-east joins ultimately river *KEN*.

As *KEN* passes through forested area on rocky bed , it is joined by numerous streams and seasonal drains . *KILKILA* is a small river flowing by Panna town , joins *KEN* , but this stream has now become almost seasonal due to large scale human intervention in the forests including unmindful diamond mining . Similar situation is with other streams like *CHANDA* which in the past had beautiful fall and grandeur upset by indiscriminate stone-mining policies of the State & Central governments.

OTHER NATURAL RESOURCES:

Panna district , having been one of the most densely forested and a natural abode of elephants at one time, has been a good source of perennial streams , picturesque water- falls , natural reservoirs called *kund* or *sehas* . Some of them are described below:

KUND PRAPAT: Situated nearby Panna town , not far from the PADMAVATI TEMPLE *Kund prapat* is a waterfall associated with a deep water body called the *kund*. *Jhiriya* is another water body near this water-fall.

PANDAV PRAPAT: Situated by the side of Panna-Chhatarpur road (NH-75) , down the valley of the *KEN* river *Pandav Prapat* is a beautiful natural fall which is associated with caves and ***Jhirna***** (the artesian flow).

CHIRAI PANI - SEHA: This is situated near Fatehpur in the vicinity of *Vyarma* river This place along with the fall and reservoir (*kund*) is important because of numerous caves with rock-paintings found here associated with Early Man's abode.

MATA KA SEHA : Near Bhairo-tek not far from Panna town , *Mata Ka Seha* , has been a picturesque water-fall and the water body . There are also Early Man's caves and the protection posts for water which would have been important even during ancient times.

LAKHANPUR - SEHA: Situated in a deep forest setting , this is the biggest *seha* also associated with Early Man's abode . There are caves, rock paintings and water-protection posts as in *Mata Ka Seha*. In addition ***SALIGPUR & KAUVA SEHA's*** are important water-falls and water-bodies in this district.

VRIHASPATI - KUND : Situated on the left side of Panna – Banda (via Kalinjar) Road near Pahadi-Khera on the bank of *BAGHEIN* river , *Vrihaspati Kund* exists as one of the most picturesque , deep and difficult water falls associated with deep water-reservoir, natural caves and old temples. River's bed here has also been reported to bear diamonds.

BEDHAK : Nearly few kilometers downstream after *Vrihaspati Kund* is *Bedhak* which is an unique place and water stream. Water dropping from the top is so highly siliceous that the wood which remain soaked turn into stony structure. Local traditional healers of this area call this water as *SHALODAK*. Such *SHALODAK* effect has been reported here for some other sites too.

**** JHIRNAS** (from which *JHIRIYA* is also derived) are the spontaneous flow of water or woozing out of water in droplets, from the rocks/ soils. In fact many *Bundelkhand* - rivers, rivulets, *kund* and *sehas* are outcome of this natural phenomena caused by conservation of rainwater within forests.

E. CLIMATE OF THE DISTRICT:

The climate of Panna district is generally hot but during winter season sometimes, it becomes severely cold. The district receives rainfall from south-west monsoon. Various indicators are discussed below:

TEMPERATURE:

The summer season is spread from March to June after which it receives rainfall. The temperature of May and June are the highest while December and January are the colder months. During the rest of the months the temperature rises or falls like in other districts of the region. Following is record of average maximum and minimum temperatures month wise for the years 1962 to 2002 (41 years).

TABLE : MAXIMUM & MINIMUM TEMPERATURE

Month	<u>1962-2002</u> Highest: 43.49°C (1991) ; Lowest: 7.18°C (1963)	
	Maximum Temperature (°C)	Minimum Temperature (°C)
<u>January</u>	24.50	<u>9.30</u>
February	27.68	11.67
March	33.13	16.45
April	38.19	21.71
May	41.19	25.92
June	38.16	26.28
July	31.69	24.33
August	29.77	23.31
September	31.16	22.69
October	32.26	19.02
November	29.11	13.78
December	25.41	9.85
Source: India Water Portal & IMD Climatological Tables		

RAINFALL:

Although rains here occasionally start in June but July to September are the main months of rainy season. Amount of rainfall between June and September of any year ranges from 80 to 90% of the total annual rainfall. Rest of the rains spread in remaining eight months. During winter season, with the western disturbance, cold waves sometimes associated with rains are received. Some unusual rains can be caused any time but mostly off-season rains are all scanty. Average annual rainfall of Panna district

as calculated from rainfall data of 110 years presented below , is 1,142.70 mm. Following table gives detailed figures:

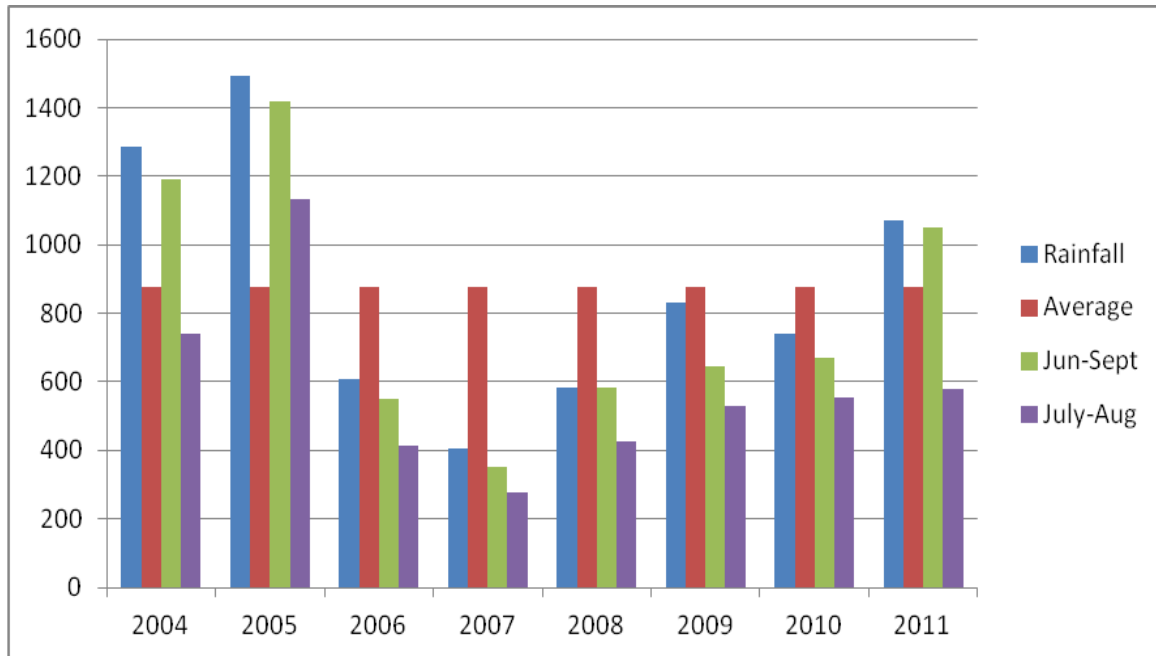
TABLE : MEAN MONTHLY RAINFALL

Mean Monthly Rainfall	Average Rainfall (mm)	Average Rainfall (mm)
Month	1901-1960	1961-2011
January	21.42	18.42
February	15.03	13.64
March	9.59	7.77
<u>April</u>	<u>5.07</u>	<u>3.65</u>
May	9.47	5.32
June	94.72	114.34
July	381.35	331.78
August	376.12	383.22
September	192.35	198.06
October	40.81	28.15
November	11.70	8.94
December	6.89	7.58
TOTAL ANNUAL AVERAGE	1164.52	1120.87
Average for past 110 years	1142.70 mm	
The rains during June-September:	1044.54 (90%)	924.40 ((82.5 %)
Maximum Rainfall:	1880.80 (1919)	1927.95 (1982)
Minimum Rainfall :	515.40 (1918)	405.70 (2007)
Source: India Meteorological Department Data & India Water Portal		

RECENT RAINFALL DATA OF PANNA (2004 TO 2011)

	2004	2005	2006	2007	2008	2009	2010	2011
Rainfall	1284.6	1494.4	606.5	405.7	584.8	832.5	741.3	1070.0
Average For 8 years	877.5	877.5	877.5	877.5	877.5	877.5	877.5	877.5
Jun-Sep	1192.9	1420.6	548.1	352.8	581.2	646.7	670.0	1048.5
July-Aug	738.6	1134.2	415.4	276.0	427.8	529.2	552.9	580.0

RAINFALL DATA GRAPH OF PANNA (2004 TO 2011)



THE HUMIDITY:

Measurement of Humidity is important for a region as it plays a complimentary role along with its rainfall and temperature. This measurement for district Panna could not be available thus it has not been included here.

THE WINDS:

Wind velocity is one of the main indicators for understanding climate of certain place / region. It measures the air current which is horizontal component of air movement parallel to Earth's surface.

Wind velocity influences intensity of rainfall. Normally rainfall is more if wind velocity is low because low wind velocity allows clouds to stay at a place longer. For Panna the average wind velocity month wise for a year is given below :

TABLE- WIND VELOCITY

Month	Wind Velocity (Km/hour)
January	3.46
February	3.56
March	3.86
April	4.03
May	4.08
June	3.86
July	3.45
August	3.11
September	2.94
October	2.54
November	2.73
December	3.03
Source: (www.synergyenvirom.com) through INDIA WATER PORTAL	

SOLAR IRRADIATION:

Solar irradiation is the amount energy transmitted from sun to Earth's outer atmosphere. This is an important factor in understanding overall weather of a place . Solar irradiation is measured normally in square units per units of time. For Panna district , the solar irradiation is as follows:

TABLE- SOLAR IRRADIATION

Month	Solar Irradiation (kWh/m ² /day)
January	4.14
February	5.00
March	5.87
April	6.50
May	6.53
June	5.36
July	4.35
August	3.94
September	4.38
October	5.00
November	4.50
December	3.99
Annual Average: 4.96 kWh/m² / day	
Source: IINDIA WATER PORTAL (Ref. from www.synergyenvirom.com)	

EVAPORATION LOSSES :

The formation of gaseous state from water or ice (in winter) near its surface and the distribution of these vapours into atmosphere is what is known as evaporation losses measured in centimeters. Evaporation losses are higher during summer season and lower during winters. Separate data for Panna district could not be available .

POTENTIAL EVAPO-TRANSPIRATION (PET) :

Potential transpiration is one of very important factors in study of climatology of certain region as it indicates the energy available to evaporate water and of the wind available to transport water vapour from ground up into the lower atmosphere. Following table gives values of PET for Panna district:

TABLE- POTENTIAL EVAPO-TRANSPIRATION

Month	Potential Evapo-Transpiration (mm/ day)
January	3.00
February	3.93
March	5.44
April	6.90
May	7.65
June	6.73
July	4.80
August	4.15
September	4.33
October	4.47
November	3.63
December	2.95
Average Annual : 4.83 mm / day	
Reference: India Water Portal & IMD (Govt. of India) Pune	

CLOUD COVER OVER THE DISTRICT:

During raining months heavy clouds are seen in sky. Measurement of clouds covering sky on average at any place are expressed in percentage now-a-days. The month wise average values for Panna district based on data for 1962 to 2002 is presented below:

TABLE-CLOUD COVER OVER PANNA DISTRICT

MONTH	CLOUD COVERAGE (%)
January	21.77
February	18.67
March	27.72
April	24.75
May	31.55
June	57.33
July	74.78
August	73.98
September	55.70
October	28.01
November	15.63
December	18.27
Reference: IMD Govt. of India through India Water Portal	

4. SAGAR

A . INTRODUCTION:

Sagar is the south-western district of *Bundelkhand* lying between Latitude $23^{\circ} 10'$ & $24^{\circ} 27'$ (north) and Longitude $78^{\circ} 4'$ & $79^{\circ} 21'$ (east) . It has the largest geographical area i.e. 10,252 sq. km. among *Bundelkhand* districts. Sagar district is bounded on the north by Guna, Lalitpur, and Chhatarpur districts, on the east by Chhatarpur and Damoh districts, on the south by Raisen and Narsinghpur districts and on the west by Vidisha and Raisen districts.



DISTRICT AT A GLANCE:

S.No.	Particulars	Statistics
1	GENERAL INFORMATION	
	Geographical Area (km ²)	10,252 .00
	No, of Tehsils	11
	No. of Development Blocks	12
	No. of Gram- Panchayats	753
	No. of Revenue- Villages	2059
	Population (2011)	23,78,458
	Average Annual Rainfall	1,172.17 mm (past 110 years' average)

2	<u>GEOMORPHOLOGY</u>	
	Major Physiographic Units The district extends over two physiographic divisions. These are :	1. Bundelkhand massif in the north 2. Malwa Plateau in the south
	Major Drainages There are two drainage basins operating in this district : These are:	1. Ganga Basin: (986 km²) a) Ken sub basin (4507 km ²) b) Betwa Sub-basin (5562km ²) 2. Namada Basin (342 km²)
3	<u>LAND-USE</u>	
	Total Area	6,375.00 km ²
	Forest Cover	2978.02 km ²
	Net Area Cultivated	7106.90 km ²
	Rest Cultivable	88.14 km ² .
4	MAJOR SOIL TYPES	Clay Loam Sandy clay loam Sandy Loam
5	PREDOMINANT GEOLOGICAL FORMATIONS	Alluvium, Laterite, Deccan Traps, Lametas, Vindhyan, Bijawars, Bundelkhand granite
6	<u>GROUND WATER SITUATION :</u>	
	Annual Replishable Ground Water Resources:	1216.97 MCM
	Net Annual Ground Water Draft:	469.79 MCM
	Stage of Ground Water Development:	46.64 %
Reference: District Statistics of Sagar (2009), Central Ground Water Board report on Sagar district (2009) Report of MSME : Sagar (2012)		

B .PHYSICAL FEATURES:

TOPOGRAPHY:

The terrain is generally undulating with numerous isolated hills. Sagar district is situated in the south-eastern corner of great Malwa plateau spread in north and north-west. This situates north of *NARMADA* river. District is covered mostly by Deccan Trap lava except for a few locations near Sagar town where Vindhyan sandstones are found.

The tract is on average 447.2 to 533.4 metres above the mean sea level. Towards the north around *DHASAN* river bed , elevation is up to 353.56 metres while in the south - west , the Naharmau peak is nearly 683.36 metres above the mean sea level. Topography of the district is understood properly by looking at its physical divisions formed by the river basins which run mostly south to north or south-west to the north-east.

The tract of Khurai *tehsil* is the only clearly demarcated separate region situated north-east of Sagar which is plain , fertile and productive. This is almost 411.5 to 426.7 metre above the mean sea level and is drained by *JIMPA*, *PARASARI*, & *BINA* rivers all of them tributaries to river *BETWA*. Except for the region of Khurai , Sagar district has long range of hills spread north-east to south-west from Pithoriya to Rahatgarh. These hills , on an average 533.40 metre above the mean sea level, act as water-divider between *BINA-JHIMPA* rivers on one side and the tributaries of *DHASAN* river on the other. The highest peak in this range is **Tora** peak which is 642.51 metre above the mean sea level.

On east and south-east of above range are five parallel river valleys of *DHASAN* , *BEWAS*, *SONAR*, *KOPRA* & *BAMNER* , forming a special feature in geography of this district. These valleys are narrower in south-west getting wider as one moves towards the north-east. This also is an important agricultural belt of Sagar district. These valley-plains are over 457.20 metre above the mean sea level and slopes towards the north-east.

HILLS : The most important hill range of this region spreads from Lidhora to Jaisingh Nagar via Bandaa; these are flat topped hills now stand almost deforested. These are high ranging from 609.60 metre to 665.07 metre at different places. Naharmau , as reported earlier , is the highest point of the district.

GEOLOGY:

Most of this district is situated over Vindhyan super group and Deccan Trap volcanic rocks. The two third of this district is made up of Deccan Trap .In the north-eastern corner around Shahgarh and Hirapur , the Archaean Bundelkhand- granite and Bijawar rocks are found while to the east and south-east of Sagar, Lameta groups of rocks are visible up to ca. 56.3 km along with the Trap. Level of Lameta group is bottom layer of the Deccan Trap. Generally Deccan Trap shows flat topped hills, conical hills, plateaus etc. , whereas Vindhyans show steep escarpments. Deccan Trap in Sagar district consists of 9 lava flows. Each flow has its own characteristics. Some of these flows are well separated intertrappean and red bole beds. Some inter-trappean beds are fossiliferous.

GENERAL GEOLOGICAL SUCCESSION OF THE DISTRICT

Recent -----	----- unconformity	lateritic soil, alluvium -----
Lower Eocene Upper cretaceous Intertrappean beds Middle cretaceous	Deccan Trap	Basalt
	Lameta	lime-stone , grit , etc.
-----	unconformity	-----
Pre-Cambrian	Upper Vindhyan	Bhander group Rewah group
	Lower Vindhyan	Kaimur group Semri group
-----	unconformity	-----
	Bijawar group	
-----	unconformity	-----
Archaen	Bundelkhand granite	gneiss and metamorphics

The Bijawar group of rocks are found near Hirapur village in this district. These rocks consist of dolomite lime-stones, ferruginous shale, ferruginous quartzites and conglomerate etc. The ferruginous shale and ferruginous quartzites contain very good deposits of phosphorite . The Bijawar rocks are overlain and underlain unconformably by Vindhyan super group and Bundelkhand- granite rocks. The Bundelkhand-granite and gneisses are Archaen in age. These are the basement rocks of *Bundelkhand* region and occur in the extreme part of Sagar district. These are introduced in metamorphic. The Bundelkhand-granite is also intruded upon by dykes and quartz reefs.

THE SOILS:

There are different soil varieties in this district depending upon location , elevation, draining behavior, rock systems, distance from streams and the slopes etc. In local dialect these different soils are:

MAR, KABAR, MUND (1), MUND (2) , RATHIA, RAYAN, PATRUA, BHATUA & KACHHAR

Introductory notes on these soil-types is presented below which can help in understanding its characteristics & potentials.

MAR : This is the best soil found in the plains which is of grey to black colour , having good depth and holds water without cracking. Such soils are mostly found at Khurai, Etawa, Barodia, Nevnagar and Eran.

KABAR : This is the best black cotton soil having fine texture, prone to cracking ,clayey and soft. Sometimes it is found mixed with *kankar*. Such soils are found in Rehli , Gorjhamar, and Baleh groups of villages. This is also found in Dhana groups of villages in Sagar *Tehsil*.

MUND (I) : This is also a grey or black coloured , coarse-grained soil, mixed with moderate *kankar* , fertile , rich in organic matter and capable of continuous wheat-cropping.

MUND (II) : This is found in shallow- based and undulating land. If mixed with alluvium and on plains this gives good crops but this is incapable of wheat production. This is an ordinary soil and is present in Sagar *Tehsil's* Sihora, Nariavali, Jhilla, and Dhana groups of villages, Khurai *Tehsil's* Etawa, Khurai, Khimlasa, and Kanaiya groups of villages and Rehli *Tehsil's* Garhakota, & Baraho group of villages. This is generally a single- crop soil.

RATHIA : This is a grey coloured inferior *KABAR* soil which is mixed with *kankar* and dries to form solid mass. This is difficult to cultivate and needs timely operation. This is found in Sagar *Tehsil's* Sihora and Nariavali groups of villages.

RAYAN : This is black coloured soil with some black stones . This is a shallow based soil with good draining nature and is found nearer to hills. This is quite suitable for *kharif* crops during the years of high rain-fall. This is a cracking soil but has capability of raising two crops. Dhana- and Jaisinghnagar- groups of villages of Sagar *Tehsil* and Naharmau groups of villages in Rehli *Tehsil* are the locations where this soil-type can be seen.

PATRUA : This is inferior *mund* soil which is drained badly. This is brown in colour and is fibre-grained. This is normally found in undulating land . Another kind of *patrua* is found in Vindhyan range which is light coloured sandy soil. This is good for rice-cultivation and found in Rehli - groups of villages in Rehli *Tehsil.*, Dhana –groups of villages in Sagar *Tehsil* and Vinayaka groups & Shahgarh groups of villages in Bandaa *Tehsil*.

BHATUA : This is red coloured inferior soil with stones. This is suitable only for the coarse crops and is found in Rehli and Bandaa *Tehsils*.

KACHHAR : It is good fertile soil formed by flodding the rivers or streams and usually used for garden crops (horticulture). This is found in Khurai *Tehsil* of Sagar district.

C . MINERALS:

Sagar district has been reported to have variety of minerals though not in larger quantities. It included occurrence of base metal like copper, dolomite with higher content of magnesia, rock-phosphate and deposits of sand-stones with varying colours. The materials useful for building- construction such as Lime-stone, Vindhyan sand-stone and flagstone are found in abundance. Near Hirapur iron ore and laterite was found which was processed to extract iron but the quality and quantity both prohibited to initiate any industry on that basis.

D . NATURAL DRAINAGE :

The drainage of this district is towards north and north-east since all the rivers and rivulets of the district namely *BABNE, KONGARA, BINA, NARAYAN, JHIMPA, BONKHERI , BILA, DEHAR, BEWAS, SONAR, KOPRA & BAMNER* etc. and their numerous tributaries flowing any direction ultimately meet the *BETWA , DHASAN* or *KEN* which flowing towards north / north-east finally join **YAMUNA** river.

A remarkable pattern of drainage system here is of radial drainage. A few elevated locations give rise to flow of their drainage towards all the directions . Such examples could be seen at Khimlasa near Khurai and Jayceenagar south –west of Sagar town.

RIVER SYSTEM:

Sagar district is just 9 km away from **NARMADA** river , yet all its rivers and streams form contributries to catchment of river **GANGA** . The three main rivers *BETWA, DHASAN* and *KEN* are filled with water drained out from this district.

BETWA:

This does not pass through this district but forms its boundary with Lalitpur district for some distance. This also receives water from many west bound rivers of this district including *BINA, NARAYAN & JHIMPA* etc.

BINA:

This river rises a few kilometers south of Sagar district touching it at Mahuna village, and flowing through Rahatgarh turns north-east forming the boundary with Vidisha district . Near Rahatgarh at Lal Bagh there is a fall on *Bina* which had been picturesque up to few years ago and attracted many visitors . This joins *BETWA* 15 km west of Bina- Etawa town.

DHASAN:

Rising south of this district , cuts through Sagar at the central tract and flows almost north-east , having contributed all the drainage of central and partial northern tract of Sagar district to flow further towards Tikamgarh district. Now-a-days *DHASAN* also has turned seasonal . One can see it near Sihora village by the side of Sagar-Bhopal Highway possibly because of severe deforestation and environmental damage in this entire region.

BEWAS:

This river passes through the central tract of Sagar district , flowing north-east and is an important tributary to *SONAR*.

SONAR :

Rising from Sagar district, *SONAR* river enters Damoh from the eastern boundary attracting many small streams and rivers like *BEWAS*, *BAMNER*, and *KOPRA* etc. as its tributaries and finally surrenders to *KEN* river.

SAGAR LAKE:

Sagar lake almost covering 2.56 km² area is the most important natural water reservoir of this tract which has influenced habitation in Sagar town . In fact the town itself had been named after this lake which, though affected severely because of urban expansion and insensitivity , serves still the life line of entire Sagar city.

E .CLIMATE OF THE DISTRICT:

Climate of this district is generally pleasant. Like in other *Bundelkhand* districts, winter season here also covers mid-November to February followed by summer season lasting up to mid-June. The rainy months are from mid-June to September. Fourth season

spread from October to mid-November is the transition period. This is semi-arid and sub-humid zone of Madhya Pradesh. The air here is generally dry except in the south-west monsoon season.

Various indicators of climate are discussed below :

TEMPERATURE:

Sagar district experiences hottest temperature in the month of May and coldest during December. Sometimes January turns colder than December.

The mean monthly temperature (maximum and minimum) for 41 years (1962-2002) as per record of the India Meteorological Department, Govt. of India give following information related to Sagar district :

TABLE - MAX. AND MIN. TEMPERATURE

Month	<u>1962-2002</u>	
	Highest: 43.13 ⁰ C (1978)	Lowest: 8.77 ⁰ C (1963)
	Maximum Temperature (⁰ C)	Minimum Temperature (⁰ C)
<u>January</u>	25.12	<u>10.67</u>
February	28.33	12.91
March	33.60	17.78
April	38.27	22.64
<u>May</u>	<u>40.89</u>	26.32
June	37.47	25.60
July	30.80	23.50
August	28.84	22.65
September	30.59	22.09
October	32.37	19.20
November	29.25	14.72
December	25.78	11.41
Reference : India Water Portal & IMD Climatological Tables of observatories in India		

RAINFALL:

Average annual rainfall calculated on the basis of 110 years' data in two sets [(1901-1960) and (1961-2011)] at Sagar is 1172.17 mm. Maximum rainfall of 1773.60 mm was recorded in the year 2000 while the minimum 644.40 mm, in the year 1913.

Usual character of the rains in this district is like other districts of *Bundelkhand* region precipitating over 90% of the total annual rainfall in just four rainy months i.e. from June to September of the year. Presence of forests on hills govern the raining pattern. Thus Deori and surroundings, south of Sagar and south-west of Garhakota receive more precipitation than the northern and north-eastern part of the district. Rehli area which is on south-east of district gets lesser rainfall because this being situated in other direction of the hill ranges.

Despite regional variation Sagar gets more rains as compared to other *Bundelkhand* districts situated in north and north-east or north-west. Average monthly rainfall data as mentioned above is presented below:

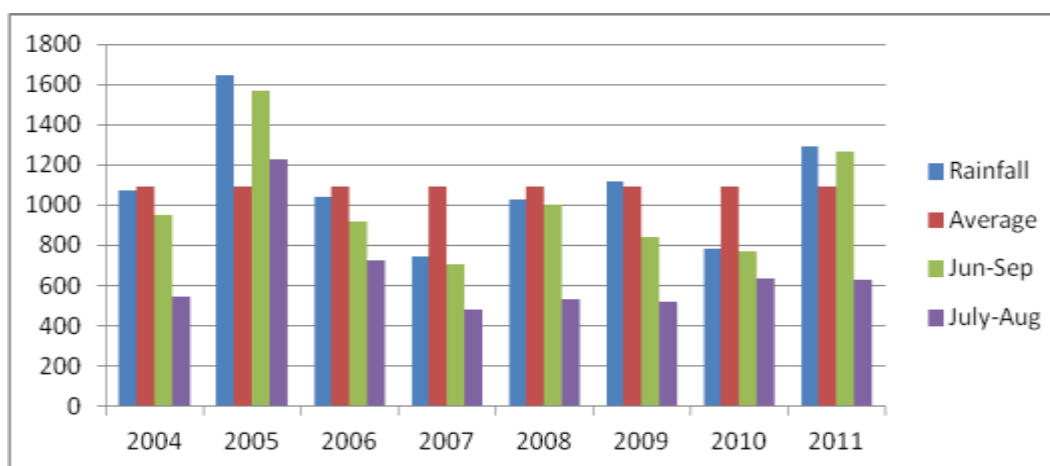
TABLE - MEAN MONTHLY RAINFALL

Mean Monthly Rainfall	Average Rainfall (mm)	
Month	1901-1960	1961-2011
January	21.35	17.43
February	11.90	14.99
March	10.20	8.86
<u>April</u>	4.89	6.46
May	9.67	8.17
June	124.92	144.17
July	388.73	340.12
August	369.74	393.91
September	189.86	169.65
October	31.15	27.41
November	16.92	13.38
December	7.35	13.29
TOTAL ANNUAL AVERAGE	1186.48	1157.85
Average for past 110 years	1172.17	
The rains during June- Sept.:	1072.85 (90.42%)	1047.85 (90.50%)
Maximum Rainfall:	1761.10 (1934)	1773.60 (2000)
Minimum Rainfall :	644.40 (1913)	671.20 (1981)
Reference: India Meteorological Department Data & India Water Portal		

RECENT RAINFALL DATA OF SAGAR (2004 TO 2011)

Year →	2004	2005	2006	2007	2008	2009	2010	2011
Rainfall	1070.7	1644.6	1040.1	746.5	1026.3	1115.5	783.5	1292.2
Average For 8 years	1089.2	1089.2	1089.2	1089.2	1089.2	1089.2	1089.2	1089.2
Jun-Sep	953.0.	1568.5	916.8	702.8	1002.3	844.0	771.9	1267.0
July-Aug	545.6	1225.3	727.9	477.3	532.3	516.0	631.7	625.7

RAINFALL DATA GRAPH OF SAGAR (2004 TO 2011)



THE HUMIDITY

Relative humidity (RH) of air at a given temperature is percentage ratio of the amount of moisture present in air to the amount necessary to saturate it at that temperature. A pattern of varying mean monthly values of relative humidity for Sagar district as reported in an earlier publication depicts almost similar behavior as in other surrounding districts. Looking for the whole year, RH is lower during summer season and touches peak during rainy season. Also afternoon values of RH are lower than the morning values. Available data for Sagar district are presented in the table which follows:

TABLE- RELATIVE HUMIDITY

Month	Relative Humidity (RH)	
	8-30 AM	5-30 PM
January	57.10	40.00
February	52.55	31.20
March	44.35	27.60
April	32.90	23.25
May	31.00	17.50
June	58.55	41.60
July	86.35	71.45
August	89.50	79.40
September	81.40	70.45
October	60.90	46.15
November	52.65	41.05
December	57.80	39.70
Source: India Meteorological Department, Govt. of India Nagpur		

THE WINDS:

Horizontal component of the air-movement parallel to earth's surface is the wind which is measured by anemometer in km per hour units. In Sagar district winds blow almost whole of the year but their direction in each season varies. The mean wind-velocity recorded for Sagar district are given as follows:

TABLE- WIND VELOCITY

Month	Wind Velocity Km/hour
January	3.35
February	3.53
March	3.65
April	3.92
May	4.27
June	4.26
July	3.85
August	3.34
September	3.07
October	2.59
November	2.70
December	2.99
Annual Average of the Wind Velocity = 3.46 km/hour	
Source: (www.synergyenviron.com) through INDIA WATER PORTAL	

Looking at the table above , May happens to be the month for highest wind-velocity while the minimum has been recorded for October. The lower wind velocity seems associated with rains as well as early winter season . Seasonal variation of atmospheric pressure takes place in a systematic manner with a maximum in the winter (January) and minimum in the monsoon season. During early winter months winds are moderate, strengthening in the late summer and early monsoon season. During late summer and the monsoon season, winds blow mostly from south-west to north-eastern direction.

In October winds from other directions also set in. October is the month of transition with weakest pressure gradient. From October onwards, the change-over of the

pressure and wind pattern to the winter pattern commences. In the winter season winds blow mostly from directions between north and south-east. These winds continue in early summer also, though these are less predominant, and south-westerly to north-easterly winds make their appearance.

SOLAR IRRADIATION:

Solar Irradiance is a measure of amount of solar power a location gets . This irradiance varies throughout the year depending on the seasons. It also varies throughout the day, depending upon the position of sun in sky and also the local weather. Measure of solar irradiation at any place can help in planning solar based power plants and devices using direct solar energy. Average solar irradiation per day on monthly basis for Sagar district has been presented in the table as follows:

TABLE - SOLAR IRRADIATION

Month	Solar Irradiation (kWh/m² /day)
January	4.43
February	5.20
March	5.45
April	6.46
May	6.33
June	5.30
July	4.08
August	3.56
September	4.46
October	5.06
November	4.53
December	4.13
Annual Average: 4.96 kWh / m²	
Source: www.synergyenviron.com through INDIA WATER PORTAL)	

EVAPORATION LOSSES:

The formation of gaseous state from water near its surface and distribution of these vapours into atmosphere is what is known as evaporation loss measured in centimeters. Evaporation of water into vapours is an ongoing process and is affected by several environmental factors itself. The monthly evaporation losses recorded for Sagar district are presented in a table below.

TABLE - EVAPORATION LOSSES

Month	Evaporation Losses (cm)
January	7.62
February	10.16
March	18.41
April	27.94
May	38.10
June	23.49
July	10.16
August	8.25
September	10.79
October	9.52
November	7.62
December	7.62
Average Annual : 14.97 cm	
Reference: IMD-Govt. of India, Nagpur	

A glance at this data brings out the fact that the evaporation losses gradually decrease till August and after a small increase in September, it decreases again during October onwards.

POTENTIAL EVAPO-TRANSPIRATION (PET) :

The Potential Evapo-Transpiration (PET) is known to be defined as the amount of evaporation that would occur if a sufficient water source were available. It is a reflection

TABLE - POTENTIAL EVAPO-TRANSPIRATION

Month	Potential Evapo-Transpiration (mm / day)
January	5.20
February	6.11
March	7.34
April	8.31
May	8.75
June	7.83

July	5.72
August	4.91
September	5.55
October	6.48
November	5.99
December	5.24
Average Annual : 6.45 mm/ day	
Ref: India Water Portal Indian Meteorological Department–Govt. of India , Pune	

of the [energy](#) available to evaporate water and of the [wind](#) available to transport water vapour from ground up into the lower [atmosphere](#) and in this way it serves as an important factor in study of climatology of a region. Following table gives values of PET as recorded from 1960 to 2002 for Sagar district :

Climatic Water Balance (CWB) , an important indicator is normally calculated as the difference between precipitation and potential evapo-transpiration of certain place for specific period of time, day, month or the year.

CLOUD COVER OVER THE DISTRICT:

Generally, sky is clear or lightly cloudy in non-monsoon season. The cloud-intensity, however, is high during south-west monsoons. It is quite in tune with Nature that July and August have maximum cloud-cover over the sky while the lowest is in November. Sometimes during winter season higher cloud cover is associated with western disturbances.

In recent years , because of several factors influencing environment cloud cover has become an uncertain indicator of climate , yet it may be helpful in understanding the regional character. The data of Sagar district recorded for the years 1960 to 2002 have been averaged to be presented in the following table:

TABLE - CLOUD- COVER OVER THE DISTRICT

Month	Coverage (%)
January	19.23
February	15.78
March	26.24
April	24.41
May	30.28
June	56.84
July	75.14
August	75.06
September	55.69

October	26.86
November	14.63
December	16.72

Source: Indian Meteorological Department , Govt. of India Pune through India Water Portal

SPECIAL WEATHER PHENOMENA:

Like in other surrounding districts of *Bundelkhand* depressions due to south-west monsoon rising from the Bay of Bengal brings storms followed by heavy rains during rainy season. The depression in October also sometimes causes rains as well as high velocity winds. The storms are generally during the summer and rainy seasons. Rains during winters are sometime followed by hails. Frost and fog may also appear during the winter months.

.....

5. TIKAMGARH

A . INTRODUCTION:

Tikamgarh (old name : Tehri) had been capital of the Orchha State since 1783 AD. After Indian independence , Maharaja of Orchha acting in tune with feelings of masses established people's responsible government which was declared on 17th December 1947. A new union of princely states of *Bundelkhand* – states, Vindhya Pradesh , was inaugurated in April 1948. Later on Government of India took over Vindhya Pradesh as a centrally administered area on 1st January 1950. Subsequently in 1956, due to reorganization of the states, Vindhya Pradesh became a part of new Madhya Pradesh . Tikamgarh as a district, thus became a part of Madhya Pradesh initially under Rewa division but later transferred to Sagar division.



The district lies between Latitude $24^{\circ} 26'$ & $26^{\circ} 40'$ (north) and Longitude $78^{\circ} 26'$ & $79^{\circ} 26'$ (east) and has a geographical area of ca. 5,048 sq. km. To the north of Tikamgarh is Jhansi district ; towards east are Mahoba and Chhatarpur districts; to the south are Lalitpur and Chhatarpur districts , and to the west is Lalitpur district. The eastern boundary is entirely made up by *DHASAN* river while the western boundary is mostly bordered by *JAMNI* river.

DISTRICT AT A GLANCE:

S.No.	Particulars	Statistics
1	GENERAL INFORMATION	
	Geographical Area (km ²)	5,048 km ²
	No, of Tehsils	06
	No. of Development Blocks	06
	No. of Gram- Panchayats	459
	No. of Revenue- Villages	865
	Population (2011)	14,45,166
	Average Annual Rainfall	982.76mm (based on past 110 years' average)
2	<u>GEOMORPHOLOGY</u>	
	Major Physiographic Units	1. The hill ranges 2. The inter-mountain fertile valleys 3.
	Major Drainages :	1. Betwa River 2. Dhasan River
3	<u>LAND-USE</u>	
	Total Area	4,519.72 km ²
	Forest Area	299.70 km ²
	Net Area Cultivated	2,619.20 km ²
	Rest Cultivable	2,409.51 km ²
4	MAJOR SOIL TYPES	Black Humus Granitic & yellowish Grey color with Kankar
5	PREDOMINANT GEOLOGICAL FORMATIONS	Bundelkhand Granite and Gneisses
6	<u>GROUND WATER SITUATION</u> :	
	Annual Replenishable Ground Water Resource: Net Annual Ground Water Draft: Stage of Ground Water Development:	766.14 MCM 393.73 MCM 51%
Reference: District Statistics of Tikamgarh (2009), Central Ground Water Board report on Tikamgarh district (2009) Report of MSME : Tikamgarh (2012)		

B. PHYSICAL FEATURES

TOPOGRAPHY :

The whole of district lies on lower part of the *Bundelkhand* Plateau. It is a part of greater Vindhyaachal Plateau which slopes to north of the Vindhyaachal range. Average height of the region is about 300 metre above mean sea level, ranging from 230 metre on the northern course of river *BETWA*, as also that of *DHASAN* to over 400 metre in the south-east of Baldeogarh in the southern part. The District is covered with hard rocks of Bundelkhand- granites and gneisses. The country is rugged and devoid of any considerable soil cover, narrow belts of fertile soil are found only along the margins of big rivers. Tikamgarh district may be divided into three physical sub-divisions:-

1. The Central Plateau
2. The *UR-DHASAN* valley in the east
3. The *JAMNI-BETWA* valley in the west.

The Central Plateau:

Central Part of the district is typical *Bundelkhand* Plateau. It is dotted all over by low and denuded granite hills which at places are aligned roughly in a south-west to north-west direction. Most of the sills and dykes out-cropping the gneisses and granitic rock surface, are straight and aligned in the same direction, they together produce, a hilly terrain with a series of parallel ridges. As the district slopes towards north, most of high points lie in the southern part, between the up streams of *DHASAN* and the *JAMNI*. The *UR*, an affluent of the *DHASAN* marks the central feature of the district. A narrow ridge runs along its eastern bank from Bajranggarh and Harijam to Bhonra and Barchhi. Second ridge to the east is axis of the water-parting line between *UR* and the *DHASAN*. It runs from Madaura and Sojna in Lalitpur district to Donra (411.5 m.), Amarpur (427.3), Sewar (427.3), Baldeogarh, Chobara (400.2 m.) and Ratangawan hill. This ridge is denuded by feeder streams of the Sadhani.

The highest point of the third eastern ridge lies near Pura (442.6 m.). The ridge starts from Kakarwad in the south, and extends north-west to Badagaon-North hill (400.2 m.), Pura, Sewar (427.3 m.), Baldeogarh, Jatara and Banpura. The eastern most ridges enter the district from Ghaura and Bhagwan in Chhatarpur district and conjoin in the Imalia hills with a peak measuring 427.0 metre. It further extends to Biswan and Bar. Across the Dhasan their counterparts of the ridge are Kurra and Bihte hills of Chhatarpur.

To the west of the *UR* river five ridges are well marked. The first runs from Tikamgarh to Parewa Pahar (411.8 m.) and Machigarh (420.0 m.) and beyond. The second one extends through Kurrai Mau-Bujurg (410.247 m.), Bachhaunra and Shahpur (406.6 m.). The Nakti Pahar lies a little north west of Shahpur. The Ratangawan hill (385.56 m.) is the third ridge running through Baria (348.37 m.) and Murga Pahar (344.1 m.) to Magarwara hill (336.18 m.) and Jiraunkasa hill (356.9 m.), lies in the centre of ridge which measures from Pura Kalan in Jhansi to Larwari, and Niwari. The Fifth is the shortest ridge between Bhailsa and Barwasagar. The Mutina hill extends from east to west in the south-eastern part of the district. The hills of Kharagapur, Chandpur, Hirdenagar, Gariba and Ramnagar are the residuals of ancient granitic heights, have denuded margins.

2 . THE *UR-DHASAN* VALLEY:

The *DHASAN* valley occupied a narrow belt in eastern part of the District. It widens in the north and also extends along its major tributaries, namely, the *UR* and the *SAPRAR*. The valley is relatively low from the surrounding plateau but the isolated hills continue to occur intermittently, general heights being 250 meters. There are some isolated hillocks like the Kakarwaha, which rises to 380 m., and hill near Jatara (390 m.) and Peer hill (388. m.). The depressions are covered with thin sheets of river alluvium, derived from the granitic rocks. The water divides and mounds are poor in soil cover which is mixed with gravel.

THE *JAMNI-BETWA* VALLEY:

The *BETWA* valley proper lies in the north-western part of the district. The land stands washed off its soil cover, exposing the hard rocks and gravels. It being unsuitable for cultivation, is normally occupied by bushes and low forests. However, its extension along the *JAMNI* river is more even and rich in soil than the main valley. The *JAMNI* valley occupies a narrow strip along western boundary of the district. The alluvial soil of mixed nature, derived from granites as well as trapeans of Lalitpur district, provides better opportunities for agriculture operations. Moreover, the construction of large tanks have extended irrigation facilities below Bir Sagar, Nandanwara, Bamhauri-Barana, etc. in this part of the district. Hill near Chandrapur is the highest point (349 m.) in the *BETWA* valley. Samarra hill (430. m.) marks another height in the *JAMNI* valley.

GEOLOGY

Entire District is covered with Archaean formation which is the oldest formation in the geological rock succession. This is plutonic igneous rock consisting of Quartz, Feldspars and small amounts of ferro-magnesian minerals like Biotite, harnblende and

Iron-oxide. The rocks are known as Bundelkhand- granites. General stratigraphical succession of the area is given below :

GENERAL STRATIGRAPHICAL SUCCESSION

Group	Period	Formation	Lithology
Pleistocene	Recent	-	Black Clayey, humus granitic, yellowish grey soils
Archaean	Older Archaeans	Bundelkhand-granite and veins & dykes	Ferruginous sand-stones, shales, Bijawars, granites & gneisses
Note: The Topography as well as Geology Of Tikamgarh has been quoted from the following source: The District Gazetteer - Tikamgarh (1995)			

Bundelkhand- granite is well exposed in the area but depending upon the texture it can be categorized in three parts:

1. Fine grained
2. Medium grained, and
3. Coarse grained

Granites are seen intruded by quartz reefs and secondary quartz-veins. At some places the granites are metamorphosed into gneissic variety, but it is very rare. The general trend of quartz-reefs is north-east to south-west. Between the two reefs natural valleys have been formed where the maximum soil cover and the weathered material is found. The maximum weathered material including soil cover have been found near the village Bamhauri-Barana and Bijrawan of Jatara block, which is 45 meters. Along its northern border Bundelkhand-granite is gradually and irregularly covered in its outlying and marginal portions by Gangetic alluvium. The soils in the district are generally of three types:

1. Black clayey humus soil-formed by the decay of vegetation and organisms,
2. Granitic soil-formed by the weathering of the parent rock, i.e., granite, and
3. Yellowish grey soil with kankars-formed by decomposition of granitic mass.

BUNDELKHAND - GRANITE

The Bundelkhand-granite which is slightly foliated belongs to Dharwar age. It is regarded as a relic of the old Dharwar sea floor on which Dharwar sediments were laid down. *Bundelkhand* tract has been protected in some way from the excessive metamorphism to which the archaean of other areas were subjected. The tract is sharply bounded by schist, several hundred feet in height of Vindhyan or Bijawar rocks which though ancient are younger than the granite. North of its main tract, granite projects through the alluvium in inliers, the largest of which is fringed by beds of Gwalior series along the left bank of the *SIND* - river.

Chief characteristic features of the granite are its massive structure, obscurely developed foliation and the rarity of accessory minerals. It is a medium to coarse grained rock, chiefly consisting of orthoclase hornblende and quartz. Plagioclase, superficially weathered is sometimes present in subordinate amounts and in much smaller crystals the orthoclase. The clearable crystals usually red or pink in color give the rock its characteristic appearance. This mineral sometimes yields crystals more than 5 centimeters long. Whitish or bluish grey quartz rarely occur in large quantity and cannot be detected in the rock. A dark colored hornblende is usually present but is never abundant, it is sometimes partially replaced by chlorite and mica.

So far as typical rock is concerned the term 'gneiss' as conveying an idea of foliation is in-applicable, there being very little difference between it and a normal granite. When discernible the plane's foliations are more or less vertical, and strike generally east-north-east to west-north-west with local variations to north-east to south-west or west-north-west to east-south-east. Much of the granite is homogeneous for considerable thicknesses, the variations which occur appear to be merely the result of local concentration or of particular mineral segregation in a single archaean mass incapable of sub-division. The rock weathers concentrically into large spheroidal masses. Traces of galena, pyromorphite, malachite and azurite have been found in granite.

Within the granite boundary other varieties of rocks are found but to a very insignificant extent. Prominent among these being a hornblende rock some of which is fine grained as the intensive dykes of dolerite or as the overlying basaltic trap. It withers into similar rounded lumps. This rock passes into much coarser variety in which the feldspar and quartz are well separated. These rocks are probably intrusions into the Bundelkhand-granite and might be of Aravalli or Cuddapah age. The great quartz reefs prevalent in granite atop form shorts of belt, sometimes with schist which lies across the strike of the reefs.

PEGMATITE VEINS

The chief differences between these veins and the parent granite lie in coarser crystallization and absence of ferromagnesian constituent in case of the former. These are commonly 2 to 25 cm in length. Their composition is not invariably uniform. Since the feldspar, whether orthoclase or plagioclase or both, is said to change with that of the adjacent parent rock, they appear to have been formed by segregation at the time of crystallization of granite.

QUARTZ VEINS

Uniformity of granite tract is diversified by the long narrow serrated ridges of the quartz reefs which form a striking feature all over the lower *Bundelkhand* landscape. They are found specially in Basai and Kandhari blocks and other southern areas. These run in straight lines in north-east to south-west direction and are exclusively confined to the granite sometimes attaining an elevation of about 150 metre over the surrounding country. Their breadth varies from one to 100 metre, and some of them are traceable in a direct line for more than 100 kilometres in the District and the surrounding regions, local interruptions, being due to denudation or strangulation of the vein itself. Others are short and abrupt. These quartz reefs are often affected by joint planes and quartz is much shattered. Foliation is often developed in reefs. Occasionally foliation in both rocks is parallel to the reef itself. Many of the reefs are formed of grayish white quartz. In many cases the granite is serpentinous for some distance on each side of a vein, there being no distinct boundary between the two rocks. Serpentinous granite has not been observed except near a quartz vein.

BASIC DYKES OF MAGMA:

Another interesting feature of the Bundelkhand- granite area is a set of numerous linear dykes of basic igneous rock many of which are oriented obliquely or at right angles to the great quartz reefs. In some cases they have been observed to traverse the reefs but none of them penetrated either the Gwalior or Bijawar sediments, which lie upon the margins of the granite. These may be regarded as the feeders of sills of trap in the Gwalior and Bijawars. Thus basic magma which rose up along the joints and fissures in the granite and basal portion of the sedimentaries found easier path along the bedding planes in the form of hills.

The basic dykes are more numerous than the quartz reefs with their prevailing direction being about north-north-west to south-south-east and making an angle of about 70° with the strike of quartz reefs. A few run north-east to south-west and others from east to west. They are sometimes parallel to foliation of granite and gneiss but are just often

across it. Intrusions vary in thickness from 2 cm. to over 30 metre and often persist for great distances and are abundant in some places, more than in others. They are fine grained and wither into large rounded blocks but with no clear tendency of exfoliation. Commonly they are hard or tough, close-grained green stone in which hornblende and white feldspar are clearly visible.

RECENT FORMATIONS

These include the superficial cover of soil, *murram* and graded material. Alluvium is formed along the river course and along the northern fringes of Bundelkhand- granite.

The black cotton soil is found in a very small area. It is locally known as *mauta* or *mar*. it has good moisture retention power but poor drainage. It is found between ridges of gneiss. The soil is rich, dark, friable and clayey. It produces good crops of wheat and grain without irrigation. Being clayey in nature it is not very suitable for growth of valuable trees, e.g., *Khair* and *kardhai* etc .

Another soil which may come under this is *kabar*. It is less dark in color and less clayey than *mar* but stiffer in structure and difficult to work. Owing to its hardness and cloddy structure it produces good crops of wheat and gram if rainfall is sufficient. The growth of tree is not good on this soil as the drainage is poor.

The Reddish soil or the *Parua* soil is a light soil or yellowish color and low depth. It is easy to work in and is suitable for *KHARIF* crops. Wheat and barley are grown under irrigated condition.

Shallower and more gravelly red soil is known as *rankar*. It is of poor quality full of *kankars*. It produces cheap crops of *til*, *bajra* and *jowar*. This soil is the commonest in forest areas. It is generally shallow and stony varying from coarse gravelly or sandy red loam to stiff loam. At the foot of the hills the soil varies from light to stiff loam and along some of the *nallas* runs a narrow belt of fairly deep *dumat* soil (loam). The soil of the slopes which is not very rocky is invariably deep, often dark red in color and resembles *murram*.

THE ALLUVIUL SOIL

The Alluviul soil is met with along the banks of the *BETWA*, and other rivers. Such soil-type is loamy and if depth is good, field crops or forest plantations of valuable species, e.g., *shisham*, *babul*, and *teak* may be successfully raised . The alluvium may be classified into old, middle and the recent.

THE SOILS: AS PEOPLE SEE IT:

Traditionally village people distinguish large number of soils , which for simple understanding have been classified as in other surrounding districts and discussed briefly as follows :

MAUTA: is a rich and fertile black loamy soil with considerable power of retaining moisture, formed by disintegration of the dykes of trap.

PATRUUA: is a less fertile variety of the preceding and considered generally inferior.

RANKAR: is a reddish soil containing small stones which requires much irrigation . Other varieties of this soil type are called *CHHARIYA*, *RETILI* and *PATHRILI* . *RANKAR* ordinarily has been favourable for the traditional crops like **rali, kutki, tili, urad, moong** and Maize.

KAWAR or KABAR : is a black loamy soil , a lighter variant of *MAUTA* which cracks when dry . It contains large quantities of lime. *HADKABAR* is a kind of *KABAR* which forms hard lumps requiring to be crushed.

MAR is a clayey black soil considered a variety of *MAUTA*.

PARUA: is the light grayish- yellow soil common wherever the gneiss is covered by alluvium. It favours crops like **jowar, til , kodon, mung, urad, arhar** etc. *DUPARUA* is a similar soil so called from its being mixture of yellow and red soils.

DUMAT : is an inferior variety of *MAUTA*, of black or grey colour. The produce of this soil is the same as in case of *MAUTA* , but the yield is lower.

KHADARI : is another variety of *MAUTA* , and is so called because it contains **khadars** or hollows filled with water. These retain water for a considerable time. It also produces aquatic plants like **gonchi (gond)** and **urai** (the vetiver plant whose roots are known as *KHAS*)

CHHAPARA : Contains lime-stone and is of very poor quality.

CHIKNI : is a loamy soil of black or grey colour which retains moisture for a long time.

Like in other districts the soils were also classified according to their location or usage.

TABLE: SOILS

S.No.	Name of the Soil	Usage/ Location
1	MAZRUA or ABADI	Land under cultivation
2	PARANTA	Soil lying fallow
3	RUND	The local name for grazing land
4	BHATO	That which has never been cultivated
5	UGAR	The soil which has been newly broken and is cultivated successively for 3 – 4 years and then left fallow for a year or two.
6	BAGH	The garden-land
7	GUHABAGHNI	Land which is reserved for cultivation of wheat near village site;
8	SAIYA	Land reserved for the RABI-crops
9	NAGARWAR	Low lying land which is kept fallow during KHARIF crop season.
10	THARO	The irrigated land
11	PATHALA	Rocky or boulder-strewn soil.
12	DUSAIA	The DUFASLI - soil where both KHARIF & RABI crops could be grown within a year.
Reference: Eastern States' Gazetteer : Vol. VI-A, <i>Bundelkhand</i> : (CE Luard) 1907		

C . THE MINERALS :

Like in other *Bundelkhand* districts Tikamgarh too has variety of minerals though all of these are not found sufficient to initiate any sizable industry. The earlier report available for initial years of 20th century does mention availability of iron ore around Prithvipur. From the deposits found within a depth of 15 ft. this ore used to be dug and smelted locally to produce iron. The District Gazetteer (1995) relates variety of minerals and the sites as follows:

TABLE- MINERALS AND ITS SITES

S.No.	The mineral	Village-Sites where found	Specific Information
1	Pyrophyllite & Diaspore	Kari (24° 58' N-78° 52' E) Khera (24° 52' N-78° 48' E) Nandanwara (25° 40' N-78° 52'E) Dhamna (24° 57'N- 78° 35'E) Ahar (24° 45'N-70° 00'E) Baragaon (24° 34' N-79° 01'E) Baldeogarh (24° 45' N 79°04'E) Gummanganj- Hillock: & Sunauniya	This is associated with quartz The reserves of Kari & Khra had been estimated to 1.9 million tones.
2	Iron Ore	Bakan Majaryara Toria	This occurs in the upper stage of Bijawar series as banded hematite quartzite.
3	Barytes	Chakrada hills (24°43'N-70° 10'E) 1km from Surajpur village, Burenkhera (23°43'N-79°9'E) Bherano (23°43'N-79° 7'E)	This associates with Bundelkhand-granite
4	Mica	Samana Vill. Baghat Vill.	Associated with pegmatite veins Found not of any economic significance
5	Lead Ore	Bahadurpur	Very small amounts were found. Not in other places.
6	Lime-Kankar	Maheba (25°12'N-78°57'E)	
7	Feldspar & Quartz	Maharajpur (Niwari Tehsil)	
8	Asbestos	Khistone (Prithvipur Tehsil)	
9	Pyrites		Small deposits have been found in the district.
Reference: District Gazetteer (Tikamgarh) 1995			

Apart from above extensive building materials like sand, clay, granite, sand-stone, and quartzite etc. have been reported having been exploited at several places within this district.

Important mineral wealth of this district have been the famous Bundelkhand-granite , the sand-stone & lime-stone. Main products are the building materials like stone-gravels , boulders and the slabs. Though not in great quantity , there is also reference of occurrence of copper , pyrophyllite & Diaspore in Tikamgarh district.

D . THE NATURAL DRAINAGE:

Tikamgarh is drained by the rivers *BETWA* and *DHASAN* and its numerous tributaries like *JAMNI*, *BARGI*, *UR*, and *BARWA* and several other seasonal streams flowing mostly towards north- or north-east direction. While *JAMNI* gets the draining of the district on its western side , *DHASAN* forms the draining line towards eastern side. *JAMNI* joins *BETWA* at the north-western corner of the district.

THE RIVERS:

Important rivers of this district are described as follows:

***BETWA* :**

This river touches at north-west corner of this district and flows through Orchha , the original capital of erstwhile Orchha State and an important historical town of this district. It goes further towards Jhansi district . The main tributary of *BETWA* in this district is river *JAMNI*.

***JAMNI* :**

Rising from Sagar district , *JAMNI* is an important river which flows through Lalitpur district (U.P.) forming boundary with Tikamgarh. As noted this river receives all the west bound drain of Tikamgarh district. It meets *BETWA* within this district itself.

***DHASAN* :**

An important river rising from south of Sagar district , it serves as the central draining river of *Bundelkhand* region . This river forms total eastern boundary of Tikamgarh district separating it from Chhatarpur and Mahoba districts. *DHASAN* during ancient times used to be called *DASHARNA* which literally meant ten forts or ten rivers and present *Bundelkhand* –region also during that period was known by *DASHARNA DESH*. *DHASAN* joins *Betwa* before the latter meets river *YAMUNA* in Hamirpur district within *Bundelkhand*.

BARWA :

This rises in Barora hills and flows into Barwa-Sagar lake situated in Jhansi district , finally paying tribute to river *BETWA*.

UR :

This is a perennial river rising from this district and joins *DHASAN* before Devri (Pahadi) - weir bordering with Chhatarpur & Jhansi districts.

Rivers *BARGI* , *SAPRAR* , *SORDA* , *NAGDA* , *UMRAR*, & *JAMRAR* are other important streams which drain this district and also give life to people here by way of forming certain good water-bodies helping irrigation as well as recharging of the ground water reserve.

F. CLIMATE OF THE DISTRICT:

The climate of Tikamgarh district is monsoon type. Like in other surrounding districts here also the year may be divided into four seasons. The cold season from December to February followed by the hot season, from March to mostly middle of June. The period from mid-June to the end of September is rainy season. The months of October and November constitute the fourth i.e. post-monsoon or transition season.

Various indicators of climate of the district are discussed as follows:

TEMPERATURE:

Climate of the district touches extremes with maximum temperature having been recorded more than 41°C in hot summer days of May. The minimum drops to 9 °C during winter season in the month of January. Hot winds (locally known as *LOO*) are common during May and June. With the onset of monsoon temperature drops appreciably as can be seen from values presented in the table below listing annual monthly average temperature (maximum as well as minimum) recorded for the years 1962 to 2002 :

TABLE: MAXIMUM AND MINIMUM TEMPERATURE

Month	<u>1962-2002</u> Highest: 43.66°C in the year: 1978 Lowest:: 7.49°C in the year 1963	
	Maximum Temperature (°C)	Minimum Temperature (°C)
<u>January</u>	24.06	<u>9.27</u>
February	27.37	11.09
March	33.12	16.83
April	38.18	22.16
<u>May</u>	<u>41.23</u>	26.16

June	38.66	26.40
July	32.20	24.24
August	30.00	22.96
September	32.25	22.32
October	33.17	19.36
November	29.43	14.34
December	25.18	10.28
Source: India Water Portal & IMD Climatological Tables		

RAINFALL:

The district gazetteer of Tikamgarh (1995) reports presence of only one rain-guage station in the District. From the pattern of rainfall in the region around this district it is clear that that rainfall, in general , increases from northwest to southwest. Parts of Niwari Tehsil and Mohangarh area of Jatara Tehsil also come in the low-rainfall zone. About 90 percent of annual rainfall in the district is received during the south-west monsoon season i.e from June to September, July being the rainiest month. Very few years have been recorded when rainfall lasted up to mid-October. The variation in the rainfall from year to year is appreciable.

The average annual rainfall calculated on the basis of 110 years' data in two sets [(1901-1960) and (1961-2011)] for Tikamgarh as presented below , is 982.76 mm. The maximum rainfall of 1693.50 mm was recorded in the year 1982 while the minimum 388.00 mm, in the year 2007. The usual character of rains in this district is like other districts of *Bundelkhand* region, precipitating over 90% of the total annual rainfall in just four rainy months i.e. from June to September of the year. Month wise average rainfall as mentioned above is presented as follows:

TABLE : MEAN MONTHLY RAINFALL

Mean Monthly Rainfall	Average Rainfall (mm)	Average Rainfall (mm)
Month	1901-1960	1961-2011
January	17.56	12.22
February	13.19	9.33
March	7.39	3.85
<u>April</u>	3.48	2.02
May	6.83	4.99
June	88.37	92.13
July	324.53	282.74
August	304.71	319.70
September	155.53	148.97
October	28.58	101.30
November	14.07	10.06
December	6.94	7.03
TOTAL ANNUAL AVERAGE	971.18	994.34
Average for past 110 years	982.76 mm	

The rains during June-September:	873.14 (89.91%)	843.54 (84.83 %)
Maximum Rainfall:	1615.30 (1926)	1693.50 (1982)
Minimum Rainfall :	447.50 (1913)	388.00 (2007)
Source: India Meteorological Department Data & India Water Portal		

RECENT RAINFALL DATA (2004-2011) FOR TIKAMGARH DISTRICT:

S.No.	particulars	year							
		2004	2005	2006	2007	2008	2009	2010	2011
1	Rainfall (mm)	567.3	713.4	593.7	388.0	1316.5	778.1	574.5	1121.4
2	Average (mm)	756.6	756.6	756.6	756.6	756.6	756.6	756.6	756.6
3	Rain in June-Sept.(mm)	550.3	698.9	552.7	343.5	1314.0	703.4	524.0	1111.2
4	Rain in July-Aug (mm)	412.8	532.1	506.0	247.4	508.8	439.0	394.1	478.6
Reference: India Meteorological Department Data & India Water Portal									



HUMIDITY :

The pattern of change in the relative humidity (RH) of Tikamgarh is like other districts of the region remaining high during the monsoon season, generally above 70 percent. In rest of year air is comparatively dry. The driest part of the year is summer season when relative humidity becomes less than 20 percent in the afternoons. The values for morning hrs. is always higher than those recorded during afternoon.

THE WINDS

Generally winds are light to moderate during major part of the year. In post-monsoon and winter months these blow mainly from north-west. In March winds are variable in direction and by April start taking a west to east direction and finally their direction becomes south-west to north east till the end of September.

Looking at the values of wind velocity as given below it is apparent that it increases during summer months especially from April onwards and peaks in June. Later the wind velocity slowly comes down which is associated with rains during July to September. In winters the speed of the wind generally is lower.

The average monthly wind velocity for Tikamgarh district are presented below :

TABLE- WIND VELOCITY

Month	Wind Velocity (Km/hour)
January	3.04
February	3.24
March	3.37
April	3.82
May	4.33
June	4.57
July	3.98
August	3.33
September	3.08
October	2.39
November	2.39
December	2.68
Annual Average of the Wind Velocity = 3.35 km/hour	
Source: (www.synergyenviron.com) through INDIA WATER PORTAL	

SOLAR IRRADIATION:

Solar Irradiance is a measure of amount of solar power one gets at any location . This irradiance varies throughout the year depending on the seasons. It also varies throughout the day, depending on the position of sun in the sky, and the local weather. Solar insolation is a measure of solar irradiance over a period of time - typically over the period of a single day. Average solar irradiation per day on monthly basis for Tikamgarh district is being presented in the table as follows:

TABLE- SOLAR IRRADIATION:

Month	Solar Irradiation (kWh/m ² /day)
January	4.37
February	5.50
March	6.50
April	7.13
May	7.36
June	6.27
July	5.09

Climatic Water Balance (CWB) , an important indicator is normally calculated as a difference between precipitation and the potential evapo-transpiration of certain place for specific period of time, day, month or year.

CLOUD COVER OVER THE DISTRICT:

Skies are generally over-cast in the monsoon season. In the post-monsoon months the cloudiness is moderate, afternoons being more cloudy than the mornings. In rest of the year skies are generally clear with occasional light cloudiness. It is quite in tune with nature that July and August have maximum cloud-cover over the sky while the lowest is in November. Sometimes during winter season higher cloud cover is associated with western disturbances. In recent years , because of several factors influencing environment cloud cover has become an uncertain indicator of climate , yet it may be helpful in understanding the regional character.

The data recorded for the years 1960 to 2002 have been averaged to be presented in the following table:

TABLE- CLOUD- COVER OVER THE DISTRICT

month	Coverage (%)
January	20.95
February	16.37
March	27.28
April	24.02
May	30.36
June	54.61
July	72.09
August	72.11
September	52.32
October	25.34
November	14.35
December	17.51
Reference: IMD , (Govt. of India) Pune / India Water Portal	

SPECIAL WEATHER PHENOMENA

During monsoon season depressions , formed in the Bay of Bengal, cross the east coast of India and extend in some westerly direction. In their passage across the central parts of the country these storm affect the district and its neighborhood and cause wide spread heavy rain and strong winds. An occasional storm from the Bay of Bengal in October may also affect the District. Thunder-storms may occur throughout the year, their frequency being least in the period October to January and highest in late summer and south-west monsoon months. Occasional dust-storms and dust-raising winds occur in the summer months.



FROST DAMAGED THE FRUIT-GROVE (2011)

Chapter - III

WATER RESOURCES OF SAGAR DIVISION:

INTRODUCTION:

In previous chapter of this report entitled “ **BUNDELKHAND-THE SAGAR DIVISION**” , natural water resources for each constituent district have been covered under NATURAL DRAINAGE . That particularly included major rivers flowing through the districts of Sagar Division viz. Chhatarpur, Damoh, Panna, Sagar & Tikamgarh and briefly touched tributaries of these rivers and other natural sources.

Bundelkhand has been well-known for its rain-water management through ponds, tanks and lakes artificially created by several ruling dynasties from around 1000 AD onwards. The topography of this region helped to build such structures but more than anything, it revealed great fore-sight of the rulers and their positive attitude towards conservation of nature including hills, forests and the rivers.

The current chapter has been planned to present and discuss the water storage structures created through human efforts during past 1000 years. The presentation here is again split district wise to understand each district and its resources in depth.

1 . CHHATARPUR

CREATED WATER RESOURCES : (TRADITIONAL & PLANNED)

As indicated above *Bundelkhand* is uniquely placed as a region where surface-water management had been taken up by ruling *CHANDELLA*- dynasty over thousand years ago. Chhatarpur area being an integral part of that regime has quite large number of such water-reservoirs. As already mentioned the ruling dynasty of *BUNDELAS* during 15-18th century too continued building rain water- reservoirs and maintaining earlier structures all over this region.

Famous BILWA-TADAG of Khajuraho built by king Yashovarman during the last quarter of tenth century which looked like sea was probably seen and appreciated by famous traveler *Ibn-Battuta* during his visit to this tract around 1335 AD. That pond, not so big today, is likely to be the same as present *SIBA-SAGAR* close to the *Lakshman - temple* of Khajuraho.

Though almost each village in *Bundelkhand* has one or more ponds but larger number of ponds and sizable reservoirs were built during *Chandella- & Bundela*-regimes. Physical and geological formation of *Bundelkhand* is very favorable for building reservoirs storing the rain-water. Unfortunately these are not properly maintained these days but their presence everywhere reminds of the great work and tradition left by those kings and people of that era.. Some of these prominent multi-purpose tanks/ ponds built during *Chandella- & Bundela regimes* and later, were renovated by British rulers during 19th and 20th century and were placed under irrigation or the revenue departments depending upon their irrigation capacity. Several such tanks/ ponds were joined by small canals also through sluice gates in order to streamline services and generate some revenue from irrigation.

WATER RESOURCES - FOR IRRIGATION :

Irrigation in Chhatarpur traditionally had been through wide-spread dug wells built and managed by farmers themselves. As mentioned elsewhere *Chandella*-kings had encouraged and built large number of tanks and ponds which also served for emergency irrigation . These basically helped in maintaining water level of the dug-wells, retain soil-moisture and served as ground-water recharging resources. Such tanks seen built amidst deep forests too helped to sustain wild life and also the dense vegetation there.

TANKS & PONDS BUILT IN THE PAST:

Tanks / ponds were highly regarded by people of past generations. During ancient times society here understood very well importance of surface water storage. The rulers as well as common people encouraged building of thousands of such structures all over *Bundelkhand*.

These were later maintained by British administration adding to them canals for irrigation purpose. A list of prominent tanks / ponds meant for irrigation as well as other usage as mentioned in District Gazetteer of Chhatarpur (1982) is given in the table which follows:

TABLE- TANKS & PONDS OF CHHATARPUR DISTRICT

s.no.	Name of Tank/ Village	Major purpose	s.no.	Name of Tank/ Village	Major purpose
1	Jagat Sagar	Multi-purpose	53	Padariya	Irrigation
2	Gora Tal	Irrigation	54	Vasia	-do-
3	Isha Nagar Tal	Irrigation	55	Jorran	-do-
4	NIWARI TAL	Multi-purpose	56	Jharkuwa	-do-
5	BOODHA	Multi- purpose	57	Raksha Purwa	-do-
6	Rajnagar	Irrigation	58	Thara	-do-
7	Sarani	-do-	59	Baghar	-do-
8	Badaura	-do-	60	Baksoi	-do-
9	Bhagwara	-do-	61	Gakariya	-do-
10	Chandla	-do-	62	Gyolari	-do-
11	Manwara	-do-	63	Sendpa	-do-
12	Angor	-do-	64	Sadwa	-do-
13	Bandha	-do-	65	Manoriya	-do-
14	Bhagwan Bazar	-do-	66	Kusum Sagar	-do-
15	Patti	-do-	67	Har Sagar	-do-
16	Imalia	-do-	68	Karohi	-do-
17	Bada Malhera	-do-	69	Lakheri	-do-
18	Malguwani	-do-	70	Andhiyara	-do-
19	Panwari	-do-	71	Pahad Gaon	-do-
20	Pura	-do-	72	Churwari	-do-
21	Baram sagar	-do-	73	Khairo	-do-
22	Kishan Sagar	-do-	74	Tendua	-do-
23	Sidh Sagar	-do-	75	Rajiya-Nala	-do-
24	Kirat Sagar	-do-	76	Magrar Nala	-do-
25	Ragoli Tank	-do-	77	Agrautha	-do-
26	Nandgaon	-do-	78	Bamitha	-do-
27	Phutwari	-do-	79	Didonia	-do-
28	Raipura	-do-	80	Naya Tal	-do-
29	Kasar Tank	-do-	81	Suraj Pura	-do-
30	Machiyara Tank	-do-	82	Vikrampur	-do-
31	Dilari Tank	-do-	83	Daharguwa	-do-
32	Ram Sagar	-do-	84	Jeron	-do-
33	Gopital	-do-	85	Alipura	-do-
34	Jhinna Tal	-do-	86	Shankar Sagar	-do-
35	Brij pur Tank	-do-	87	Bajrang Tal PIRA)	-do-
36	Baniyara Tank	-do-	88	Mamon	-do-
37	Lampti Tank	-do-	89	Khiriya Buzurg	-do-
38	Motigarh Tank	-do-	90	Pitwa-kawa	-do-
39	Raichore Tank	-do-	91	Bhaira Tal	-do-
40	Amkhera Tank	-do-	92	Kadaura	-do-
41	Lalpur Tank	-do-	93	Ghatra	-do-

42	Nayagaon	-do-	94	Buxwaha	-do-
43	Dhubela Tank	-do-	95	Deopur	-do-
44	Matagaon Tank	-do-	96	Amarwa	-do-
45	Bagota Tank	-do-	97	Bhaira-Pungawa	-do-
46	Jhijhan Tank	-do-	98	Singro	-do-
47	Bharatpur Tank	-do-	99	Dalipura Tank	-do-
48	Pipat Tank	-do-	100	Bamnora Tank	-do-
49	Ghuwara Tank	-do-	101	Kamodpura Tank	-do-
50	Paniya Tank	-do-	102	Bandha Tank	-do-
51	Panwari Tank	-do-	103	Tula Tal	-do-
52	Bhirata	-do-			

LATER STRUCTURES FOR IRRIGATION:

The structures including tanks / ponds developed later for irrigation and other applications as reported by Water Resources Department of Chhatarpur district are as follows:

STRUCTURES BUILT FOR IRRIGATION

Block	s.no.	Name of the structure	Villages under command Area
BADA MALHARA	1	Bada Malhara tank	Bada Malhara
	2	Bandha tank	Bandha
	3	Kamodpura tank	Kamodpura
	4	Panwari tank	Panwari
	5	Phutwari tank	Phutwari
	6	Sendhpa tank	Karki, Gora, Bamnaura, Ghinochi, Ghurawali, Dogarpur, Bandhar, Deoran, Bandha, Mugawali
	7	Siddhsagar tank	Bazarpatti, Madhikhera, Phutwari
	8	Baramsagar tank	Hardaul Patti, Sapan Patti, Pura-Patti, Chek No 2
	9	Sadwa tank	Sadwa
	10	Kathan (lift irrigation)	Kayan, Khirkuwa, Nadiya, Bandha, Namroi
	11	Barkhera (lift Irrigation)	Barkhera
	12	Salaiya (lift irrigation)	Saliya
	13	Barma Nala (Regulator)	Barma
	14	Syamari (Anicut)	Rajapur, Baraj, Bada Malhara, Togra
BIJAWAR	15	Jharkuwa Tank	Jharkuwa
	16	Kasar Tank	Kasar

	17	Lampti Tank	Lampti
	18	Raieपुरा Tank	Raieपुरा
	19	Motigarh Tank	Motigarh
	20	Ragoli Tank	Ragoli
	21	Dilari Tank	Kadwara
	22	Machiyara Tank	Machiyara
	23	Brijपुरा Tank	Brijपुरा
	24	Angaur Tank	Angaur
	25	Bharatपुरा Tank	Bharatपुरा
	26	Bagaha Tank	Bharatपुरा, Jasgawa, Kishengarh, Sahrपुरा
	27	Baniयारा Tank	Angaur
	28	Kishen Sagar Tank	Bijawar
	29	Pipat Tank	Pipat
	30	Ram Sagar Tank	Kishengarh
	31	Baksoi Tank	Baksoi
	32	Adhiयारा Tank	Adhiयारा
	33	Nayatal Tank	Nayatal
	34	Daharguwa Tank	Daharguwa
BUXWAHA	35	Gakariya Tank	Gakariya, Mad Devra
	36	Gyolari Tank	Gyolari, Gadohi, Dagrai, Sanodha, Maraa, Bhatator.
	37	Kacheri (Feeder Tank)	Kacheri
	38	Padora (Anicut)	Karri
	39	Jamuniya (Anicut)	Jamuniya
	40	Mad Devra (Regulator)	Mad Devra
	41	Kacheri (Anicut)	Kacheri
CHHATARPUR	42	Bagota Tank	Bagota
	43	Matuguwa Tank	Matuguwa
	44	Boodha Tank	Kadari, Basari, Satna
	45	Raksha Purwa Tank	Raksha Purwa
	46	Tharaa Tank	Tharaa, Baraich-khera
	47	Amkhera Tank	Amkhera
	48	Gora Tank	Gora, Shyamajhor, Raja Purwa, Purwa, Baraa, Sukwa
	49	Isha Nagar Tank	Isha Nagar, Katara ka Purwa, Pahadgaon
	50	Moti Sagar Tank	Salaiya
	51	Nandgaay Tank	Nandgaay
	52	Bhirata Tank	Kiratपुरा
	53	Padariya Tank	Padariya, Raura, Basata, Dalon
	54	Pahadgaon Tank	Pahadgaon
	55	Boodha (Feeder)	
	56	Gora (Feeder)	
	57	Dhubela Tank	Mau, Tidni
	58	Silap (Anicut)	Chandora, Sikarpura, Simardha
GAURIHAR (Barigarh)	59	Manoriya Tank	Manoriya
	60	Tula Taal (Tank)	Badora Kala

LAUNDI (Lavkush nagar)	61	Gopi Taal (Tank)	Bachhon
	62	Jhinna Tank	Jhinna
	63	Giloha Tank	Giloha
	64	Bamhori Purwa (lift irrigation)	Bamhori Purwa
	65	Lohruk (Anicut)	Lohruk
	66	Kail (Anicut)	Kail
	67	Hinota (Anicut)	Hinota
	68	Sohai (Anicut)	Sohai
NOWGONG	69	Vasiya Tank	Doriya
	70	Jagat Sagar (Tank)	Mau, Tidni, Nayagaon, Nowgong
	71	Jorran (Tank)	Joran, Badagaon, Alipura
	72	Jhinjhan Tank	Jhinjhan, Sardarpur
	73	Madarka (Bandhi)	Madarka
	74	Naiguwa (Bandhi)	Naiguwa
	75	Machaa (Bandhi)	Banchhora
	76	Alipura (lift irrigation)	Alipura
	77	Dhrampura (lift irrigation)	Dharampura
	78	Vasiya (Regulator)	Doriya
	79	Khakri-Veerpura (Regulator)	Khakri-Veerpura
	80	Nawalgarh (Regulator)	Nuna
	81	Churwari Tank	Churwari, Karatha
RAJNAGAR	82	Kusumsagar Tank	Imalaha
	83	Kharrohi Tank	Kharrohi
	84	Harsagar Tank	Pahara
	85	Lakheri Tank	Lakheri
	86	Beniganj (Feeder)	
	87	Pahara (Regulator)	Pahara
	88	Pathargawa (Regulator)	Pathargawa
	89	Ratiya (Regulator)	Ratiya

Canal Schemes:			
NOWGONG		URMIL*	Bhirota, Ujra (Prithvipura), Malka, Khiri, Urdmau, KJhikmau, Dhikpura, Matodhabasin, Matodha, Chauvan, Suda, Suda-Haar, Manpura, Khirwa, Mukherra, Natuwa, Tatam, Singhpur, Baja-kheda, Dumra, Baraa, Deokaliya, Mamua, Umariya, Bamhori Bhatan, Sura, Digoni.
RAJNAGAR		RANGAWA**	Pipra, Bamari, Tikri, Peera, Surajpura, Chandranagar, Shivrajpur, Bhiyatal, Barkhera, Dhamna, Toriya, Basata, Khadkhurai, Rajpura, Dhawad, Akona, Sapoha, Pahadi Bavan, Dhavgawa, Dupariya, Imlaha, Pathargawa, Baharpura, Patan, Rajgarh.
-do-		BENISAGAR	Bamitha, Jatkara, Beniganj, Bamnora, Mau-Sahaniya, Tikri, Peera, Kharrohi, Gora, Lalgawa, Rajnagar, Khajuraho, Chitrai -Achnar, Hakimpur, Dibyapura.
<p>* URMIL: The canal is under renovation these days for raising its present irrigation capacity (2356 hectares) to additional 5336 hectares when completed.</p> <p>** RANGAWA canal is under renovation these days for raising its present irrigation capacity (3523 hectares) to additional 2955 hectares when completed.</p>			

ONGOING MINOR SCHEMES:

Latest information available regarding ongoing minor schemes towards improving existing sources of irrigation in Chhatarpur district jointly shared by centrally sponsored Bundelkhand Package is presented as follows:

ONGOING MINOR SCHEMES

s.no.	Kind of source	Name of Project	Status / Completion planned by March 2013	RABI-irrigation (Potential) (hectare)
TANKS	1	Churwari	Complete	101
	2	Nayatal	-do-	89
	3	Magrar	-do-	172
	4	Rajiya	-do-	300
	5	Dahargaon	-do-	67
	6	Didonia	-do-	227
	7	Mamon	-do-	650
	8	Pali	-do-	291
	9	Kusmad	-do-	318

	10	Agrotha	-do-	81
CANAL DIVERSION	11	Benisagar	Was to be completed by March 2013	1,350
	TOTAL			3,646

NEW MINOR SCHEMES

Kind of source	S.No..	Name of Project	Status	RABI-irrigation (Potential) (hectare)
TANKS	1	Khiriya Buzurg	Completed	794
	2	Buxwaha	Completion tentatively by March 2013	275
	3	Gonchi	-do-	247
	4	Bhelda	-do-	205
	TOTAL			1,521

PROPOSED SCHEMES:

The table below lists the proposed schemes in this district:

TABLE- PROPOSED SCHEMES

s.no.	Block	Schemes
1	Chhatarpur (Isha Nagar)	TARPER River-Medium
2	Bijawar	Junvani Tank
3	Bada Malhera	Pathaghat weir (Kharduti)
4	-do-	Gurjan Ghat Weir (Kutora)
5	Buxwaha	Lilon Tank
6	-do-	Tedu Haar
7	-do-	Belghat
8	-do-	Kishenpura

R.R.R.- SCHEMES FOR CHHATARPUR DISTRICT :

RRR schemes have been planned to rejuvenate some of the existing sources to reach its full capacity of irrigation . Most of these have been reported completed by December 2012. A brief account of these structures / storages are presented as follows:

TABLE- RRR SCHEMES

Kind of source	Name of Scheme	Actual Irrigation (hectare)	Additional Irrigation after rejuvenation	Work Completed Up to December 2012 (%)	
TANKS				Dam	Canal
1	Bharatpura	183	59	100	100
2	Thara	80	197	80	70
3	Ragoli	121	30	100	100
4	Jagat Sagar	340	83	100	100
5	Tula Tal	61	195	100	100
6	Gopital	08	37	100	100
7	Issanagar	321	137	100	100
8	Kishen Sagar	30	140	100	100
9	Angor	05	48	100	100
10	Baram Sagar	198	312	100	100
11	Baksoi	51	84	100	100
12	Sadwa	112	168	100	100
FEEDERS					
13	Boodha	0	400	100	100
14	Beniganj	1166	300	100	100
15	Kacheri	0	109		
ANICUT					
16	Parora	0	81	100	100
	TOTAL	2328	2615		

TANKS HANDED OVER TO GRAM-PANCHAYATS

There are few more smaller *Chandella*-Tanks listed below which have been handed over by Chhatarpur- Water Resources Department to GRAM-PANCHAYATS for its local management :

S.No.	Name of scheme	Block	Designed Irrigation Area (hectares)
1	Pandawa Purwa Tal	Laundi	17
2	Bansora Tal	-do-	32
3	Bhitariya Tal	-do-	20
4	Khurda Bandhi	Nowgong	28
5	Sindurki Bandhi	-do-	21
6	Pachwara Bandhi	-do-	21
7	Putarya Bandhi	-do-	18
8	Madwara Bandhi	-do-	13
9	Bilhari Bandhi	-do-	32
10	Baijnath Tal	-do-	17
11	Chaukhada Tank	-do-	26
12	Chaubara Bandhi	-do-	16
13	Matta Tal	Bijawar	28
14	Sighadi Nala Regulator	Ishanagar (CPR)	36
15	Sarani Tank	Ishanagar (CPR)	16
16	Gora Tal	Rajnagar	32
17	Nayagaon	-do-	32
18	Lalpur Tal	-do-	32
	Total (18)		437

THE SCHEMES UNDER CONSTRUCTION:

The WRD (Chhatarpur) reports two schemes presently under construction in Bada Malhera block which are as follows:

1. Devpur – II
2. Mankahari (Bilai Nala Feeder)

Another medium scale project which is under construction is the weir on Urmil river 23 km downstream the Urmil dam built by Uttar Pradesh in consultation with Madhya Pradesh. The weir which may still take some more time for its completion, is proposed to irrigate 12474 hectare of Laundi (Lavkush Nagar) *Tehsil*.

THE BARIYARPUR LEFT CANAL & KUTNI DAM:

Bariyarpur Left Canal Scheme (BLCS) was proposed long back in 1977 to utilize water which is left after supplying to Uttar Pradesh , the negotiated 2500 cusec of water per day from the storage of Bariyarpur weir on KEN river built by Govt. of Uttar Pradesh in the year 1906 during British period. The proposed area to be irrigated from this canal , when completed , was 38,990 hectare in KHARIF and 4,860 hectare during RABI season. In order to meet the deficit *KUTNI*, a tributary to **KEN** river was planned to be dammed with storage capacity of 114.53 mcm (4.04 TMC).

The scheme though initiated in 1979 could not be completed for many reasons including lack of finances. Around the year 2000-01 and later during 2010-11 the two centrally sponsored schemes including the special Bundelkhand Package , were tapped and the work progressed. Hopefully this will start functioning soon as planned .

FUTURE PLAN OF CHHATARPUR DISTRICT:

Several old tanks and other structures are presently under survey or proposed to be surveyed for increasing their capacity of irrigation . All such sources reported so far are listed below:

S.No.	Name of scheme	Block	Designed / Expected Irrigation Area (hectares)	Status
1	Churwari Tank	Nowgong	200	Survey complete
2	Nayatal Tank	Bijawar	89	-do-
3	Pathar	-do-	61	-do-
4	Dronsagar Tank	Nowgong	115	-do-
5	Govind Bandh	Bijawar	57	-do-
6	Hasora Tank	Laundi	30	Survey Proposed
7	Mudari Tank	-do-	30	-do-
8	Bhawani Purwa Tank	-do-	30	-do-
9	Mania Baberi Tank	Gaurihar	30	-do-
10	Garhi Tank	Nowgong	40	-do-
11	Lohata Tank	-do-	40	-do-
12	Duriya Tank	-do-	30	-do-
13	Binwari Tank	-do-	40	-do-
14	Maharaj sagar	Bijawar	40	-do-
15	Manna Tank	-do-	40	-do-

16	Madhkhera Tank	Bada Malhara	30	-do-
17	Makhwa Tank	-do-	40	-do-
18	Barethi Tank	-do-	40	-do-
19	Chandoli Tank	-do-	40	-do-
20	Amroth Tank	-do-	40	-do-
21	Garkhawa	-do-	40	-do-
22	Kanjhuwa Tank	-do-	30	-do-
23	Jara Tank	Buxwaha	40	-do-
24	Naiguwa Tank	Ishanagar –CPR	40	-do-
25	Kadwa Tank	-do-	40	-do-
26	Gorgawan Tank	-do-	40	-do-
27	Radhasagar Tank	-do-	40	-do-
28	Sargee Tank	-do-	30	-do-
Reference: Report of Water resource Department , Chhatarpur (2012)				

Table which follows gives names of the ***Chandella*** tanks which have been proposed to be repaired to be used as **NISTAR TANKS** and also help to raise sub-soil water level:

TABLE- NISTAR TANKS

S.No.	Name of Tank	Block
1	Maharajganj Tank	Bada-Malhara
2	Barkhera Tank	Ishanagar (CPR)
3	Panotha Tank	-do-
4	Narsingh Sagar	-do-
5	Dilariya Tank	-do-
Reference : Information provided by Water Resources Department, District Chhatarpur (MP) for up to 2012		

GROUND WATER SCENERIO:

AQUIFER SYSTEM

Northern and north-central part of the district which covers almost 65% of total area of the district is comprised of Bundelkhand- granite under a thin soil cover. The granite here is of pink colour, medium to coarse grained , very hard and compact with well developed joints. The joints are open at the surface and persist to about 20 m below land-surface. Beyond 45 m depth these are very tight , thus restricting the storage as well as movement of ground water. The granite country in the district is traversed by

quartz reef and basic dykes. These basic dykes generally occupy topographic depression whereas quartz reefs stand out as wall like structure.

The exposure of Bijawars is triangular in shape and constitute about 15% of the south eastern part of Chhatarpur district . The Vindhya's are exposed in the form of NE-SW trending strike ridges and alternating valley in the southern part of the district these occupy about 20% of the district areas represented by conglomerates , sandstone, shale and limestone in a sequence. Exposure of Deccan Trap flows are seen in the south western extremity of the district. Alluvium is restricted mainly to the area along the *KEN* and *DHASAN* rivers . On the left bank of *KEN* it has maximum thickness of 30 m and along *DHASAN* it has maximum thickness of 10 m.

Ground-water in granites occurs in joints , fracture planes and in weathered zone mostly under water table conditions and its occurrence is controlled by extent , size, and inter-connections of joints and degree of weathering which varies from place to place and under favourable conditions tube-wells having discharge of 0.5 to 7.8 l.p.s. Bijawar limestone , where Karst and well developed solution cavities are available are quite promising from ground water point of view. Vindhyan sandstone and limestone when occurring in lower deviation and having well developed joints , yield moderate amount of ground water generally below 3.0 l.p.s. The Semri limestone at places , has well developed and inter-connected solution opening and ground water occurs under confined conditions. The yield recorded in Vindhya's and Bijawar formation ranges from 1.8 l.p.s. to 9.5 l.p.s.

Ground water in Deccan Traps also occurs in weathered mantle in joints and fracture under water table conditions and can sustain the well having up to 2.0 l.p.s. discharge. Ground water in the alluvium also occurs under water table conditions. The grain size of *DHASAN* alluvium is coarser as compared to *KEN* alluvium and thus the former can sustain tube-wells having discharge up to 15-20 l.p.s. and tube wells of latter can have discharge in range of 10-15 l.p.s.

WATER-LEVELS:

Water level data , including the historical ones are essential not only for knowing present ground water conditions but also forecasting future trends in response to ground water reservoir operations. Using water level data of 26 monitoring wells of Chhatarpur district for Pre- and Post- monsoon depth to prepare water level maps are reproduced as follows:

Pre-Monsoon (May 2006) : The depth of water level was found to range from 4.6 to 14.57 mbgl.

Post Monsoon (November 2006) : During this period the water level was found to range from 2.57 to 12.55 mbgl .

Reference: District Ground Water Information Booklet (Chhatarpur District) published by Central Ground Water Board (North-Central Region) , Ministry of Water Resources (GOI).

THE DRINKING WATER RESOURCES :

Traditionally Chhatarpur district has been an area dominated by dug- wells for providing to inhabitants water for drinking and also other uses. This being a decentralized arrangement was managed by people themselves. During earlier days local land-lords used to build such resources and its maintenance had been responsibility of users only. In some isolated areas ponds too were used as drinking water sources.

Under centralized rule and governments stepping into provision of drinking water, Departments of Public Health Engineering (PHE) were created with its office at district-level which became solely responsible for looking after the water supply of towns and also rural areas . The rural set up are expected to be managed by Gram-Panchayats and / or the Development-Blocks.

There are four ways by which normal management of drinking water is expected to be done in the districts:

- 1- Improvement of existing wells,
- 2- Construction of new wells,
- 3- Installation of Hand-pumps,
- 4- The piped water supply.

Presently most villages seem to have been covered under some kind of arrangement for provision or availability of drinking water. The information available for 2008-09 and 2009-10 describes 1080 problem- villages but the villages covered under tube-well fitted with hand-pumps to be 1049 and 80 villages which have been given piped water supply.

All the towns have been given piped water supply through tube-wells or / and nearby river. An ambitious plan has recently been almost completed to bring water from *DHASAN* river to city of Chhatarpur.

INFORMATION FROM THE DISTRICT:

Regarding management of drinking water situation a recent official report from Deptt. of Public Health Engineering (Chhatarpur) covering the years 2007-08 to 2011-12 has following information to share :

TABLE- DRINKING WATER MANAGEMENT

Location.		Dug Wells	Total HP's installed	HP's installed between 2007 & 2012	Piped Water Supply (Block wise)	New Projects* (Block-wise)
Whole District		NIL	8972	1816	94	30
Blocks 1	Bada Malhera	-	1205	-	12	07
2	Bijawar	-	987	-	14	09
3	Buxwaha	-	639	-	06	00
4	Chhatarpur	-	1394	-	19	01
5	Gaurihar	-	1072	-	15	03
6	Laundi	-	1211	-	02	02
7	Nowgong	-	1061	-	10	02
8	Raj Nagar	-	1403	-	16	06
*The new projects which have been reported under progress are listed in next table.						
Reference: report from the Dept. of Public Health Engineering (Chhatarpur) 2011-12						

TABLE- NEW PROJECTS UNDER PROGRESS

s.no.	Block	Name of Scheme	No.
1	Bada Malhera	Bokna	1
		Sadwa	1
		Kayan	1
		Sedhpa	1
		Pura Budor	1
		Phutwari	1
		Garkhuwa	1

2	Bijawar	Nandgay Battan Nandgay Khurd Jharkhuwa Nagda Lakhanguwa Pipat Berkheri Raichur Chapner	1 1 1 1 1 1 1 1 1
3	Buxwaha	Nil	Nil
4	Chhatarpur (Issa Nagar)	Brijpura	1
5	Gaurihar	Mudhara Thakurra Nehra	1 1 1
6	Laundi (Lavkush Nagar)	Atkauha Laundi	1 1
7	Nowgong	Putarya Chandrapura	1 1
8	Raj Nagar	Dhunchu Kadauha Shivraj Pur Bara Chandra Nagar Pratap Pura	1 1 1 1 1 1
	GRAND TOTAL:		30

The urban water supply especially for Chhatarpur town has so far been done through drawing water from NIVARI and BOODHA ponds / reservoirs in addition to several hundreds of individually bored tube-wells within the recently developed colonies in and around the town. In Nowgong domestic supply is mainly through a temporary check on river *DHASAN*.

Presently large number of tankers have to bring water from rural tube-wells to supplement need of town-dwellers especially during summer months as local supply as well as personal bores usually fail to cater the needs . Recently public distribution of drinking water in Chhatarpur town has been planned to be linked to a check-dam on *DHASAN* river some 30 km south – west of Chhatarpur bordering Tikamgarh district. The water will have to be transported though pipe-line to overhead storage in the town linking to regular supply. But looking at the condition of *DHASAN* river, itself, during non-raining months , success of this plan has to face many questions.

2 . DAMOH

CREATED WATER RESOURCES: (TRADITIONAL AND PLANNED)

THE PONDS / TANKS:

The district does not have any natural lake. Though 300 ponds have been reported present in this district but most of them were used by villagers to meet their essential needs. Only 20 of these ponds were sometimes used for limited irrigation.. People in general for their water-needs have been dependent on rivers, streams and the wells.

Since farming in this district was basically rain-fed people did not bother about irrigation. Thus any structures including reservoirs were the last priority here. Up to 1908 irrigation was almost nil. Though droughts occurring from time to time were the factors forcing governments as well as people to plan building large reservoirs. From 1912 onwards and up to 1965 , many reservoirs were built tapping rivulets and *Nallas* . Some of the important water reservoirs created during this time, expected to irrigate more than 1000 acre of land are being presented as follows:

TABLE: IMPORTANT RESERVOIRS

S.No.	Project	Location Village/s	Year of construction	Expected Irrigation Area (acre)
1	GADAGHAT	Dhangri	1912	1,024
2	MALA	Mala & Richhai	1913-14	6,500
3	CHIRAI PANI	Chiraipani	1913	1,320
4	MAJHGAWA- HANSRAJ	Majhgawa Hansraj	1914-15	2,000
5	RICHHAI	Mala & Richhai	1918	2,000
6	BARPATI	Gori	1957	1,170
7	TEJGARH	Tejgarh	1958	8,230
8	JABERA	Jabera & Bandarkola	1958	2,250
9	MOTINALA	Patharia	1958	1,665
10	DAROLI	Daroli	1964	5,531
Reference: Madhya Pradesh Distt. Gazetteer (DAMOH) 1980				

WATER RESOURCES - FOR IRRIGATION :

A report of Water Resources Department related to Damoh district updated 2002 has following information to be shared:

TABLE- RESERVOIRS

S.No.	Block	Reservoir	Designed Capacity (mcm)	Designed irrigation Area (ha)			Actual Irrigated Area 2001-02 (ha)		
MEDIUM PROJECTS				KH	RB	total	KH	RB	total
1	Jabera	MALA	16.864	1619	1012	2631	1310	1472	2782
2		JABERA	3,431	455	455	910	112	430	542
3	Tendukheda	Tejgarh	5,718	1133	486	1619	381	567	948
4		Daroli	4,602	810	485	1295	128	486	614
SMALL PROJECTS									
1	Batiyagarh	Harat Lift Irrigation	-	202	446	648	-	170	170
2	Damoh	Patna	0.740	40	89	129	-	68	68
3		Barpati	1,658	473	-	473	25	240	265
4		Jamunia	3,688	576	233	809	-	280	280
5		Basani	0.796	85	83	168	-	80	80
6		Chiraipani	2,515	283	453	736	-	308	308
7		Chiraipani-upper	1,228	This is the feeder to Chiraipani listed above					
8		Nonpani	0.711	121	101	222	-	144	144
9		Kevlari	0.594	81	77	158	-	40	40
10		Aanu	0.823	120	45	165	-	144	144
11		Sanyasi	0.234	48	-	48	-	22	22
12		Kalapani	3,975	-	550	550	-	180	180
	Hatta	-	-	-	-	-	-	-	-
13	Jabera	Richhai	1,795	474	-	474	282	512	794
14		Baheria	0.549	82	82	164	76	40	116
15		Gadaghat	3,417	414	-	414	139	214	353
16		Hardua Sadak	0.176	-	40	40	-	26	26
17		Hardua Mudar	1.599	77	113	190	-	120	120
18		Pipariya Jugraj	0.430	121	99	220	82	85	167
19		Jalehri Dhana	0.946	163	116	279	104	106	210
20		Bhat Khamariya	0.422	85	36	121	34	10	44
21		Paudi	3.129	202	445	647	-	322	322
22		Hardua Paudi	2.050	360	125	485	64	144	208
23		Kalreva	1.274	153	126	279	-	90	90
24		Singrapur Regulator	-	304	-	304	The Nallah has stopped flowing		
25		Jamnera	1.279	194	134	328	172	232	404
26		Bhajiya	8,288	670	710	1380	78	544	622

27	Patera	Kulua	0.552	142	-	142	97	80	177
28		Patna (Sagoni)	0.286	51	51	102	05	60	65
29		Chhoti Devri	0.725	263	-	263	77	176	253
30		Majhguwa Vill.	0.187	61	-	61	-	40	40
31		Majhgawa Hansraj	3,850	810	202	1012	260	340	600
32		Motinala	1.696	178	267	445	155	160	315
33		Bilguwa	0.184	40	-	40	24	24	48
34		Datia	2.447	267	243	510	-	107	107
35		Gadaghata sagoni	0.710	80	61	141	74	70	144
36		Khamariya Bagsari	1.479	181	114	295	64	80	144
37		Gudri	4.855	405	324	729	-	240	240
38		Tirgarh	2.077	243	97	340	-	20	20
	Pathariya	-	-	-	-	-	-	-	-
39	Tendukheda	Muhra	0.475	109	-	109	42	41	83
40		Jhalon	0.437	93	-	93	-	-	-
41		Beldhana	2.809	221	394	615	22	111	133
42		Chandan Harrai	0.832	210	-	210	-	32	32
43		Jharoli Nallah	-	101	61	162	-	-	-
44		Dhangaur	1.279	200	119	319	129	162	291
45		Basi Chikhli	2.360	323	110	433	-	61	61
46		Hardua Panji	0.311	31	25	56	-	20	20
Reference: Report from Executive Engineer, Water Resource Dept., Damoh (1999 & 2002)									

THE SCHEMES UNDER CONSTRUCTION:
(situation : 2008)

S.No.	Block	Scheme	Designed Irrigation Potential (ha)	Remarks Expected Completion by:
1	Damoh	PANDA Reservoir	357	December 2008
2		PAYAS Flood Control Scheme	-	June 2009
3		JAGTHAR Weir	75	June 2009
4		DIGSAR Weir	125	March 2009
5		KAKARA weir	100	March 2009
6	Jabera	KALUMAR reservoir	127	December 2008
7		BANDARKOLA Reservoir	47	December 2008
8		GADHA Reservoir	98	March 2009
9		MANGRAI Reservoir	130	June 2009
10		PATI MAHARAJ SINGH reservoir	118	March 2009

11		GHANA MAILI reservoir	126	June 2009
12	Pathariya	CHAUPRA reservoir	162	December 2008
13		MADIYA-SATPARA Causeway-weir	80	June 2009
14		NEGUWA causeway- weir	75	March 2009
15	Tendukheda	PONDI-JAITGARH reservoir	203	December 2008
16		LALPANI reservoir	233	-do-
17		SHIVLAL KHAMARIYA Causeway-cum-weir	268	June 2009
18		SEHRI causeway- cum-weir	270	March 2009
	TOTAL		2594	
Ref: Report from Executive Engineer, WRD- Damoh (2008)				

**PROPOSED SCHEMES
(situation 2008)**

S.No.	Block	Scheme	Designed Irrigation potential (ha)	Remarks Expected Completion by:
1	Damoh	Rajnagar Drinking water-cum-Irrigation	486	June 2011
2		Parasia Weir	110	March 2009
3		Bari causeway cum weir	125	March 2009
4		Balakote	275	June 2010
5		Shishpur Pati reservoir	128	June 2010

6	Jabera	Sunvarah reservoir	140	June 2009
7		Karariya reservoir	450	-do-
8		Hardua-Pipariya reservoir	320	-do-
9		Singrampur reservoir	328	December 2009
10		Boodha-Gubra reservoir	283	-do-
11		Parna Reservoir	1280	June 2011
12		Sakha Reservoir	408	June 2011
13		Jujhar causeway-cum-weir	125	March 2009
14	Tendukheda	Mohar Patti reservoir	144	June 2009
15		Ambahi Reservoir	419	June 2011
16		Gahara Nala Reservoir	301	June 2010
	Total:		8759	
Ref: Report from Executive Engineer, WRD Damoh (2008)				

THE DRINKING WATER SITUATION:

As in other parts of *Bundelkhand* , masonry wells had been major traditional sources of drinking water in Damoh district also. While the drinking water supply depended upon tanks and wells at Damoh and river *sonar* at Hatta, the rural drinking water arrangement in past had been through the masonry wells only. Respective *Gram Panchayat* or the *Janpad Panchayat* (Development Blocks) was assigned responsibility of building new wells or renovating old structures. Later India Mark-II hand-pumps became popular although their erection, operation and maintenance was not that simple as traditional masonry wells in a villages. A report from Public health Engineering office of Damoh (updated 2008) gives following information.

1. Hand-pumps in running condition : 7091

2. Hand-pumps installed from December 2003 to August 2008 : 1317

The Piped Water Supply Schemes planned and executed till 2008 are given as follows:

TABLE- PIPED WATER SUPPLY SCHEMES

(ANJPY = avardhan nal-jal praday yojna; NJPY= nal-jal praday yojna)

<u>S.No.</u>	<u>Block</u>	<u>Location</u>	<u>Scheme</u>	<u>Remarks</u>
1	Batiyagarh	Kerban	Kerban ANJPY	completed
2		Phutera Kala	Phutera-kala ANJPY	-do-
3	Damoh	Bandakpur	Bandakpur NJPY.	-do-
4		Devri	Devri NJPY	-do-
5		Chaupara Khurd	Chaupra Khurd NJPY	-do-
6		Bilai	Bilai NJPY	-do-
7		Imlai	Imlai NJPY	-do-
8		Balarpur	Bal;arpur NJPY	-do-
9		Vanvar	Vanvar ANJPY	-do-
10	Hatta	Hinauti	Hinauti NJPY	-do-
11		Khamargaur	Khamargaur NJPY	-do-
12		Majhguwa	Majhguwa NJPY	-do-
13		Bhainsa	Bhainsa NJPY	-do-
14		Muharai	Muhrai NJPY	-do-
15		Bhiloni	Bhiloni NJPY	-do-
16		Rajpura	Rajpura NJPY	-do-
17	Jabera	Madankheda	Madankheda NJPY	-do-
18		Patloni	Patloni NJPY	-do-
19		Tejgarh	Tejgarh ANJPY	-do-
20		Nohta	Nohta ANJPY	-do-

21	Patera	Kudai	Kudai NJPY	-do-
22		Deodogra	Deodogra NJPY	-do-
23	Pathariya	Bilani	Bilani NJPY	-do-
24	Tendukheda	Sarra	Sarra Avardhan	-do-
25		Jhalon -Guhchi	Jhalon Guhchi (punarikshit)	-do-
26		Taradehi	Taradehi ANJPY	-do-
27		Khamariya Maujilal	Khamariya Maujilal- NJPY	-do-
28		Harai Singorgarh	Harai Singorgarh NJPY	-do-
29		Jamunia	Jamunia Sultan NJPY	-do-
30		Chaupra Chaubisa	Chaupra Chaubisa NJPY	-do-
31		Mehra	Mehra NJPY	-do-
Reference: Report from Executive Engineer (PHE) Damoh (2008)				

PROJECTS UNDER CNSTRUCTION

S.No.	Block	Number	Villages benefitted
1	Batiyagarh	03	Khaderi, Gugra Kala,Ghooghas
2	Damoh	10	Balakot, Hirdepur, Imalia, Baansa Kala, Aanu, Raiyatvari - Aam Chopra , Erora, Mudiya, Basatarkheda, Bandakpur.
3	Hatta	04	Kanti, Pateriya, Alampur, Bhatiya.
4	Jabera	01	Jalehri
5	Patera	00	-
6	Pathariya	03	Nandrai, Narsingharh, Lakhroni
7	Tendukheda	04	Pura, Bijadogri,Kulua, Dhangaur
TOTAL		25	

3 . PANNA

CREATED WATER RESOURCES: (TRADITIONAL AND PLANNED)

THE LAKES AND PONDS:

People believe that Panna town is situated where at one time there was a huge lake, Whatever it might be , the ruling dynasty of *BUNDELAS* constructed number of big-sized tanks which were almost like lakes, serving even today as sources for drinking water as well as the irrigation. Some such tanks are listed below

1. *Dharma-Sagar:*

This tank is situated at high rise over Panna town wherefrom water is taken to feed the drinking water supply. In spite of this fact, two things look disturbing : 1. people are not advised not to use detergents and soaps while bathing and washing there, and 2. the same place has been used as burning *ghat* and remains extremely dirty all around.

2. *Nirpat Sagar:*

This is the main tank from where drinking water is supplied to Panna town. Situated far from the town, this used to be quite clean. Depth of the Lake is 102-104 feet during rainy months while water recedes in other seasons. During summers only 10% water remains in the reservoir. The only problems which was felt during our visit that the lake is used for fish-rearing . This results into water of lake turning dirty and filthy and unfit for drinking purpose especially during dry season.

3. *Kamala Sagar:*

Kamala Sagar is a big tank which has been normally used for fish-rearing.

4. *Lok Pal Sagar:*

This tank is also one of the suppliers of drinking water to the city. In addition to it, this is used for fisheries as well as irrigation purpose.

In addition to above, there are many more tanks in Panna as well as other places which are used for irrigation. Some of them are also being developed to serve for drinking water supply to towns and villages.

DAMS & WEIRS:

There is one dam of significance near Devendra Nagar town which is known as **Devendra Nagar dam**. A century old weir known as **Bariarpur Barrage** on river *KEN* is also located in this district ; both are discussed below:

Devendra Nagar Dam:

Built to serve for irrigation in 1968, Devendranagar Dam gets water from numerous streams including *SATNE* river. Some Technical details of Devendra Nagar dam are as follows:

DEVENDRA NAGAR DAM	
Sources; Catchment area Length of the dam Maximum height; Total storage capacity	Seasonal streams and <i>satne</i> river 36.91 sq. km. 426.72 metre 15.62 metre 10.88 Million cubic metre
Reference: Noted from the Dam-site	

BARIARPUR WEIR:

Built by obstructing river *KEN* during 1900-1905 **Bariarpur weir** was built essentially to irrigate the agricultural area of Banda through Ken-canal system but since the reservoir was located in this district, benefit of recharging of ground water reserve naturally was to Panna district. On the basis of a later agreement of MP with UP, water share of Madhya Pradesh is being planned to feed a canal being built by M.P.- Irrigation Department known as **Bariarpur Left Bank Canal** for irrigating land of Chhatarpur district. Salient features of **Bariarpur reservoir** are as follows.

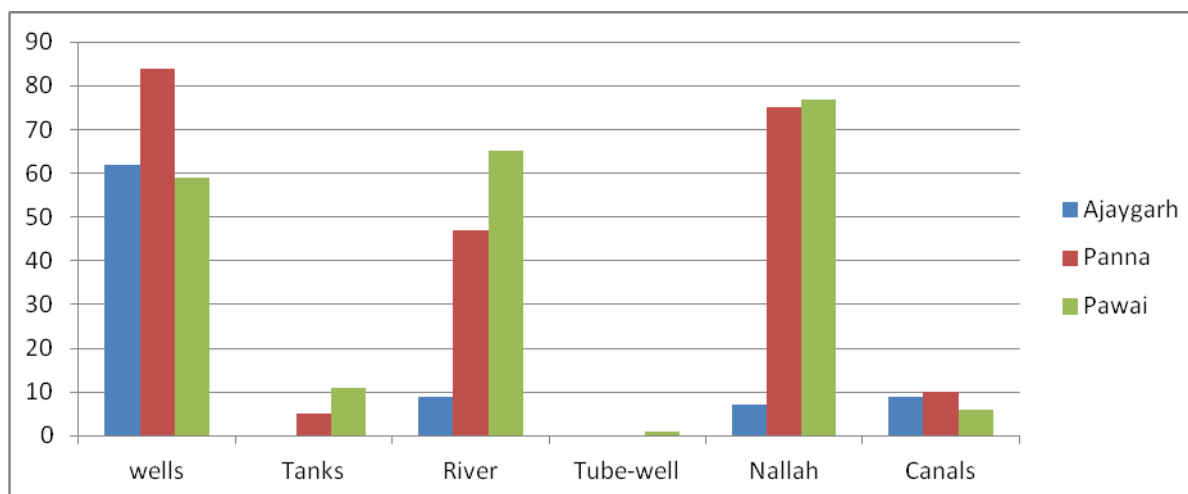
BARIARPUR WEIR	
Name of Reservoir: Sources: Catchment area: Total Storage Capacity:	Bariarpur Weir Ken River 20760 km ² 12.59 million cubic metre
Note : Above figures have been taken from site and are related to the time it was built	

IRRIGATION RESOURCES :

Panna being basically a forest-dominated tract and its non-forest area having a poor soil-base, agriculture was limited although rural population far exceeded the urban population in all previous census-surveys. The situation of irrigation as reported in the census handbook (1981) could be taken as the situation up to 1980's. Following table and graphs may help to understand the situation:

TABLE - IRRIGATION IN PANNA DISTRICT
Source wise coverage (Situation : 1980)

TEHSIL	Wells	Tank	River	Tube-well	Nallah	Canals
Ajay Garh	62	0	09	0	07	09
Panna	84	05	47	0	75	10
Pawai	59	11	65	01	77	06
Total	205	16	121	01	159	25
Out of 527 Irrigated villages	21.65%	1.69%	12.78%	0.11%	16.79%	2.64%
Source: District Census handbook –Panna- Part XIII-A (1981)						



Since formation of M.P. state in 1956, some consistent efforts have been made in Panna district to raise its irrigation potential and thus to popularize agriculture. The data of 1994-95 reveals that out of total sown area of 2,38,534 ha, irrigated area was 41,916 ha i.e only 17.6% . Irrigation of cultivated area has enlarged since then and all available means like masonry wells, ponds and tanks, canal-system taken out from some of the

dams and lakes, using stop dams especially built for the purpose, lift irrigation projects, watershed development projects and sprinklers are used whichever wherever possible.

Our previous report on *Bundelkhand* included information on lift-irrigation schemes including sprinklers used during the year 1995. Recent report, however, does not touch this aspect. But, I am sure, these may have multiplied several times by now.

Previous data as recorded during 1995 is being presented here as some basic information in this regard:

TABLE- LIFT IRRIGATION AND SPRINKLERS ETC.

S.No.	Dev. Block	Source River/Nalla	Location	Benefeciaries	Area to be Irrigated (ha)
1	Ajaygarh	<i>RANJ</i>	Sukwaha	60	51.63
2		<i>-do-</i>	Rajapur	63	49.41
3		<i>NALA</i>	Ranipur	23	30.93
4		<i>BAIRAHA</i>	Majhgawa	16	25.45
5		<i>KUDIAN</i>	Gararian- Purwa	25	40.65
6		<i>BILOO</i>	Nayagaon	28	39.63
7		<i>NALA</i>	Kalyanpur	35	32.73
8		<i>KEN</i>	Mudwari	70	44.19
9	Gunnaur	<i>GURMA</i>	Hijaura	29	28.44
10		<i>SOHJANI</i>	Matia	42	56.51
11	Panna	<i>KEN</i>	Latwara	29	04.00
12		<i>ITAWAN</i>	Itawan khas	17	29.60
13		<i>BAGHEIN</i>	Lohrai	27	31.30
14	Pawai	<i>KUDLI</i>	Bagha	26	23.28
15		<i>-do-</i>	Narayanpur	18	23.18
16	Shah Nagar	<i>KEN</i>	Pipariya	57	52.17
Reference: Information provided by Agriculture Department, Panna (1995) as quoted in PROBLEMS AND POTENTIALS OF BUNDELKHAND WITH SPECIAL REFERENCE TO WATER RESOURCE BASE by B.Prakash, Santosh Satya, S.N.Ghosh & LP Chaurasia : published by IIT/ Delhi with Vigyan Shiksha Kendra, Atarra (Banda) in 1998					

NATIONAL WATERSHED AREA DEVELOPMENT:

No information has recently been provided on above aspect. The report up to 1995, however, mentions following projects having been taken up then under the National Watershed Development Program:

TABLE- WORK DONE UNDER NWDP

S.No.	Dev. Block	Project	Villages Involved	Area Covered (ha)
1	Ajaygarh	KUDIAN	08	1778
2	Gunnaur	PIPARWAHA	07	2804
3	Panna	SAWAIGANJ	07	1952
4	Pawai	BARAJ NALA	08	2,236
5	Shah Nagar	ARTHA NALA	06	7,019
Reference: Problems-----Resources Base by B.Prakash et al (1998) as mentioned in last table				

DEVELOPMENT DURING PAST TEN YEARS:

Huge investment on developing irrigation potential has been reported during this period (2003 to 2012) . The support to these schemes / projects has been managed from State Government of Madhya Pradesh as well as the Central Government under various programs and special packages:

Following tables give some useful information:

TABLE- A : SMALL IRRIGATION SCHEMES / PROJECTS

(In Working Order : Situation 2008)

Vidhan-Sabha Conditue ncy	S.No.	Project	Area under Irrigation				
			Designed For Area (ha)	Actual Irrigated Area (ha)			
				2003-04	2004-05	2005-06	2006-07
PANNA	1	Lokpal sagar (T)	520	350	410	240	160
	2	Dube Taal (T)	40	40	40	20	35
	3	Brijpur Talaab (T)	60	40	30	27	0
	4	Sunehra Talaab (T)	52	30	20	15	10
	5	Adhar Sagar (T)	272	117	174	160	33
	6	Rampura Talaab (T)	314	160	205	162	60

	7	Haatupur Talaab(T)	260	150	150	185	0
	8	Januhai Tallab (T)	176	145	165	120	20
	9	Bhawanipur Talaab	260	218	230	290	50
	10	Mutwa Talaab (T)	160	60	110	100	45
	11	Badagaon Weir	160	23	0	0	0
	12	Sawaiganj Weir	220	0	63	0	05
	13	Rajapur Weir	200	50	22	25	15
	14	Rani Tal (T)	56	18	20	20	0
	15	Pokhra Diversion	138	0	0	0	0
	16	Tironi Anicut	80	0	0	0	0
	17	Vimataha Weir	80	0	0	0	0
	18	Singhpur Lift – Irrigation	250	0	55	0	0
	19	Bhapatpur Tank	220	90	100	110	0
	20	Katra Talaab (T)	180	150	110	105	130
	21	Padraha Tank	220	135	140	90	0
TOTAL			3,919	1776	2044	1669	573
AMAN GANJ	1	Barachh Tank	600	300	260	310	173
	2	Vikrampur Tank	120	52	55	55	10
	3	Kohni Weir	80	0	0	0	0
	4	Ranipur Weir	100	26	18	15	0
	5	Kakarahati Weir	80	20	10	08	0
	6	Dwari Weir	120	0	0	15	0
	7	Cheepa Weir	60	0	0	0	0
	8	Niwari Weir	100	0	0	0	0
	9	Pawaiya Talaab	81	0	06	02	04
	10	Kakarhai Talaab	120	65	75	78	75
	11	Sungaraha Raja Taalaab	60	18	07	12	10
	12	Bamuraha Diversion	200	0	0	0	0
	13	Mitari Diversion	120	0	0	0	0
	14	Jamuniya Diversion	180	0	0	0	0
	15	Koha Talaab	60	45	50	53	60
	16	Kakarhai Lift Irrigation Scheme.	465	0	0	0	0
TOTAL			2546	526	481	548	332

PAWAI	1	Karahi Tank	1040	280	300	305	210
	2	Chhiraha Tank	248	89	140	138	0
	3	Kunwarpur Tank	56	25	30	35	30
	4	Khamariya Tank	60	24	08	10	0
	5	Umari Tank	60	18	32	35	40
	6	Jhilmila Lift I.S.	540	6	0	0	0
	7	Kuwa Tal (T)	72	49	75	56	80
	8	Puraina Lift I.S.	340	0	0	0	0
	9	Patori Tank	48	35	60	15	18
	10	Sungraha Tank-1	46	35	60	15	18
	11	Sungraha Tank-2	40	35	50	15	12
	12	KEN- Anicut	600	25	50	0	15
	13	Umehi Anicut	120	0	20	0	15
	14	Bora Nala Tank	140	50	75	30	40
	15	Khairo Tank	60	39	45	10	10
	16	Raipura-Babawari Tank	56	32	15	38	35
	17	Raiya Sata Tank	52	35	32	32	40
	18	Bada Gaon Tank	95	65	105	85	110
	19	Amdar Tank	260	90	190	105	190
	20	Amaha Tank	646	256	415	395	300
	21	Hardua Lift I.S.	363	0	0	0	0
TOTAL			4942	1201	1702	1364	1146
Reference: Report from Executive Engineer, Water Resources' Department, Panna (2008)							

TABLE-B : SCHEMES/ PROJECTS UNDER CONSTRUCTION
(Status : May 2008)

S. No.	Development Block	Project	Designed Capacity (ha)	Completion deadline	remarks
1	Ajaygarh	Pata Tank	104	June 2010	No progress – forest land involved
2		Udaipur Lift I.S.	255	June 2009	Under Progress
3	Panna	Tal Gaon Tank	400	June 2010	Cancelled as it encroaches Panna Tiger reserve
4	Pawai	Mudwari Lift I.S.	405	Aug. 2009	Under Progress
5		Simra Tank	164	Dec. 2009	-do-
6		Shiv sagar Tank	57	March 2009	-do-

7	.	Amaha Canal Extn	252	Aug 2008	-do-
8	Shah Nagar	Dewra Tank -1	96	Dec 2008	-do-
9		Rangoli Tank	243	Dec 2009	Not started till then
10		Lipri Tank	1251	June 2010	Under Progress
11		Sata Tank	68	May 2009	-do-
12		Shyamgiri Tank	1'00	March 2009	-do-
13		Rampur tank	59	June 2010	Work Stalled because of no forest clearance
Reference: Report from Executive Engineer, Water Resources' Department, Panna (2008)					

Table-C : PROJECTS UNDER NREGS
(Status on 25th June 2008)

S.No.	Block	Project	Gram-Panchayat	Status
1	PANNA	Jharkua Tank Improvement	Jharkua	Progressing
2		Khaptaha Weir-cum-Stop-dam	Khaptaha	-do-
3		Badwara Weir-cum-Stop-dam	Badwara	-do-
4		Ramkhiriya Weir-cum-Stp-dam	Ramkhiriya	-do-
5		Hardu Ghat Weir-cum-Stop-Dam	Tilgawa	-do-
6		Dahlan Chowki Weir-cum-Stop-Dam	Dahlan	-do-
7		Diya Weir-cum-Stop-Dam	Diya	-do-
8		Kudiya-Nala Stop-Dam	Purushottampur	Yet to Start
9	GUNNAUR	Majhgawa S. Sto-Dam-Causeway	Majhgawa	Under Progressing
10		Barha Kala Weir	Barha Kala	-do-
11		Khabra Stop-Dam-Causeway	Sathaniya	-do-
12		Maheba Tank Extension	Maheba	-do-
13		Girwara Tank	Girwara	-do-
14	PAWAI	Khairi Stop-Dam	Padwar	-do-
15		Mehdighat Stop-Dam	Gadhi-Karahia	-do-
16		Danwara Tank	Danwara	-do-
17		Umaria Tank	Murachh	-do-
18	SHAH NAGAR	Roopjhir Stop-dam-causeway (S.D.C.)	Roopjhir	-do-
19		Shakti Ghat S.D.C.	Mulpara	-do-
20		Weir on Aloni river	Paraswara	-do-
21		Shyamarghat Stop-Dam	Simri	-do-
22		Kishunpatan Stop-Dam	Mankora	-do-
23		Paroha Tank Extn.	Roopjhir	-do-

24		Shaktighat Adhrad Stop-Dam	Adhrad	-do-
25		Amgawa Stop-Ddam	Raipura	-do-
26		Chargawa Ghat Stop-Dam	-do-	-do-
27		Tullaghat Stop-Dam	Maldhan	-do-
28		Koha Dol Stop-Dam	Beerampur	-do-
29		Raipura Tank -Deepening	Raipura	-do-
30		Ganga Mai Tank Improvement	Baghrod	-do-
31		Hathkuri Stop-Dam	Hathkuri	Yet to Start
32	AJAY GARH	Bhujwai Weir (Survey)	Pratappur	Progressing
33		Bhairaha Weir (Survey)	Bhairaha	-do-
34		Gidraha PC (Survey)	Gidraha	-do-
35		Ichaulia Weir (Survey)	Rajapur	-do-
36		Amarchhi Weir (Survey)	Amarchhi	-do-
37		Udaipur Stop-Dam –cum- RAPTA	Uday pur	-do-
38		Tisai Nala Weir	Khora	-do-
39		Nandanpur Weir Survey	Nandanpur	DPR Ready
Reference: Report from Water Resources' Department, Panna (2008)				

TABLE-D : APPROVED PROJECTS UNDER B.G.R.F.
(Status 25th June 2008)

S.No.	Block	Project	Gram Panchayat	Status
1	PAWAI	Hirapur-Rajapur Causeway-cum-Stop-Dam	Puraina	Under Progress
2		Kharhar Ghat Stop Dam on PATNE river	Murachh	Under Process
3		Budheda Stop-Dam –Causeway	Budheda	-do-
4		Amghart Stop-Dam (on Vyarma Nala)	Hardua-Vyarma	-do-
5	SHAH NAGAR	Puraina Stop-Dam –Causeway (Between Puraina and Hardua on KEN river	Heerapur	Under Progress
Reference: Report from Water Resources' Department, Panna (2008)				

Above tables give list of many weirs and stop-dams whose analysis reveals that most of these have not benefitted villages for which they were planned and area designed.

RESOURCES BEING DEVELOPED UNDER SPECIAL *BUNDELKHAND* - PACKAGE:

In addition to many ponds created during past, large number of such storages and irrigation schemes have been planned to be modified , developed and renovated by M.P. Water Resources Department under the Special *Bundelkhand* - Package provided by Central Government for *Bundelkhand* region. Following is the list of such projects in Panna district:

TABLE-PROJECTS UNDER *BUNDELKHAND* - PACKAGE

S.No.	Block	Name of the project	Planned Irrigation Capacity (ha)
PROJECTS UNDER CONSTRUCTION			
1	Shah Nagar	Jugarwara Tank	158
2		Lipri Tank	1,679
3		Sata Tank	96
4		Bharra Tank	80
5	Shah Nagar	Baghwar Kala	229
NEW PROJECTS UNDER CONSTRUCTION			
1	Panna	Ramkhiriya Tank	117
2		Janakpur Tank	157
3		Girwara Tank	83
4		Bhilsai Tank	350
5		Diya Tank	252
6		Padadi-Khera Tank	600
7		Sakariya Tank	380
8		Bahari Tank	374
9		Barar Nala (Mokachh)	182
10	Ajaigarh	Sabdua Tank	189
11		Bilahi Tank	139
12	Ajaigarh	Gumanganj Tank	113
13		Barahepur Tank	269
14		Pati Tank	354
15	Shah Nagar	Gajanda Tank	132
16		Raipur Tank	397
TOTAL			4088

PROJECTS UNDER R.R.R. SCHEME			
1	Panna	Rajapur Weir	200
2		Bhawanipur Tank	330
3	Panna	Sunahara Tank	40
4		Rampura Tank	314
5	Gunnaur	Dwari Weir	120
6		Sawai Ganj Weir	220
7		Kakarhati Weir	80
8	Panna	Badagaon Weir	108
9	-do-	Barachh Tank	170
10	-do-	Mutwa Tank	72
11	Ajaigarh	Katra Tank	138
12		Adhar Sagar Tank	158
13	Gunnaur	Bamuraha Diversion	200
14	Shah Nagar	Jamuniya Diversion	120
15	Gunnaur	Bhitari Diversion	180
16		Nivari Weir	100
17		Cheepa weir	80
18	Pawai	Karahi Tank	1,040
19		Amaha Tank	646
20		KEN-Anicut	600
21		Umehi Anicut	120
22		Amdar Tank	98
23		Padraha Tank	220
24		Pokhra Diversion	139
25		Vimtaha weir	80
26	Ajaygarh	Tarauni Anicut	80
27	-do-	Bhapatpur Tank	125
Total			5,778. ha
Reference: Report from Executive Engineer –WRD-Panna 2012 (MP)			

MULTIPURPOSE IRRIGATION SCHEMES :

According to a document published by Department of Water Resources, Madhya Pradesh a few years ago describes Panna district to *have* only 58 small schemes of irrigation having total irrigation capacity of 13767 ha. till then. During past years four major multipurpose schemes had been approved by the government with a potential of irrigation of another 69,979 ha and some electricity generation. Available information regarding the aforesaid four schemes is presented here in two tables as follows:

TABLE-A : SPECIAL SCHEMES

S.No.	Name of the Scheme	Block to be benefitted	Source of water	Catchment Area	Planned Area of Irrigation
1	Pawai Multi-Purpose Project	Shah Nagar	KEN river	995 km ²	30,365 ha
2	MIRHASAN-Diversion Multi-purpose Project:	Gunnaur	MIRHASAN river	913 km ²	11,571 ha
3	Bhitri-Mutmuru Medium Irrigation Project	Gunnaur	GURNE river	296 km ²	10,000 ha
4	PATNE – Multi-purpose Project	Pawai	PATNE River	1,410 km ²	18,000 ha
TOTAL AREA PLANNED TO BE IRRIGATED : 69,979 ha					

TABLE –B

S.No.	Particulars	Pawai Multi-Purpose Project	MIRHASAN-Diversion Project:	Bhitri-Mutmuru Irrigation Project	PATNE – Multi-purpose Project	Remarks
1	Location (village)	Padariya	Hinauti	-		
2	River involved	KEN	MIRHASAN	GURNE	PATNE	
3	<u>Dam-details</u> <u>PAKKA</u> Length (metre): Height (metre) <u>KACHCHA</u> Length (metre) Height (metre)	915.31 33.53 699.91 -	100 - 500 -	150 28 1,400 -	1,500 30 - -	
4	Catchment Area (km ²)	995	913	292	1,410	
5	Total Storage (MCM)	252.81	n.a.	88	-	
6	<u>Canal Details</u> Left Bank Canal: Length (km): Right Bank Canal Length (km)	34 67	14 11	Main Canal: 40 km	-	
7	<u>Irrigation Area</u> (ha) KHARIF: RABI::	12,000 18,365	7,000 5,571	2,025 7,975	7,200 10,800	
8	<u>Submerged Area</u> (ha) Normal Land: Forest Land:	2907.04 546.96	n.a.	325 325	240 730	

9	Affected Villages	27	n.a.	04	-	
10	Villages to benefit: No. (Block)	136 (Pawai,Shah Nagar, Gunnaur) 45 (Pawai)	28 (Gunnaur)	82 (Gunnaur)	37 (Pawai)	Irrigation will be through a weir on <i>Patne</i> river 8km from this dam
Reference: Reference: NAI UMMEEDON KA SAFAR: Panna Zile Me : (WRD, MP, Bhopal)						

The available information for 2012 in this aspect is given as follows:

TABLE - BLOCK-WISE MASONRY WELLS AND TUBE-WELLS
(Contribution to Irrigation)

S.No.	Block	Masonry Wells		Tube-wells.	
		No.	Area Irrigated	No.	Area Irrigated
1	Ajaygarh	9,586	3,053	251	320
2	Gunnaur	1,187	6,554	528	715
3	Panna	2,570	6,490	547	680
4	Pawai	1,187	3,565	346	575
5	Shah Nagar	1,715	1,565	445	520
TOTAL		16,245	21,227	2,117	2,810
Source: Report from WRD (Panna) 2012					

TABLE - SOURCE-WISE IRRIGATED AREA

S.No.	Sources	2012
		Irrigated Area (ha)
1	Canals	6,326
2	Tanks	1,074
3	Masonry Wells	21,227
4	Tube-wells	2,810
5	Others	61,950
TOTAL		93387
Source: Report from Executive Engineer WRD (Panna) 2012		

From above tables it is quite clear that higher investment on sinking tube-wells , laying canals and building tanks for the purpose of irrigation does not qualify as economically sound alternatives. Out of the total area the contribution of masonry

wells is still larger than any single source (ca.23 %) . The maximum area under irrigation sources termed as others has not been specified.

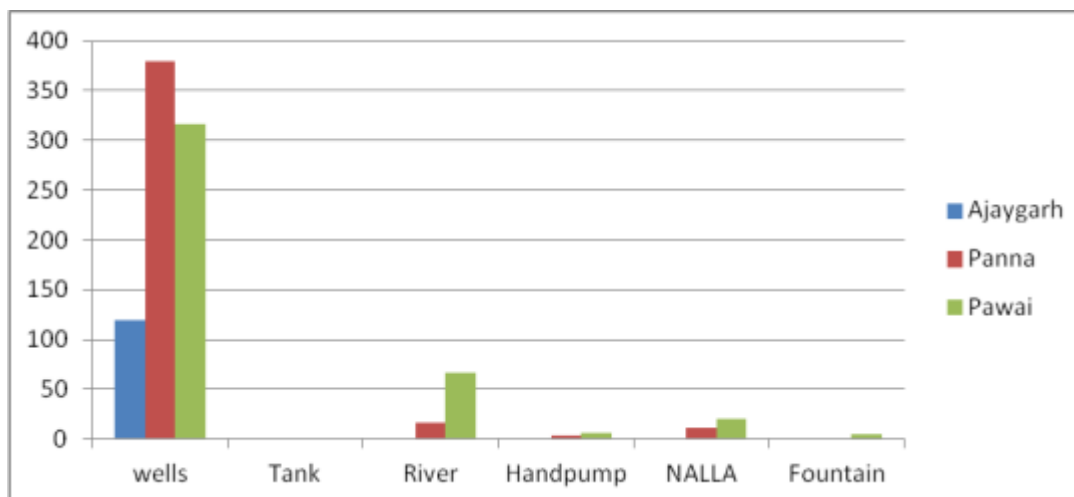
THE DRINKING WATER SITUATION:

Water , for drinking as well as all domestic purpose, used to be managed by villagers from number of masonry wells built within the villages. An account of sources for drinking water has been given in district's census-handbook (1981) . Situation up to that time was as follows:

**TABLE:DRINKING WATER MANAGEMENT
SOURCE WISE DEPENDENCE OF VILLAGES
(situation: 1980)**

TEHSIL	WELL	TANK	RIVER	HAND-PUMP	NALLA	FOUNTAIN
Ajaygarh	119	0	0	0	0	0
Panna	380	01	16	04	11	01
Pawai	316	01	67	06	20	05
Total	815	02	83	10	31	06
Out Of 1047	77.84%	0.19%	7.93%	0.96%	2.96%	0.57%

Source : District Census Handbook of Panna , Part XIII-A (1981)



Above table and graph show that almost 78% of villages in the district dependent on the masonry wells which were cheaper to be built and simpler to be managed by villagers themselves. Dependence over tanks or the Handpumps at that time was very minimal. Only a small number of villages depended upon nearby rivers and the *Nallas* up to that period.

The most problematic area reported then was the Pawai - Shahnagar region, more specially the Kalda-(Parasmania Pathar) area where water seepage being difficult, did not allow ground-water reserves. The geophysical nature of this region normally did not promote borings of tube-wells etc. Thus installation of India MK II hand-pumps promoted by Deptt. of Public Health Engineering till 1996 had by and large benefited Panna, Gunnaur and Ajaigarh areas only. In our previous report (published during 1998) figures regarding hand-pumps and piped water supply are as follows:

1. **4,053 Hand-pumps mainly covering Ajaygarh, Gunnaur and Panna blocks ,**
2. **27 villages and 6 towns were provided piped water supply with help of two surface water storages and 31 ground water sources.**

LATER SITUATION :

The love towards non-sustainable and dependence- enhancing technologies continued to be used by the State Public Health Engineering Departments in each district. Changes did occur during past 15 years. All five blocks ,today, are covered by installed hand-pumps ; piped water supply has also been extended to many of the villages. A recent report from Department of Public Health Engineering (2012) gives following information regarding management of drinking water in this district:

TABLE- DRINKING WATER MANAGEMENT

S.No.	Block	Hand-pumps	Piped Water Supply	
			working	In progress
1	Ajaygarh	1,415	07	05
2	Gunnaur	2,163	12	16
3	Panna	1,772	16	11
4	Pawai	1,751	10	04
5	Shah Nagar	1,605	11	02
Total		8,706	56	38

YEAR WISE BREAK UP OF INSTALLED HAND-PUMPS:

Year	Hand-pumps
2007-08	6565
2008-09	6663
2009-10	7282
2010-11	7965
2011-12	8429

Source: Report from Dept. of Public Health Engineering (Panna) 2012

-----..

4 . SAGAR

CREATED WATER RESOURCES:

(TRADITIONAL AND PLANNED)

Like in other parts of *Bundelkhand* ponds in villages had been very common here too. Masonry wells , however, were the most important sources for people's day to day life. Ponds were also the reservoirs of surface water collected from rains which served people for their normal use. Masonry wells as well as the ponds were part of people's cultural life, thus these were highly regarded by people in rural as well as urban areas.

WATER RESOURCES FOR IRRIGATION:

Farmers in Sagar district mostly followed / practiced dry-land farming and irrigation was confined to sugarcane and the garden crops. Masonry wells were common and popular means of irrigation too. Like in other districts, embankment on the fields were regarded helpful in raising *RABI*-crops in this district also but masonry wells had become popular because of these being within control of farmers individually. During 1864-65 total no. of such wells were 3,190 which irrigated ca. 2,310 ha land forming 90% of the total irrigated area of the year. Tanks were used to irrigate some land in some places only. In 1894-95 twenty three tanks were reported to have been used for irrigation.

SAGAR-SAROJ published in 1922 (edited by R.B. Hiralal Ishwardas , the then deputy Commissioner of Narsinghpur) and the District Gazetteer of Sagar published in 1970 give following historical information :

Around 1922 maximum irrigation was in 8000 acres (ca. 3238 ha) mainly done through 2000 masonry and 1500 *katchcha* wells. The water used to be drawn through traditional *MOTE* and *RAHAT* (the Persian Wheel). Up to that time ca. 200 tanks which existed had no role in irrigation. The area under irrigation by different sources during 10 selected years between 1915-16 and 1960-61 are given below in order to see the gradual changes in irrigated cultivation :

TABLE- SOURCE WISE IRRIGATED AREA

Year	Irrigation Sources (Area shown in acres)					
	Canal	Tank	Well	others	Total	% of the total cultivated area
1915-16	-	216	6,632	378	7,226	0.73
1920-21	-	379	7,067	423	7,869	0.86
1925-26	885		6,514	453	7,852	0.86
1930-31	1,843		7,231	340	9,414	1.04
1935-36	2,658		5,140	392	8,190	0.91
1940-41	6,045		3,205	590	9,480	1.01
1945-46	5,142		4,376	472	9,990	1.00
1950-51	3,295	389	7,452	392	11,448	1.20
1955-56	3,777	337	8,526	480	13,120	1.21
1960-61	4,301	325	9,281	585	14,492	1.48
Note: During the years 1925-26 to 1945-46 area irrigated through canals & tanks are combined.						

Looking at above table one can draw a conclusion that irrigation was badly neglected during British period up to 1947. In fact , long-stretched famines around the end of

19th and beginning of the 20th century forced administration think seriously of creating sources which could minimize people's miseries.

Based on recommendations of the Famine Commission (1898) , Irrigation Commission was constituted which planned various projects for this district. But work in the initial years of 20th century was confined only up to surveys and planning.

The six schemes which were designed during that time are listed as follows:

TABLE- DESIGNED SCHEMES FOR IRRIGATION THROUGH PONDS

S.No.	Scheme	Tehsil	Capacity (million cft.)	Average Irrigation Potential (acre)
1	GADOLA	Khurai	44.80	400
2	TEELA	Sagar	84.42	947
3	RAJWAR BADHONA	Sagar	103.59	1,137
4	GULAI LOHARA	Khurai	28.33	289
5	KHWAJA KHEDI	Khurai	43.29	405
6	PAGARA	Sagar	42.29	477
Reference: Sagar District Gazetteer (Hindi) published in 1970				

The first project, however, which was completed in 1916 was the Narayanpur Pond having a dam of 3,750 feet with maximum height of 37.6 feet. The catchment area of this pond was 2.3 square mile , it had 2.57 mile long canal with command area nearly 382 acres. In 1921 work on Chandiya reservoir in Bandaa tehsil was taken up . In the year 1924 Ratona Pond was completed and by 1926 Narayanpura and Chandia tanks were also ready for use. But overall work on irrigation schemes moved at snail's speed and was almost neglected.

By 1928 all the new projects were thrown in cold storage. Need of creating artificial irrigation sources was felt again during the World War when raising food-production was started as a campaign. Following steps were taken in order to fulfill this need:

1. Construction of new masonry wells and repair of old ones was promoted through TACCABI credit to farmers at subsidized interest.
2. Construction of smaller ponds at subsidized TACCABI credit . On meeting all terms and conditions of the credit farmers were promised half debt as a grant.
3. Village level planning of damming ponds and small drainages (NALLAS),
4. Building major Irrigation projects made responsibility of the Public Works Department (PWD) ,

5. Purchase of Persian wheel at subsidized TACCABI credit. 25% of it was made a grant on fifth year.
6. Purchase of pumping sets was financed through TACCABI credit.

There is further reference of construction of some projects like ZINDA-regulator (year 1950) , Gangasagar Tank (year 1950), Bhipel regulator (year: 1952) , but with initiation of the Community Development Program in 1951, irrigation became an important constituent of agriculture development measures. On 14th October 1958 , a new Department of Minor-Irrigation was created under the Executive Engineer (Irrigation) .This expedited the process and from 1958 onwards following projects were gradually completed mostly during 2nd Five Year Plan and also later.

TABLE- IRRIGATION PROJECTS

S.No.	Project	Tehsil	Proposed Irrigation (acre)
1	Tigoda Anicut	Bandaa	360
2	Bandaa Regulator	-do-	160
3	Sagar-Lake Regulator	Sagar	150
4	Khodi Simariya	Rehli	100
5	Parasari Anicut	-do-	400
6	Bhorai Nala Anicut	-do-	400
7	Sanodha Regulator	Sagar	100
8	Rasulla Anicut	Khurai	60
9	Khimlasa Anicut	-do-	400
10	Noona Nala Regulator	Rehli	100
11	Simariya Nala Regulator	-do-	100
12	Sagar Nala Regulator	-do-	100
13	Mokiya Nala Regulator	-do-	100
Reference: Sagar District Gazetteer (Hindi) published in 1970			

SOME OTHER PROJECTS WORTH - MENTIONING

S.No.	Project	Block	Proposed Irrigation (acre)
1	Amarmau Regulator	Shahgarh	04
2	Barayatha Tank	Shahgarh	142

In addition to above, work on other ca. 15 projects were planned during the 3rd Five Year Plan (1961-66). These were Khairana, Lidhora, Dhanora, Bilhera & Papet regulators and Bhojpur, Dharda, Tyora, Vinayaka, Baroda, Papariya, Basari, Kukrera & Tigra projects. In 1969 Bhanhari Tank was completed which became operative during 1970.

BILA RIVER PROJECT:

This was the biggest irrigation project of Sagar . A dam was erected on *BILA* River near Dulchipur village. Height of this dam was designed to be 32 metres , length of earthen wall being 404 metres and *pacca* wall being 181 metres with a catchment area of 148 km² . The total availability of water for this dam as estimated was 760 lakh cubic metres. This *BILA*- reservoir situated at north-east of Sagar was planned for irrigate 12,257 ha of which 4,332 ha was to be in Sagar district, the rest in Chhatarpur district.

FURTHER DEVELOPMENT:

SITUATION DURING SEVENTIES AND EIGHTIES:

Reports available for the above mentioned period refer to number of projects having been undertaken and completed to augment irrigation potential of Sagar district. Such projects are listed as follows:

TABLE- PROJECTS UNDERTAKEN

S.No.	Year of Completion	Project	Dev. Block	Proposed Irrigation (ha)
1	1960	Rasula Anicut	Khurai	24
2	1963	Tigoda Tank	Shahgarh	121
3	1967	Garhula Tank	Khurai	121
4	-do-	Teopra Tank	-do-	89
5	-do-	Basari Tank	-do-	51
6	-do-	Khimlasa Tank	-do-	162
7	1969	Bhanhari Tank	Sagar	145
8	1970	Binaika Tank	Bandaa	68

9	1973	Bila Reservoir	Shahgarh	4332
10	1974	Malthone Tank	Malthone	149
11	1974	Bandari Tank	-do-	121
12	1977	Dattapura Lift Irrig. Scheme(LIS)	Rehli	243
13	1980	Surkhi Tank	Sagar	419
14	1985	Mansoorvari Tank	Deori	1801
15	1987	Mala Tank	Khurai	182
16	1988	Sanodha LIS	Sagar	243
17	1988	Vijaipura LIS	Rehli	152
18	1988	Imaliya LIS	-do-	162
19	1988	Bichhia LIS	-do-	243
20	1990	Girhani Tank	Khurai	182
21	1990	Silarpur Tank	Khurai	182
22	1990	Indora Tank	Shahgarh	109
TOTAL				9,301
Reference: Irrigation Division 1, and 2 (Sagar) - Report 1996				

SITUATION DURING NINETIES:

According to the reports from Irrigation Divisions No. 1 and 2 (Sagar) following projects were further added enhancing the capacity of district's irrigation potential:

S.No.	Year of Completion	Project	Dev. Block	Proposed Irrigation (ha)	Actual Irrigation (ha) (1995-96)
1	1991	Naya Kheda	Sagar	59	20
2	1991	Bachhlon Tank	Sagar	243	20
3	1991	Padrai Tank	Jayceenagar	198	-
4	1991	Hirapur Tank	-do-	313	15
5	1992	Chhewala Tank	Deori	242	304
6	1992	Machhariya Tank	-do-	556	232
7	1992	Tora Tank	Kesli	136	45
8	1993	Devalchauri LIS	Jayceenagar	344	28
TOTAL				2,091	664
Reference: Report of Irrigation Division No.1 and 2 (SAGAR) 1996					

LATER SITUATION:

The two Irrigation divisions of Sagar planned and executed large number of projects to augment irrigation potential of the district. Report available in the beginning of 2009 lists these projects under three heads:

- Large Projects
- Medium projects
- Small projects

Following is the list of all such projects reported in the aforesaid reference:

TABLE- IRRIGATION PROJECTS

IRRIGATION DIVISION SAGAR –NO. 1				IRRIGATION DIVISION SAGAR –NO. 2			
Project Type	S.No.	Project	Designed Irrigation (ha)	Project Type	s.no.	Project	Designed Irrigation (ha)
WORKING SOURCES OF IRRIGATION							
LARGE		Nil	Nil	LARGE		nil	nil
MEDIUM	<u>Reservoir</u>	Mansoorwari	1,801	MEDIUM	<u>Reservoir</u>	BILA-	4332
SMALL	1	Ratona	121	SMALL	1	Basari	51
	2	Bhauhari	145		2	Tevra	69
	3	Naya Kheda	59		3	Mala	182
	4	Bachhlone	243		4	Maheri	131
	5	Surkhi	419		5	Bandari	149
	6	Padrai	198		6	Malthone	149
	7	Hirapur	313		7	Gadhaula	121
	8	Chhevla	243		8	Chandiya	1214
	9	Machhariya	559		9	Narayan pura	155
	10	Tada	136		10	Barayatha	142
	11	Khirana	295		11	Tigoda	121
	12	Mahuakheda	200		12	Indaura	109
	13	Madhaiya Gaud	121		13	Hinauta khar Mau	248
	14	Jhiriya	440		14	Gugra khurd	152
	15	Gangasagar	138		15	Binaika	68
	<u>L.I.S.</u>				16	Bamnora	81
	16	Sanodha	243				
	17	Deval chauri	344		17	Kirat Sagar	113
	18	Vijaipur	162		18	Ram-tauriya	101
	19	Imiliya	162		19	Paniya	73
	20	Bichhiya	243		20	Dalipura	73
	21	Dattapura	243		21	Ghuwara	101

	<u>REULATOR</u> 22	Bhapel	45		<u>LIS</u> 22	Girhari	182
	23	Sagara	36		23	Silarpur	182
	24	Bhorai Nala	138		24	Baraudiya	283
	25	Sagar Lake	61		25	Sookhanal a	202
	<u>ANICUT</u> 26	Parasari	162		<u>REGULA TOR</u> 26	Khimlasa	162
TOTAL			7,267		27	Amarmau	04
PROJECTS UNDER CONSTRUCTION (2008 Situation) <u>Block Wise</u>					28	Rasulla	25
LARGE		nil	nil		<u>ANICUT</u> 29	Tigoda	145
MEDIUM		nil	nil	TOTAL			9121
SMALL	<u>WEIR</u> 1	RAHATGARH Bhaisa	160	PROJECTS UNDER CONSTRUCTION BLOCK WISE (2008 Situation)			
	2	Dhana	160	SMALL	<u>L.I.S.</u> 1	BINA Pahlejpur	385
	3	Dhoha	180		2	Hansalkhe di	180
	4	SAGAR Bhauhari	180		3	KHURAI Hinauta	160
	5	Ghureta	175		<u>RESERV OIR</u> 4	Kansia	138
	6	JAICEENAGAR Khajuriya	140		5	BINA Belai	42
	7	Bakhra Weir	160		6	MALTHONE Agasiras	130
	8	Karaiya	140		7	Dabdera	138
	9	REHLI Simariya	120		8	Chanari	153
	10	Mahuna	102		9	Parsone	121
	11	Khaikheda	100		10	SHAHGARH Aparchandia	1368
	12	<u>KESLI</u> Roje Ghat	121		11	BANDAA Kwayala	239
	13	<u>DEORI</u> Belghat	158		12	Manjala	500
	<u>RESERVOIRS</u> 14	<u>SAGAR</u> Pagara	105		13	Chakeri Binaika	240
	15	Gadoli	380		14	Khajra	167
	16	Badauna	260		15	Sona Nala	338
	17	Mokalpur	163		16	Dhaboli	240

	18	<u>REHLI</u> Tinsimarpani	1057		17	Babir Matiya	1368
	19	<u>KESLI</u> Kishenpur	309		18	Sagari	110
	20	Bamhari	324		19	Jagthar	188
	21	<u>DEORI</u> Satdhara	2112	TOTAL			6205
TOTAL			6607	SURVEYED PROJECTS (Status: 2008)			
APPROVED PROJECTS (SMALL)					RESERVOI RS		
S.No.	Block	Project	Proposed Irrigation (ha)		1	BINA Deval	244
1	JAYCEE NAGAR	<u>RESERVOIRS:</u> Tikari	1760		2	B. MALHARA (Chhatar pur) Bagajmata	118
2		Sookha Nala	482		L.I.S.		
3	DEORI	Samnapur	2320		1	BANDAA Doma	795
4		Bilhari	671				
5		Beerbharaka	165		RIVER- SCHEME		
6		Dongar Salaiya	99		1	Laanch	2185
7	KESLI	Soorajpura	2774	TOTAL			3342
8		Jolanpur	275	Reference: Report from Executive Enginner, WRD- Irrigation Division No. 1 and No. 2. (2009)			
9		Karaiya	201				
10	REHLI	<u>WEIR</u> Hardua	145				
TOTAL			8892				
In addition to above 20 small projects in Sagar (14),Rahatgarh (1), Jayceenagar (1) and Rehli (4)- blocks with proposed irrigation potential of 3328 ha were reported to have been surveyed till that time.							

THE DRINKING - WATER SITUATION:

Sagar district traditionally had been fully dependent on masonry wells for its drinking water needs. The well-laid Vindhya and Trap-rocks normally resist the seepage to ground water and therefore, wells generally get dry during summer season. Up to 1970 tube-wells were not recommended at all. Some fractured zones of lime-stones were, however, located which promised reasonably good amount of ground-water but the drinking water supply schemes to the towns were mainly dependent on rivers, reservoirs, stop-dams on local streams and the wells (which gave sufficient water discharge). Later efforts to put up India MK (II) hand-pumps in towns and villages were made which in due course of time became the mainstream for drinking water management.

By 2008 at least 9,033 hand-pumps were installed in Sagar district of which 8,720 were in working order. In addition nearly 236 piped water supply schemes were in operation. Block wise distribution of these sources is as follows :

TABLE- DRINKING WATER MANAGEMENT

S.No.	Development Block	No. of Piped Water Supply Schemes (working)	Schemes under Progress
1	Bandaa	22	16
2	Bina	11	07
3	Deori	13	08
4	Jayceenagar	26	07
5	Kesli	20	08
6	Khurai	08	02
7	Malthone	08	01
8	Rahat Garh	37	02
9	Rehli	34	33
10	Sagar	44	10
11	Shahgarh	13	00
	Total :	236	94
Reference: Report from Public Health Engineering Deptt. District Office, Sagar (2009)			

5 . TIKAMGARH

CREATED WATER RESOURCES

(TRADITIONAL AND PLANNED)

THE *BAVARIES* , LAKES AND TANKS :

In *Bundelkhand* districts ***bavaries*** (masonry wells with steps up to the water level) had been popular constructions meant for drinking water and also for general purpose. Tikamgarh district has been particularly rich in lakes and tanks, probably having largest number of lakes and tanks within *Bundelkhand* . The settlement records, as referred to in District Gazetteer of Tikamgarh (1995), mention construction of 962 tanks during the *CHANDELLA* –period , most of them being small with low bunds. Out of these 125 tanks were used for tank-bed cultivation also.

The number of tanks over the years have now reduced to 421. However, several tanks are of considerable size particularly those at Baldeogarh , Bambaouri Barana , Lidhaura, Jatara, and Bir Sagar etc. All these tanks, constructed adjacent to temples, palaces, and favorite resorts of the rulers , originally were not meant for irrigation. The basic purpose these reservoirs served was to maintain water-wealth for any seasonal emergencies and water- table of masonry wells used extensively as drinking water sources and for limited irrigation in villages. Their conscious adoption for irrigation has been a modern development.

Diwan Pratipal Singh in the first of twelve volumes of his famous book “ *Bundelkhand Ka Itihaas* (History of *Bundelkhand*) ” has given a list of eight important large size tanks in erstwhile state of Orchha which is what we have Tikamgarh district presently. These are:

1. **Baldeogarh Tal:** at Baldeogarh town ($24^{\circ}46'$ N, $79^{\circ}07'$ E)
2. **Lidhaura Tal:** at Lidhaura village ($25^{\circ}05'$ N, north of Ratangaon village ($25^{\circ}02'$ N, $78^{\circ}52'$ E) $78^{\circ}55'$ E)
3. **Bir Sagar Tal:** an extensive lake situated at village Bir Sagar ($25^{\circ}12'$ N, $78^{\circ}45'$ E) constructed by Maharaja Bir Singh Deo.
4. **Arjar Tal :** situated near Arjar village ($25^{\circ}18'$ N, $78^{\circ}53'$ E)
5. **Yajnya sagar :** situated at Vindpura village ($25^{\circ}13'$ N, $78^{\circ}48'$ E) ; Local tradition has it that Maharaja Janmejaya of Pandhavas' dynasty performed his great sacrificial Yagnya.

-
6. **Nandanwara Tal**, near : Ratangaon village ($25^{\circ} 02'N, 78^{\circ} 52' E$)
 7. **Madan Sagar** : . at Jatara town ($25^{\circ} 01' N, 79^{\circ} 06' E$) , said to had been constructed by king Madan Varman (1129-63 AD) of the *Chandella*- dynasty.and
 8. **Jeron Tal** : at Jeron village of present Prithvipur Block ($25^{\circ} 07' N, 78^{\circ} 44' E$)

Some other historically important tanks of significance are listed below:

1. MAHENDRA SAGAR
2. PADMA SAGAR
3. DIP SAGAR :
4. NAGDA SAGAR:
5. SANERA TANK, and
6. SINDUR SAGAR

As mentioned earlier this district has even now large number of tanks especially meant for irrigation .

IRRIGATION RESOURCES:

Like all other *Bundelkhand*-districts, Tikamgarh, has been dependent mostly on masonry wells for its essential irrigation. The usual means of drawing water from these wells had been the MOTH (leather-bucket/rope) and Persian Wheel both powered by a pair of bullocks. With changing times these means were gradually replaced by the diesel / electrical pump-sets. The use of machines, however, resulted into waste of water and ultimately contributed to fast receding of water table of the wells. Presence of many lakes and tanks, however, gave this district a great potential of canal irrigation. Most of the lakes and tanks described earlier were used for irrigation. That gave rise to several canal systems including Kuriyala and Nagda canals.

Around 1995 , when we first studied this district comprising of about 869 villages had 995 tanks . Of these at least 49 tanks had occupied area more than 40 hectare each. Ownership of these tanks had been resting with different departments, namely the Forest (9), Agriculture. (10), Irrigation (88), Panchayat (211), and the Revenue Deptt. (35). The rest were private or general-use tanks spread over the villages. Active tanks which were fully or partially used for irrigation around that period are listed block wise in following table:

TABLE- TANKS USED FOR IRRIGATION

S.No.	BLOCK	Tank used for irrigation	Potential of irrigation (acre)	Remarks
1	Baldeogarh	Tuharra , Besa Gukhrai Brishbhanpur Hata Surajpur Hirapur Babar Ramsagra Gaiti Guna	50 35 60 70 50 30 45 40 45 35 55	Out of total 14 only 11 tanks had been used for irrigation
2	Jatara	Mitha Tal Gaur Tal Toriya Tal Raghnath Tal Bharguwa Tal	- - - - -	Out of 33, only five had been used for irrigation
3	Niwari	Ladwari Kalua Neemkhera Astari Kuthar Purailiya Sadikpura Salooki (2 tanks) Dudhni Ladpar Lathesra & Pathari Maharajpura Janauli	20 10 20 20 10 10 20 10 15 10 20 10 Maharajpura Janauli	Only 14 tanks were used for irrigation
4	Palera	Kudwara Gajadhar Tal Sumera Majhguwa Lidhaura Tal	130 120 110 120 100	Out of 18 , thirteen are smaller Tanks irrigating less than 50 acres.
5	Prithvipur	Nandanwara <u>Others:</u> Chamra Tal Sane Talaiya Kakawani		1-Nandanwara used to irrigate 4495 hectare (11107.15 acre) but the miners have de-shaped it badly..

		Amroomata Purainiya		2-Both Salera Tanks have been damaged 3- Kandhari Tank is also in bad shape
6	Tikamgarh	Girora Tal Majna Bamhauri- Nakiban Purainiya	45 03 20 20	Six of the tanks within Tikamgarh town have either been flattened or misused)
Reference: Above information has been taken from : “PROBLEMS AND POTENTIALS OF BUNDEL - KHAND WITH SPECIAL REFERENCE TO WATER RESOURCE BASE “ by B.Prakash,Santosh Satya,S.N.Ghosh & L.P.Chaurasia ; IIT Delhi & Vigyan Shiksha Kendra ,Banda (1998)				

A study of tanks in Niwari Block of Tikamgarh district conducted by Dr. Krishna Gandhi & Dr. Sunanda Kirtane for SPWD in the years 1998-99 reports at least 67 tanks in 34 villages of that block which itself is indicator of popular tank-culture in this district . Each village has one or more tanks which are mostly used for essential needs of people. Some of them are meant for irrigation also . Following 6 tanks were reported to be under management of Irrigation Department of Madhya Pradesh during the years of study :

TABLE- TANKS UNDER IRRIGATION DEPTT (M.P.)

S.No.	Tank	Village	Area of Submergence (acre)	Water lasts for months	Remarks
1	Ghooghsi (bigger Tank)	Ghooghsi	50	10	Usually drying before summer season
2	Sindur Sagar	Kudar	385	12	Storage could be increased
3	Ladpura Tal	Ladpura	100	10	Needed better management
4	Niwari (Big Tank)	Niwari	100	10	Rain-water- incoming obstructed
5	Sakuli Tal	Sakuli	20	9	Insufficient incoming of rain- water, Jagatiya Nala needed to be properly linked.
6	Arjun Sagar	Tehraka	475	12	Insufficient incoming of rain- water
Reference: Survey of Bundelkhand Tanks : Dr. RK Gandhi & Dr. S. Kirtane (Study sponsored by SPWD- New Delhi)					

TANKS/ PONDS CREATED / DEVELOPED / RENNOVATED :

Since 1951 there have been conscious efforts to expand irrigation through tanks, ponds and lakes and construction as well as renovation of old water bodies was done. **NAGDA SAGAR** in Tikamgarh Tehsil has been reported to be the largest in this district. Other tanks constructed were : **THAGATORE TANK** , **CHITA NALLA TANK**, and **TEHRAKA TANK**. In the year 1961 tanks irrigating more than 100 acres each , were 65. Some of the larger tanks renovated were **NANDANWARA TANK**, **DHARAM SAGAR TANK**, **MADANSAGAR TANK** , **PADMA SAGAR TANK**, and **GWAL SAGAR TANK** besides other smaller ones.

LATEST REPORT:

Report from Irrigation Department of Tikamgarh district lists most of the tanks of this district which are used for irrigation. Following is the information drawn from the 2008-09 report as mentioned above:

TABLE- THE TANKS USED FOR IRRIGATION

S.No.	Type of Scheme	Source / Project	Development Block	Designed for area to be irrigated (ha)
	<u>Large Scale</u>	NIL	-	-
1	<u>Madium Scale</u>	Jamni Canal		2,429.00
2	-do-	Rajendra Sagar Tank		3.036.00
3	-do-	Nandanwara Tank		1,819.00
1	<u>Small Scale</u>	<u>TANK</u> Acharra	Jatara	72
2	-do-	Baharu	-do-	235
3	-do-	Barana Bamhauri	-do-	708
4	-do-	Bairki Nala	-do-	45
5	-do-	Bairwar	-do-	41
6	-do-	Bilwari	-do-	76
7	-do-	Brishbhanpura	-do-	186
8	-do-	Chanderi	-do-	146
9	-do-	Chaturkari	-do-	46
10	-do-	Chita Nalla	-do-	190

11	-do-	Dargaay Kala	-do-	57
12	-do-	Dargaay Khurd	-do-	116
13	-do-	Digaara	-do-	93
14	-do-	Dushiyara	-do-	96
15	-do-	Gidvasan	-do-	118
16	-do-	Kiratvari	-do-	127
17	-do-	Kumhaidi	-do-	504
18	-do-	Madan Sagar	-do-	973
19	-do-	Mohangarh	-do-	557
20	-do-	Padma Sagar	-do-	652
21	-do-	Pateria	-do-	93
22	-do-	Futera	-do-	135
23	-do-	Samdua	-do-	78
24	-do-	Shahpur	-do-	41
25	-do-	Tudiyara	-do-	61
26	-do-	Kharo	-do-	53
27	-do-	Atrar	Palera	64
28	-do-	Bandka Murraha	-do-	97
29	-do-	Chhutki	-do-	72
30	-do-	Morpariya	-do-	64
31	-do-	Dharam sagar	-do-	1984
32	-do-	Ghoora	-do-	304
33	-do-	Kandwa	-do-	56
34	-do-	Para (Palera)	-do-	55
35	-do-	Palera	-do-	89
36	-do-	Futera	-do-	123
37	-do-	Purainiya	-do-	134
38	-do-	Ram Nagar	-do-	81
39	-do-	Ram sagar	-do-	77
40	-do-	Erora	Baldeogarh	146
41	-do-	Balwantpura	-do-	101
42	-do-	Chanderi	-do-	69
43	-do-	Chhidari	-do-	73
44	-do-	Dadgaay	-do-	55
45	-do-	Deri	-do-	214
46	-do-	Dhanera	-do-	93
47	-do-	Khodera	-do-	547
48	-do-	Kotra	-do-	77
49	-do-	Kudiyal	-do-	53
50	-do-	Matol	-do-	153
51	-do-	Sarkanpur	-do-	424
52	-do-	Dudian Khera	-do-	455
53	-do-	Gwal Sagar	-do-	1757

54	-do-	Nandan sagar	-do-	1232
55	-do-	Madrakha	-do-	73
56	-do-	Rani Tal	-do-	114
57	-do-	Ratan Sagar	-do-	95
58	-do-	Vindhyvasini	-do-	214
59	-do-	Aston	Tikamgarh	72
60	-do-	Belatal	-do-	74
61	-do-	Bhitarwar	-do-	71
62	-do-	Chhotatal	-do-	46
63	-do-	Deep Sagar	-do-	210
64	-do-	Dikoli	-do-	43
65	-do-	Hanuman sagar	-do-	81
66	-do-	Hanumatpura	-do-	65
67	-do-	Hira Nagar	-do-	54
68	-do-	Jhinguwa	-do-	41
69	-do-	Lakhera	-do-	113
70	-do-	Laar	-do-	104
71	-do-	Mahendra Sagar	-do-	275
72	-do-	Mamon	-do-	59
73	-do-	Nanhi Tehri	-do-	80
74	-do-	Para (Tikamgarh)	-do-	44
75	-do-	Pokhna	-do-	255
76	-do-	Prem Sagar	-do-	61
77	-do-	Raira	-do-	82
78	-do-	Rigora	-do-	510
79	-do-	Sidhkhad	-do-	362
80	-do-	Sunera	-do-	49
81	-do-	Upat Sagar	-do-	233
82	-do-	Hira Nagar Vijay	-do-	41
83	-do-	Arjun Sagar	?	1113
84	-do-	Atarra	Prithvipur	81
85	-do-	Darretha	-do-	79
86	-do-	Dumduma	-do-	69
87	-do-	Jeron	-do-	104
88	-do-	Simra	-do-	65
89	-do-	Veer Sagar	-do-	607
90	-do-	Ghooghsi	Newari	55
91	-do-	Ladpura	-do-	54
92	-do-	Ladwari	-do-	82
93	-do-	Bhajal	-do-	92
94	-do-	Newari	-do-	202
95	-do-	Sakooli	-do-	64
96	-do-	Sindur Sagar	-do-	652

97	-do-	<u>REGULATOR</u> Bijravan	Jatara	142
98	-do-	Imlana	Baldeogarh	101
99	-do-	Jamrar River	Tikamgarh	121
100	-do-	Kuwarpura	-do-	51
101	-do-	Bhelsi	-do-	81
102	-do-	Putri Khera	?	41
103	-do-	<u>STOP DAM</u> Chirol Ghat	Jatara	81
104	-do-	Keshav Garh	-do-	81
105	-do-	Narosa Nalla	Baldeogarh	141
106	-do-	<u>LIFT IRRIGATION</u> Hanauta	Jatara	440
107	-do-	Keshav Garh	-do-	140
108	-do-	Maalpidha	-do-	178
109	-do-	Pithnaura	-do-	890
110	-do-	Manikpura	Tikamgarh	848
111	-do-	Mokhra	-do-	376
112	-do-	Sujara	-do-	971
113	-do-	<u>WEIR</u> Jamrar	Tikamgarh	121
	TOTAL	Designed Irrigation Area		33078.00 ha
Reference: Report from District Office of Irrigation Deptt. (Tikamgarh) 2008-09				

OTHER PROJECTS AND THEIR STATUS (2008)

S.No.	Block	Project/ Scheme	Proposed Irrigation Capacity (ha)	Status
1	Baldeogarh	Jarua Tank	613.36	Approved
2	Jatara	Kariyapatha Tank	700.00	-do-
STOP-DAM –CUM-RAPATA				
3	Jatara	Amghat	170	Survey Completed
4		Bhawarghat	175	-do-
5		Gorghat	180	-do-
6		Tapariyan Village	180	-do-
7		At confluence of sajnam and jamni Rivers	180	-do-

8		Near Mastapur Chungi Village- approach Road	175	-do-
9		Near Mastapur	180	-do-
10		On Mohangarh- Ekbalpura Road	140	-do-
11		Kaim Ghat	170	-do-
12		Chautaraha Ghat, below Hatauna Lift	190	-do-
13		Daudara above Ghooghta Ghat	120	-do-
14		Nagju Ghat	120	-do-
15	Prithvipur	Rongtaghat	200	Approved
16		Neemghat	150	Survey Completed
17		Gursaya Ghat	180	-do-
18		Majra-Kachhar	170	-do-
19		On Bhelsi-Virdha approach road	170	-do-
20		Sanvara Ghat	180	-do-
21		Digwar Kala	180	-do-
RENOVATION OF TANK				
22		Veer Sagar Tank	607	-do-
23	Tikamgarh	Lahar Tank	438	Approved
24		Bagajmata Tank	1050	-do-
STOP-DAM –CUM-RAPATA				
25		Harpura Ghat	200	Survey Completed
26		Shoodan Ghat	160	-do-
27		Gopal Ghat	140	-do-
28		Vanpurya Ghat	140	-do-
29		Renua Ghat	160	-do-
30		Near Ram Nagar Nayakhera	120	-do-
31		Mau Ghat	130	-do-
32		Sindwa Ghat	180	-do-
<p>Note: According to report all these must have been completed within one or two years after 2008.</p> <p>Since latest reports were not available nothing positive can be said presently.</p>				
Reference: Report from District Office of Irrigation Deptt. (Tikamgarh) 2008-09				

DRINKING WATER SITUATION:

Tikamgarh has been a tradition-bound area where masonry wells, tanks, and perennial streams formed the basic lifeline as far as water is concerned. The tanks or lakes here seek their origin to the *CHANDELLA & BUNDELA* kings who were extremely fond of building large tanks with stone boulders arranged as masonry wall (without using any binder or cement like material) to hold large quantities of water. Basic contribution of these reservoirs was to maintain water level in the masonry wells of villages which served inhabitants by providing safe drinking water and also for all other domestic usage. Maintaining these wells was responsibility of people and there had never been a problem.

Department of Public Health Engineering (PHE) as per Govt.'s policy and officers' technical training started planning rural water supply also on the lines of usual urban water supply. They promoted installing India-Mark II hand-pumps all over without any scientific planning. This led to many hand-pumps being failed and abandoned.

The piped water supply or installation of hand pumps were not within means of villagers and since they were not involved at planning or installation stages, all these sources for them became outsiders which were neglected and largely misused.

RURAL DRINKING WATER SUPPLY:

EARLIER SITUATION:

The records available up to 1995, mention working of 38 rural drinking water supply schemes through piped water supply. These were looked after by Gram-Panchayats. According to the 1991 census report all the inhabited 818 villages had been provided at least one source of drinking water. The problem villages till that time were known to be 760, all of these were reported covered providing them at least one drinking water-source. Up to December 1995, 2,849 of the total 3,437 hand-pumps were in working order.

Masonry wells had been totally neglected and also no efforts were done to create a situation so that water table of these wells or the ground water is maintained. In fact failure of hand-pumps and later the tube-wells occurred only because of this lapse.

PRESENT SITUATION :

Report received from Dept. of Public Health Engineering office at Tikamgarh for the years up to 2007-08 gives following information:

TABLE- MANAGEMENT OF DRINKING WATER

S.No.	Year	Construction of masonry wells	Installation of hand-pumps	Total Hand-pumps installed till 2008	Number of working Hand-pumps
1	2003-04	NIL	371	-	-
2	2004-05	NIL	476	-	-
3	2005-06	NIL	505	-	-
4	2006-07	NIL	572	-	-
5	2007-08	NIL	582	-	-
	Total:	NIL	2506	8,678	7433
Reference : Report from Executive Engineer – PHE division, Tikamgarh (2008-09)					

TABLE- BLOCK WISE SITUATION OF HAND-PUMPS

S.No.	Block	Inhabited Villages	Installed Hand-pumps	Working	Non-working	Cause of failure		Villages where water was to be transported
						Technical + others	Water Table	
1	Baldeogarh	151	1426	1284	142	51	91	64
2	Jatara	171	1905	1665	240	93	147	63
3	Niwari	123	1257	983	274	119	155	45
4	Palera	135	1261	1073	188	49	139	48
5	Prithvapur	130	1392	1179	213	94	119	54
6	Tikamgarh	155	1437	1249	188	121	67	46
	Total	865	8678	7433	1245	527	718	320
Reference: Reference: Report from Executive Engineer, PHE , Tikamgarh (2008-09)								

TABLE- PIPED WATER SUPPLY

S.No.	Block	Piped Water Supply (working)		Schemes Under Construction 2009 situation	
		NO.	AT	NO.	AT
1	Baldeogarh	08	Bhelsi, Devardha, Hata, Deri, Vanpura Khurd, Ganeshpura, Farakka Pathrai, Guna	01	Kudila

2	Jatara	09	Manchi, Mastaur, Chandera, Mohangarh, Bamhori Barana, Bairwar, Shah, Digauda, Beerau	03	Hatheri, Barana, Muhara,
3	Niwari	04	Ghooghsi, Baghat, Bahera, Dhamna	06	Sakuli, Mudara, Mador, Purvi, Biharipura, Puchhi, Karguwa, Tehraka
4	Palera	01	Bamhori Kala	03	Gauna, Jevan, Laron
5	Prithvipur	01	Birora Khet	02	Sakerabhadaran, Bhopalpur
6	Tikamgarh	11	Kundeswar, Mabai, Sapon, Samarra, Ganeshganj, Ninora, Budera, Amarpur, Naya Gaon, Dhanwaha, Aston	06	Darguwa, Dunda, Lar- Khas, Ranipura, Para, Patha,
TOTAL		34		21	
<p>Note: 1- In addition to the schemes already in progress four schemes for extension at Kundeswar, Mabai, Budera and Mohangarh were under process . 2- Out of total 54 completed schemes 20 schemes were not working for one or other reasons.</p>					
<p>Reference: Report from Executive Engineer, PHE , Tikamgarh (2008-09)</p>					

THE URBAN DRINKING WATER SUPPLY:

1. Tikamgarh:

Tikamgarh town has been under a well planned water supply scheme with more than one source to feed the water requirement of the town. In addition to river Jamni and its reservoir, the following sources had been used to keep the supply of the town going:

1. Tal-Darwaja-well
2. Bajaj Ki Bagiya-well
3. Mahendra Bag-well
4. Haridas Mandir-well
5. Old Tehri-well
6. Mau-Nala-Bawari
7. Hospital-Tubewell
8. Gol Quarter Tubewell
9. Vinodkunj Tigaila-Tubewell
10. Dr. Khan Lane-Tubewell

Up to 1995, some 41 India Mk.- II hand-pumps were also installed in the town. An extension plan was proposed then by Nagar Panchayat Tikamgarh.

3 . Other towns:

Piped water supply has been arranged for other urban locations along with India Mark-II hand-pumps installed to reach sufficient water for domestic purpose. Following table gives some relevant information though it relates to the years around 1995.

TABLE : SOURCE OF WATER

S.No.	Urban Centre	Population 1991	Source of Water	Maintained by
1	Orchha	2,500	R,TW-01,HP-02	Nagar Panchayat
2	Kari	6,649	R, TW-01,HP-02	-do-
3	Kharagapur*	9,649	TW-01,HP-20	-do-
4	Jatara	12,300	TW-02, HP-16	-do-
5	Jeron Khalsa*	6,729	R, HP-24	-do-
6	Tarichar Kala*	5,202	TW-01, HP-19	-do-
78	Niwari*	15,040	TW-03, HP-15	-do-
8	Palera*	10,493	TW-03, HP-13	-do-
9	Prithvipur*	17,020	TW-03, HP-12	-do-
10	Badagaon Dhasan*	7,111	R, TW-01, HP-16	-do-
11	Baldeogarh*	5,959	TW-01, HP-10	-do-
12	Lidhaura	8,490	TW-03, HP-05	-do-
Reference: Report from District Deptt. Of Public health Engineering, tikamgarh (1998)				

Recent district level report , the District Development Handbook (2009) gives very brief information which is included in the following table.

The District Statistics Handbook (2009) , however, is silent on this aspect.

year	Urban Centres (no.)	Organized Piped Water Supply	Non-Organized Piped Water Supply
2004-05	13	10	03
2005-06	13	10	03
2006-07	13	10	03
2007-08	13	10	03
2008-09	13	10	03
Reference: District Development Handbook of Tikamgarh (2009)			

-----..

AGRICULTURE & HORTICULTURE

Agriculture has been the primary occupation of people here because majority population has always been in villages. These villages used to be almost republics in themselves because they, in a cluster, were self supporting in all respects of essentiality of life. Forests used to be dense and rich in flora & fauna. Tribal community within forests was the chief protectors of forests along with the wild animals like tigers etc. In fact all these sustained each other. Forests provided essential inputs to all inhabitants including timber, fruits, herbs, grasses and the most important gift was water through rains, rivers, and recharge of ground water. The rain-water, rivers and the organic matter i.e. humus used to give life to people, vegetation, and the soils. Presence of hundreds of varieties of food-grains and oil-seeds along with all necessary inputs provided by nature helped local agriculture here quite rich in quality.

Though being a homogeneous region every district within *Bundelkhand* had some uniqueness. Following pages will give relevant up to date information on all aspects of agriculture & horticulture district wise:

1 . CHHATARPUR

AGRICULTURE :

Since major population of this district depended upon agriculture, people had given importance to it right from ancient days. Large number of crops have been grown here depending upon the varied soil structure and climate of the district. As the production was varied, the staple diet too was varying on the basis of three main seasons i.e. Rains, Winter and Summer.

Food grains, pulses, oil-seeds and other crops which had been growing in this district in two main cropping seasons KHARIF (*siyari*) and RABI (*unhari*) are as follows:

TABLE- DIFFERENT CROPS GROWN SEASON WISE

s.no.	Cropping Season	Crops
1	KHARIF	Paddy, <i>Jowar</i> , Maize, <i>Bajra</i> , <i>Moong</i> , <i>Urad</i> , <i>Saman</i> , <i>Kodo</i> , <i>Kutki</i> , <i>Arhar</i> , <i>Til</i> , <i>San</i> (hemp) and Cotton.
2.	RABI	Wheat, Gram, Barley , Linseed, Mustard. <i>Masoor</i> , and <i>Matar</i> .
3	CROPS CROSSING OVER SEASONS	Sugar-cane, Betel , Garden crops : Vegetables , Spices and Fruits
Note: Some of the crops which had been mentioned in the District- Gazetteers (1907) : <i>Kakun & Rali</i> in KHARIF and <i>Pissi</i> in RABI cropping season do not find reference in later publications indicating in this tract loss of these seeds.		

Area of cultivation in this district has been consistently increasing in each decade . Similarly there has been consistent increase in irrigated area. In six decades the area under cultivation has become more than double and the irrigated area 6.5 times which if correctly reported , seems remarkable achievement.

Following is some relevant information::

TABLE- PROGRESS IN IRRIGATION

Year	Total area under cultivation (Hectare)	Area under Irrigation (Hectare)	Percentage of Irrigated area (of cultivated area)
1950-51	2,05,000	36,698	17.9
1971-72	322,000	67,300	20.9
1996-97	3,87,000	79,400	20.5
2008-09	3,92,335	1,90,294	48.50
2009-10	4,07,390	2,08,512	51.2
2011-12	4,28,608	2,37,733	55.5
Reference: District Gazetteer of Chhatarpur (1982) Reports from District Agriculture office (2012)			

STATUS OF IRRIGATION :

As discussed elsewhere irrigation in Chhatarpur had been basically through the dug-wells owned and operated by farmers themselves. The water used to be drawn by *RAHAT* or *TARSA* depending upon the depth of water , crop and the land (soil type) to be irrigated.

Information regarding source-wise irrigation in Chhatarpur district as taken from the available reports of District Agriculture - office (Chhatarpur : 1997 & 2012) and District Statistics Handbook (2010) is presented as follows:

TABLE : SOURCE-WISE IRRIGATION AREA

	Source wise Irrigated Area (ha)						
Year	Canal	Tanks	Tube-well	Masonry well	Lift & Stop-Dam	Others	Total
1996-97	25,365		466	79,400	1,854	6,000	113085
2008-09	20,608	4,516	4,597	1,55,921	-	24,652	210294
2009-10	12,507	4,377	7,301	1,53,606	-	21,108	198899
2011-12	13,520	4,231	13,512	1,78,472	-	27,998	237733
Reference: Report from Deptt. of Agriculture , Chhatarpur District office (1997) District Statistics Handbook (Chhatarpur) 2010 Report from Deptt. of Agriculture , Chhatarpur district office (2012)							

From above tables it is clear that people still prefer dug-wells which provide necessary irrigation on expense of their own labour and of the draught-cattle . The dug-wells situated at the farms , though give farmers control over their share of water and save farmers' energy in transporting water from larger distances but speedy withdrawal due to installed power- pumping devices do not allow wells to quickly resume their water table. Each year water table is fast receding as there is no proper recharge of ground water due to large scale human intervention in forests , hills and rivers.

Looking at the present contribution of tanks and ponds to irrigation in this district we find large number of tanks / ponds dating back even to 10th century AD present here do not provide any appreciable irrigation.

If we calculate average irrigation from tanks for the years 2008-09, 2-009-10 and 2011-12 from above table we find their share in irrigation to be of the order of 2.03%. only. The fact is that most tanks have never been properly maintained because the new technology of quick extraction of ground-water has come as an easy solution, though this option is very costly on long term basis and could hardly be sustained.

GREEN REVOLUTION ENTERS CHHATARPUR:

Around late sixties GREEN REVOLUTION (GR) [a term given by USAID] adopting highly chemical intensive, water intensive, mechanized and hybrid seed-based (in a way commercial) agriculture was declared by agriculture-scientists as well as Governments, the only key to improve productivity and meet growing food needs. This highly technological and anti-nature farming was introduced in India with all national & international might, aiming at higher food-grain production probably to boost import-export business also. Like other areas of India, GR touched *Bundelkhand* and also the district of Chhatarpur though slightly later than other areas..

Consumption of chemical fertilizers started basically for irrigated wheat crop but 1973 onwards gradually extended to leguminous crops. Amount of chemical fertilizers consumed as reported for 1969-70 to 1971-72 is as follows:

**TABLE- FERTILIZER CONSUMPTION
(in Tonnes)**

Year	Nitrogenous	Phosphatic	Potassic
1969-70	3,490	3,281	465
1970-71	5,875	5,038	395
1971-72	7,790	5,613	376
Ref: District Gazetteer of Chhatarpur 1982			

This reveals farmers' growing inclination towards consumption of Nitrogenous and Phosphatic chemicals rather than the Potassic ones probably because soils here probably not deficient in Potash. Recent annual consumption of chemical fertilizers as reported by Agriculture Department (Chhatarpur) is presented in the table as follows:

TABLE- CONSUMPTION OF FERTILIZERS

Year	Nitrogenous (mT)	Phosphatic (mT)	Potassic (mT)
2007-08			
KHARIF	12.20	15.60	0.50
RABI	52.50	45.10	0.40
2008-09			
KHARIF	15.20	21.40	1.40
RABI	58.90	47.60	7.10
2009-10			
KHARIF	6.15	4.59	2.39
RABI	26.9	23.40	4.50
2010-11			
KHARIF	11.00	15.90	0.20
RABI	40.30	37.80	1.20
2011-12			
KHARIF	20.80	30.50	0.08
RABI	39.35	27.07	0.46
Ref: Report from Agriculture Department (Chhatarpur) 2012			

From above table consistent increase which chemical fertilizers were registering in the initial years is not maintained later. Although report from Dept. of Agriculture office, Chhatarpur says agriculture in Chhatarpur is largely based on chemical intensive technology and mechanization. According to it there are hardly 3 to 4% farmers follow traditional organic farming.

Tractors and Irrigation pumps were the first to enter the scene but during last few years combined harvesters from Punjab and Haryana have started visiting and rendering large scale post harvest burning of the valuable straw on the fields itself. The modern farming has affected cattle population of the district, hitting specially cows and bullocks, the spinal cord of Indian agriculture and rural economy from time immemorial.

STEPPING INTO MODERN IMPLEMENTS & MACHINERY:

Chhatarpur having been a traditional rural society, mechanization in the initial two decades after 1950 did not show any remarkable preference, but the year 1971 seems to have taken over as number of irrigation pumps both diesel and power operated showed a boom. Iron-ploughs started multiplying and also the Tractors.

Following is some information about use of the modern machineries in agriculture :

TABLE- MACHINES IN USE

Year	Plough		Irrigation Pumps		Tractors
	Wooden	Iron	Diesel	Electricity	
1951	71,091	02	n.a.	07	09
1961	1,13,013	138	146	04	28
1971	95,735	144	834	883	40
2008-09	79,620	4,886	28,989	47,530	7,930
2009-10	84,365	5,071	29,183	49,483	12,148
Ref: District Gazetteer (Chhatarpur) 1982 District Statistics Handbook –Chhatarpur (2010)					

MODERN TECHNOLOGY v/s THE SUSTAINABILITY:

Till 1973-74 dug wells held their prime position in irrigation but later due to water table having gone down rapidly possibly because of environmental imbalance (resulting into lack of ground water recharge), drop in annual rainfall, drying of the rivers and poor ground water-recharge deep bored tube-wells were initiated by State Public Health Engineering Department primarily for drinking water through installing India Mark II hand-pumps. But the technology soon took over area of agriculture by way of promoting deep tube-wells for irrigation. This became major strategy of management of water for any application.

Since other factors like denudation of forests and destruction of hills had rendered insufficient ground water recharge this technology itself, became biggest enemy of ground water. Being drawn from deeper aquifer water brought with it enormous heavy metals and fluorides etc. thus making drinking water unsafe and irrigation water unsustainable.

PRODUCTIVITY OF VARIOUS CROPS :

The productivity data (kg / hectare) of various crops for past 8 years i.e. from 2004-05 to 2011-12 as provided by District Agriculture Department is given in following tables:

TABLE -1 PRODUCTIVITY OF CROPS

	Crop	Year			
		2004-05	2005-06	2006-07	2007-08
s.no.	RABI				
1	Wheat	1991	1818	1444	1032
2	Barley	1240	1298	987	821
3	Gram	1140	1050	1012	741
4	MATAR	331	1207	1077	601
5	MASOOR	317	643	664	479
6	Mustard	386	714	582	549
7	Linseed	406	643	605	504
8	Sugar cane	2043	1349	1143	777
s.no..	KHARIF				
1	Paddy	901	1047	450	341
2	JOWAR	954	860	953	800
3	Maize	1181	1000	957	624
4	KODO-KUTKI	721	333	330	300
5	ARHAR	527	463	586	475
6	MOONG	169	468	481	183
7	URAD	164	593	555	178
8	TIL	284	452	530	377
9	Soybean	664	1051	751	316
10	Ground-nut	699	885	780	516
Table Continued					
		2008-09	2009-10	2010-11	2011-12
s.no.	RABI				
1	Wheat	1592	1489	1243	1592
2	Barley	1135	1078	961	1199
3	Gram	1025	1029	933	1523
4	MATAR	319	319	177	188
5	MASOOR	272	283	159	169
6	Mustard	321	332	305	298
7	Linseed	419	463	256	387
8	Sugar cane	2346	2426	-	1633

S.No.	KHARIF				
1	Paddy	338	690	480	1376
2	JOWAR	798	935	1058	733
3	Maize	627	683	582	415
4	KODO-KUTKI	307	346	355	299
5	ARHAR	376	460	443	247
6	MOONG	183	147	242	130
7	URAD	178	243	237	214
8	TIL	340	349	334	363
9	Soybean	298	637	632	401
10	Ground-nut	516	958	628	768
Reference: Reports from District Agriculture Department, Chhatarpur					

Above table of crops' productivity is so varied that nothing could be concluded by taking this data. In fact productivity of crops depends upon many other factors including fertility of soils, kind of seeds, water available for irrigation including the rainfall and other climatic factors. Varying just one factor has no deciding impact on productivity. This aspect will be discussed later.

HORTICULTURE:

Bundelkhand in past has been largely forested and its overall topography favoured fruit trees within forests as well as in private lands. People had hobby of planting fruit trees and maintain groves. The garden crops including sugar cane and betel leaves fetched good income. This gave the farmers sustenance even during harsh weather condition, low rainfall and droughts. These crops were mostly taken with assured irrigation through individual dug wells.

The modern farming and specially introduction of Soybean has upset water absorption by soils, storage which each farm was able to do because of embankments and subsequent ground water recharge. The incoming of bigger machines like tractors have also contributed in breaking the bunds for making farm-field large enough for machines to operate. This development has affected the grove-culture and also the garden-cropping. The Horticulture Department, however, has a long list of fruit and vegetable plants having been grown in Chhatarpur district in the year 2012-13. The list is presented in the table as follows:

TABLE- HORTICULTURE PRODUCTION

s.no.	Fruits/Vegetable /Spices	Covered Area ha	Production (ton)	Remarks
FRUITS				
1	SITA PHAL (custard apple)	25.00	500.00	
2	ANAR (pomengranate)	2.00	6.80	
3	AONLA	326.00	6,520.00	
4	AAM (mango) DESHI	90.00	2,250.00	
5	AAM (mango) SPECIAL	47.00	1,410.00	
6	AMROOD (guava)	182.00	3,640.00	
7	JAMUN	10.00	150.00	
8	SINGHARA	5.00	35.00	
9	KELA (Banana)	6.00	180.00	
10	SANTARA (Oranges)	10.00	170.00	
11	NEEBU (Lime)	172.00	2,924.00	
12	PAPITA (papaya)	109.00	3,815.00	
13	TARBUJ(Water Melon)	50.00	2,000.00	
14	KHARBUJ (Melon)	30.00	600.00	
15	OTHERS	128.00	1,280.00	
	Total Area under fruits	1,192.00		
FLOWERS				
	All types of flowers	80	560.00	
VEGETABLES				
1	AALU (potato)	2,690	67,250	
2	SHAKAR KAND	400	12,000	
3	PYAZ (onion)	1,100	33,000	
4	HARI MATAR (green peas)	500	30,000	This figure is unbelievable
5	TAMATAR (Tomato)	1,800	45,000.00	
6	BHINDI	518	5,180.00	
7	BAINGAN (brinjals)	2,042	6,260.00	
8	PHOOL GOBHI (cowli Flower)	210	525.00	
9	BAND GOBHI (cabbage)	75	1,875.00	
10	ARAVI	1,220	30,750	
	Total Area:	10,555		

SPICES				
1	Mirch (8,508	1,02,096.00	
2	Adrak (Ginger)	8,000	80,000.00	
3	HALDI	2,120	3,39,920.00	
4	LAHGUN (garlic)	3,160	41,060.00	
5	DHANIYA (coriander)	8,568	1,28,520.00	
6	METHI (fenugreek)	2,000	2,400.00	
	Total Area:	32,356		
	GRAND TOTAL:	44,183.00		
REF: Report of District Office of Horticulture (Chhatarpur) 2012-13				

-----.....

2. DAMOH

AGRICULTURE:

Since ancient days agriculture has been major occupation of people here. Though *KHARIF* (called *SIYARI*) and *RABI* (called *UNHARI*) both seasonal crops are grown here but reports reveal wheat being principal crop of this district occupying half of the cultivated area. Wheat has been popular to be grown in ***kabar, mund,*** and ***rathia*** soils specially in *HAVELI* area : around Hatta , Damoh Pathariya and Batiagarh .

There had always been fear in farmers regarding ***kans-*** grass which grew faster in uncultivated fields. Thus they tried to cultivate maximum possible land to avoid setting in of this dangerous weed not allowing any cultivation until its cycle was completed.

Other important crops in *RABI* cropping season are the gram (*chana*) , mustard, and linseed. During *KHARIF* cropping season paddy had been major crop but others like *jowar, urad* and *moong* , *til* and *arhar (TUAR)* were also grown depending upon the soils . The crop of *arhar (TUAR)* covers both the seasons; having been sown during July it is harvested during next March .

Prior to 1947 status of major crops and its total area of coverage in different years are presented in the table as follows:

TABLE- MAJOR CROPS

Year	Area covered by major crops (ha)						
	Wheat	Paddy (rice)	Jowar	Chana (Gram)	Alsi (Linseed)	Til	Kodo-Kutki
1893-94	86951	30318	14345	21051	15425	10469	22632
1903-04	70385	20748	19563	18236	8230	20529	27238
1913-14	80346	22244	15353	31829	6624	17050	19490
1921-22	77541	22932	31350	18971	2380	16806	16586
1926-27	104085	26961	18037	16384	10157	6403	11264
The data in acres has been converted to hectares (1 ha= 2.471 acre)							
<p style="text-align: center;">Reference: Gazetteers of India - Damoh District B-Volume : Statistical Tables (1891-1928)</p>							

Since irrigation expanded in the first half of twentieth century wheat and paddy became more popular even on the soils, one could not think of earlier. Soybean is the new introduction in this province which has affected quality as well as quantity of food replacing various pulses and oilseeds grown earlier for mostly local consumption. The old crops *kodo* & *kutki* etc. which used to be grown in inferior soils have disappeared from the scene.

Following table gives coverage by major crops grown here after 1947 and the changes in cropping pattern with time:

TABLE: KHARIF SEASON - COVERAGE BY MAJOR CROPS
(Area shown in hectare : Productivity in kg per hectare)

Year of report	Paddy	Jowar	Urad	Arhar (TUAR)	TIL	Soybean	Others
1955-56	35297	28405	na	na	12033	nil	Not specified
Productivity	439	310	-do-	-do--	116	-	-do-
1965-66	45000	16000	-do-	-do-	11000	nil	-do-
Productivity	320	944	-do-	-do-	109	-	-do-
1995-96	53163	9185	2323	-do-	na	38963	-do-
Productivity	761	702	na	-do-	-do-	821	-do-
2002-03	65280	5330	18519	2752	1659	32342	-do-
Productivity	1082	755	192	557	193	904	-do-
2004-05	53230	4060	13540	3010	1660	45300	-do-
Productivity	949	585	547	723	341	910	-do-
2005-06	53298	4063	13545	3013	1664	45302	-do-
Productivity	1454	1236	na	642	285	1031	-do-
2010-11	50196	1779	21088	63818	1896	62110	-do-
Productivity	2408	2315	n.a.	247	363	1457	-do-
2011-12	53261	1471	26645	21447	2215	87667	-do-
Productivity	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	-do-
<p>Source: 1. M.P.District Gazetteer (Damoh district) 1980 ; 2. Important Statistics of Sagar Division , Divisional Statistics Office, Sagar (1996) 3. Report from Agriculture Department , District Damoh (2007-08) 4. District Statistics Books (District Damoh) 2007 and 2011</p>							

TABLE: RABI SEASON- COVERAGE BY MAJOR CROPS
(Area shown in hectare : Productivity in kg per hectare)

Year of report	Wheat	Gram	Linseed	Masoor	Mustard	Others
1955-56	98395	20683	8231	na	-	Not specified
Productivity	504	493	170	-do-	-	-do-
1965-66	86000	34000	8000	-do-	-	-do-
Productivity	440	526	150	-do-	-	-do-
1995-96	87251	70603	22310	39572	-	-do-
Productivity	1405	937	345	456	-	-do-
2003-04	41620	176020	4644	11859	433	-do-
Productivity	1286	926	515	690	490	-do-
2004-05	67610	169250	5160	15540	630	-do-

Productivity	1376	1076	578	798	586	-do-
2005-06	68961	166725	5102	-n.a.	756	-do-
Productivity	2803	858	502	-do-	1017	-do-
2010-11	71811	111324	1003	n.a.	768	-do-
Productivity	4420	543	603	n.a.	988	-do-
2011-12	85726	116963	986	n.a.	824	-do-
Productivity	n.a.	n.a.	n.a.	n.a.	n.a.	-do-

**Source: 1. M.P. District Gazetteer (Damoh district) 1980 ;
2. Important Statistics of Sagar Division , Divisional Statistics Office, Sagar (1996)
3. Report from Agriculture Department , District Damoh (2007-08)
4. District Statistics Book (District Damoh) 2007 and 2011**

Analysis of the above data gives indication of changing pattern of agriculture in Damoh district as follows :

- Area of wheat has decreased but productivity has increased which could be attributed to expansion in irrigation and the quality of seeds,
- Area under paddy had remained almost similar with occasional gradual increase along with its productivity due to the reason cited above.
- Area of *Jowar* and *TIL* has constantly decreased possibly to give space to Soybean.
- Linseed has shown some increase during the 90th decade but later has dropped considerably.
- Area under soybean has shown steep rise replacing several indigenous *KHARIF*-crops.

STATUS OF IRRIGATION:

Before 1908 artificial irrigation was almost negligible. Till then hardly 2,000 acres (809.4 ha) were shown as irrigated which is quite insignificant. Irrigation was applied only to rice, sugarcane, vegetable gardens and very little area under wheat. Wells were constructed mainly to irrigate sugarcane crops. As mentioned earlier 300 tanks were recorded but of them only 20 were used for irrigation. Till then 700 durable and 300 temporary wells were recorded with the average depth 25 to 30 feet (i.e. 7.62 to 9.15 metres).

The cost of constructing a masonry well at that time was Rs. 300 while the non-masonry wells were not feasible here because of the nature of earth, disintegrating easily.

Embanking the fields was considered by farmers very effective in retaining rain water. These embanked fields used to give two crops in a year but major portion of Damoh district being sloppy did not allow embankments in the fields. In southern region , however, embankments were possible and fields there grew two crops in a year.

Looking at continuing droughts Indian Famine Commission (1901) had recommended development of irrigation in this district and on the basis of comprehensive survey between 1904 and 1908 some work was started. The first tank to be used for irrigation was in the year 1909; it was BAHERIA tank.

Building tanks and laying canals out of them for irrigation started since then . Details have already been covered.

-----..

Source of above information : Gazetteer of India- Damoh District (EV Russell) - 1906

LATER REPORTS:

Information on irrigation reported in District Gazetteer of Damoh (1980) related to 1964-65 and 1970-71 reveals major source of irrigation to be canals only through which 87.3% and 81.6% area were irrigated in those years respectively. Masonry wells had been the second important sources but their use decreased and irrigation through them was limited (merely 10.6% during 1970-71). Drawing of water from wells had been with the help of multiple techniques including the traditional *RAHAT*, *MOT*, *DHEKLI*, and later by electric- and diesel operated pumps. In 1965-66 well-digging or deepening and boring was promoted . Farmers welcomed this move because of erratic rain- pattern of Damoh. Masonry wells were promoted in Pathariya, Damoh, Batiagarh and Hatta area while the *NALLAH*-bundling , canal-irrigation along with well digging found potential in Pathariya, Damoh and Jabera areas.

The diesel- or electrical pumps gradually started replacing traditional techniques of drawing of water for irrigation. Popularizing diesel pumps and provision of high subsidy in electricity for pumping boosted irrigation activities. But this killed initiatives of farmers of building or using their age old wells and also affected considerably the already deficient rivers affecting flow of its water throughout the year. The later emphasis on expanding use of deep tube- wells for irrigation affected the ground water table. Available information related to source-wise distribution of irrigated area is as follows:

TABLE : SOURCE WISE IRRIGATION

S.No.	Resources	Irrigation 1994-95		Irrigation 2005-06		Irrigation 2010-11		Irrigation 2011-12	
		No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)
1	Canals through different projects (Medium or Small) (private and governmental)	04	15000	139	12,969	139	10,412	139	12,127
2	Stop-dam	07	150	-	-	-	-	-	-
3	Wells	12994	13,600	14,705	26,576	1645	30,793	1726	36,032
4	Tube-wells	426	2,556	3,614	28,708	9	14,257	3	35,442
5	Tanks	-	-	47	482	8148	1,105	8484	1,254
6	Other sources	-	15,070	-	45,453	69	36,279	69	38,697
		-	46376	-	1,14,188	-	92,846	-	1,23,552
Reference: Report from Deptt. Of Agriculture (1996) District Statistics Book (Damoh) 2007 and 2011									

In spite of presence and performance of canals masonry wells still had greater influence since these were in the hands of farmers and did not levy any extra charges for which traditionally farmers were never mentally prepared.

THE GREEN REVOLUTION

The U.S. promoted modern farming based on intensive use of chemicals as fertilizers, plant-protectors as well as machines, using hybrid seeds, and requiring more irrigation was accepted by Govt. of India as the only road to food-security. It was essentially a step towards commercialization of agriculture which so far was in the hands of majority rural farming communities in India.

The earliest reference of using hybrid seed in this district was found when C-591 wheat was introduced in the year 1947 which became a popular variety giving better yield under irrigated condition. In 1956 H.Y.65 and H.Y.11 varieties were introduced which promised higher yield as well as freedom from rust, the most dangerous pest during those days. Farmers in Damoh did not show very keen interest in GR- promoted commercial and dependence-enhancing farming. The growth was very slow. Its first entry was through seeds only and that was Mexican Sonara in 1966.

1965-66 was a severe drought affected year for Damoh too. Rains were delayed , scanty and absent after September . This killed both the crops. Production turned out almost 50% while scarcity of food, fodder and water did affect common people's life very badly. Governmental help was crucial in saving lives and also undue migration of rural population. Probably scarcity of food during this year triggered the process of introducing GR-techniques in this district in a big way. By 1969-70 there came up at least 22 fertilizer distribution centres within the district. Later Cooperative Societies and private traders also were pushed into this trade.

For improving fertility of the soils application of green manure by way of using koppergaon- *moong, san, and dhaincha*, however, became popular during that period. Traditionally farmers used to have same benefit through mixed farming and crop-rotation they had been practicing this very often. The GR package largely discouraged mixed cropping which was so traditional in entire *Bundelkhand*.

SITUATION UPDATED:

Reports for recent years related to use of hybrid seeds, chemical fertilizers , pesticides, insecticides and seed treating chemicals etc. are presented as follows:

TABLE- USE OF EXTERNAL INPUTS

Year	Hybrid Seeds	Chemical Fertilizer	Pesticides/Insecticides		Chemicals for Seed-Treatment
	Quintal	m.Tonne	Powder Quintal	Liquid Litres	Quintal
2005-06	10,215	13,311	4,278	9,470	22.17
2006-07	14,008	12,069	3,497	22,079	52.03
2010-11	44,727	34,751	17,085	28,591	350.00
2011-12	95,574	35,053	1,404	75,426	441.00
Reference: District Statistics Handbook (Damoh) 2007 District Statistics Handbook (Damoh) 2011					

The data as above shows an exponential growth in use of chemical fertilizers as well as poisonous chemicals for crop-protection and seed-treatment. There is also growing tendency of mono-cropping popularized by agriculture scientists as well as the State department of agriculture . This has resulted into loss of self-sufficiency of people here for their essential foods . The commercial nature of farming introduced with high advertisement as well as powerful push under Green Revolution put enormous burden

of debt on the farmers and coupled with erratic rains and untimely drying of rivers due to severe deforestation, made them highly vulnerable. In recent years cases of farmers' committing suicide because of above factors has finally stamped aforesaid facts.

The GR-technologies in the name of scientific farming has pushed sale of bigger implements and machines like tractors, electrical and diesel pumps and has invited use of combined harvesters to render burning of residual straw of wheat on the field itself. The tractors have been pushed to plough deep during summers, all this has literally finished most micro-organisms of the soils. Thus soil -fertility and its natural quality of self-rebuilding and regeneration has considerably damaged.

Following table gives available information regarding use of agricultural machines for different years. The change in population of GOVANSH-cattle is also being presented:

TABLE: MECHANIZATION OF AGRICULTURE AND THE GOVANSH

Year	Plough		Pump		Tractors (pvt) (no.)	Population of GOVANSH (Cow & Bullocks And calves)
	Wooden	Iron	Diesel	Electric		
1955-56	52,863	29	13	01	16	2,38,255
1960-61	40,946	171	16	05	16	2,64,518
1965-66	63,217	106	155	17	29	4,35,493
1968-69	59,584	725	179	95	59	3,62,806
2005-06	49,527	19,392	5,346	18,675	4,067	3,91,570
2006-07	48,365	17,921	5,651	20,831	4,306	3,99,692
2010-11	44,659	18954	5,723	21,591	4,422	3,64,935
2011-12	41,927	19,465	6,200	21,904	5,688	3,78,612
Reference: 1. M.P.District Gazetteer (Damoh) Appendix 1980 2. District Statistics Handbook – Damoh (2007) 3. District Statistics Handbook -Damoh (2011)						

HORTICULTURE:

According to District Gazetteer (1906) sugarcane (for *GUR*-preparation) was most popular and remunerative crop. This was followed by vegetables which used to be grown for local consumption. Of the 13000 acre (nearly 5300 hectare) classed as garden land, 1400 acre (nearly 570 hectare) were used for sugarcane only. The tribal community of GONDS had traditional practice of home-stead vegetable cultivation which they followed intensively.

Sugarcane grown here was mostly without much irrigation . It continued till the imported sugar being cheaper affected income of cultivators. Betel-vine gardens were another popular horticultural activity of which Damoh, Hindoria and Raneh were the chief cultivation centres .

Other crops included : *AL* , or Indian madder (*Morinda citrifolia*) as dyeing agent, Yams (sweet potatoes) being grown in *kachhar* land along the banks of rivers, ordinary potatoes, brinjals, radishes, beans, *methi* (*Trigonella foenum greecum*) and *singhara* (water-nut) etc.

Fruit trees and its groves had been always in private lands although earlier plantation on the road side did include several fruit trees like mango, *mahua* , *imli* , *munga* and *jamun* etc. Even during British period fruit-trees like *mahua*, mango, *jamun*, tamarind, *Koha* (*arjuna*) and trees with good shade like *PIPAL* & *NEEM* etc. were opted under arboriculture , but now-a-days these trees include mostly *propis juliflora* and eucalyptus etc. which neither give shade nor the confort. The former being a dangerous thorny specie is totally unsuitable for road side plantations.

In villages *mahua*, *neem*, *bargad*, *peepal*, *imli*, and *munga* trees are still popular. Mango-groves are becoming rare these days.

.....

3. PANNA

AGRICULTURE:

As is well understood agriculture of any place/ region depends upon various factors like soils, climatic behavior, seasons and the availability of water etc. Choice of crops and the food-habit also depends upon these factors. Some of these as reported in the Eastern State's Gazetteer (1907) for the erstwhile states of Ajaygarh and Panna (which form district of Panna today) are discussed as follows:.

THE SOILS:

People's classification of soils in the district was based upon its appearance, characteristics and the locations. A brief account is given below:

TABLE - SOIL TYPES

S.No.	Soil-Type	Description
1	RETILI	Red soil containing stones and sands. Suitable for growing <i>TIL</i> and <i>KUTKI</i> . If irrigated, can produce wheat crops.
2	PAHADI (PATHRILI)	Red Soil, full of boulders & stones, bearing <i>TIL</i> & <i>KODO</i> .
3	PARUA	Yellowish grey soil of soft texture, Suited for URAD, Jowar, and Motha etc. If irrigated, can produce wheat crops.
4	SIHARA	Partially black-red soil Suitable for Kodo, Jowar, Til, and Gram etc. If irrigated, can produce wheat crops.
5	BHATAN	A rough yellow colored stoney soil. Growing most of the KHARIF crops.
6	MAR	A soft black soil Growing wheat, and Linseed.
7	KABAR	A darkish brown colored soil containing lime, Suitable for Wheat, Gram and Linseed etc.
8	BINWA	This is the soil near human habitation getting natural manures Can grow both KHARIF & RABI crops, one after other.
9	KACHHAR	Soils near rivers, tanks, and NALAS; The silt left behind after the rains forms natural manures- This soil retains moisture.
Notes: <ul style="list-style-type: none">• In Panna soils were also recognized on the basis of their colour. People termed soils as PILI (yellow), BHURI (Brown or Grey) and LAL (Red) etc.• The land adjacent to villages was known as GEUNRA while the land at a distance was termed as HAAR.		

Soils later classified as **MAAR**, **KAABAR**, **PARUA** , and **RANKHAR** cover all the above types under one or other types.

CROPPING PATTERN:

Like in previous centuries two main cropping seasons : **KHARIF** and **RABI** are followed even today and the crops are all the same as described for *Bundelkhand* in general or other districts surrounding Panna , i.e. Chhatarpur and Damoh etc in particular. Farmers knew very well and followed mixed cropping and crop-rotation/ crop-cycling in order to enrich the soils through retaining its fertility. The previous practice of mixed cropping , however, was not the same as it is followed today.

Crop-mixing or rotation during nineteenth century compared with the present practices are discussed as follows:

TABLE- CROP-MIXING & CROP ROTATION

S.No.	Earlier Practice	Explanation and difference from present practice	Specific Reasons
1	Chana (Gram) and matar (Peas) with Wheat or jowar	chana & matar which are normally sown during RABI –season separately or along with Wheat could be mixed with jowar during KHARIF season.	In kabar soils Gram and matar were sown together with Wheat while in sandy soils or in kachhar this was mixed with jowar .
2	Rice (Paddy) mixed with urad & jowar	Paddy is sown these days as single crop and not mixed with jowar as was done earlier	
3	Urad & Cotton used to be mixed	This practice is not followed these days	This practice was in the yellow soils.
4	Kodon & rice (Paddy) mixed with jowar	<i>Kodon</i> is not popular these days. May be available in some remote villages only.	This was followed in <i>kabar & binwa</i> soils
Note: When <i>TIL</i> , <i>KODON</i> , <i>JOWAR</i> & <i>URAD</i> were taken in succession for some years, the field was left fallow for 2-3 years to continue the same cropping further. This was to allow soils to regain their fertility.			

AGRICULTURE IN PANNA : LATER YEARS:

As already mentioned Panna district being hilly and densely forested was not favorable for intensive agriculture. Yet, people here always tried to grow enough to meet their basic food-needs. Irrigation was almost a private affair and most popular sources were the masonry wells. Later irrigation projects were initiated though all together could not match the contribution as the masonry wells used to serve. According to 1981 census following land-use picture appears for Panna district:

TABLE- AREA UNDER CULTIVATION

Particulars	Values
Inhabited villages (no)	947
Total Area (ha):	5,85,626.19
Cultivable Area(ha):	3,17,409.96 (54.20%)
Irrigated Area	13,885.11 (4.37% of the cultivable area)
Reference: District Census Handbook (Panna) (1981)	

Information regarding cultivated area under selected major crops ,their gross production and productivity ,calculated on that basis, for the years 1994-95 is as follows:

TABLE-MAJOR CROPS , AREA AND PRODUCTIVITY

S.No.	Particulars	Area (ha)	Production (in m.tonnes)	Productivity (in kg/ha)
<u>KHARIF</u>				
1	Paddy	61,435	40,738	663
2	Jowar	6,762	4,783	707
3	Urad	1,863	678	364
4	Soybean	2,679	2,061	769
<u>RABI</u>				
1	Wheat	78,409	1,07,876	1376
2	Gram	64,398	48,314	750
3	Masoor	13,151	5,515	419
4	Linseed	14,892	6,384	429
Reference: Important Statistics of Sagar Division, Divisional Statistics Office, Sagar (1996)				

Comparative Crop Productivity in Panna District :

Report from Department of Agriculture –district office for the productivity of most of the crops grown in Panna district for ten years (2003 to 2012) compared with productivity of major crops presented in previous table may give an idea of change in agricultural production. Available information is presented as follows:

TABLE:- PRODUCTIVITY OF CROPS (kg/ ha)

S.no.	Crop	2003-4	2004-5	2005-6	2006-7	2007-8	2008-9	2009-10	2010-11	2011-12
KHARIF										
1	Paddy	1140	410	1225	530	514	874	553	771	1116
2	JOWAR	1566	427	1011	600	601	601	842	842	842
3	Maize	962	619	750	584	559	846	846	846	818
4	ARHAR	520	500	275	398	410	666	666	410	728
5	URAD	425	320	398	300	291	383	383	383	383
6	MOONG	358	286	377	250	290	381	381	511	511
7	Soybean	846	400	748	490	413	517	517	672	672
8	TIL	425	125	396	295	260	325	273	273	390
9	Groundnut	702	360	300	374	422	556	617	617	669
Table to continue										
RABI		2003-4	2004-5	2005-6	2006-7	2007-8	2008-9	2009-10	2010-11	2011-12
1	Wheat	1198	1035	1191	1000	885	1239	1239	-	1199
2	Barley	1037	656	720	708	650	650	1010	938	1010
3	Gram	855	532	756	860	750	964	991	737	977
4	MATAR	364	368	670	365	439	632	632	545	545
5	MASOOR	494	416	406	223	529	688	688	423	730
6	SARSON	415	300	309	328	328	460	460	361	473
7	ALSI	400	320	367	350	330	420	420	360	360
<p>Reference: Report from DD-Agriculture-. District Panna (2008) for 2003 to 2007, Report from DD-Agriculture –District Panna (2012) for 2008 to 2012.</p> <p>* The data recorded in above tables look surprising because productivity of any crop for consecutive years being exactly equal as has been indicated by the blue marked data is surprising.</p>										

Looking at above it becomes quite clear that despite popular push and use of chemical fertilizers and other inputs, productivity did not show any improvement. It

seems factors influencing weather are more effective in entire process of agriculture and the resultant productivity of any region.

IRRIGATION:

The section of Water Resources in this chapter has given information about resource-wise irrigation of agricultural fields. Some facts which could not be shown there because these were mentioned in District Agriculture deptt. reports and not in the reports furnished by WRD for 2010- 2011 are as follows:

RESOURCE WISE IRRIGATION

s.no.	Source of Irrigation	Number	Area Irrigated (ha)	Area Irrigated per unit (ha)	% of Irrigated Area
1	Canals	23	6,236	271.1	6.77
2	Tube-wells	2117	2810	1.3	3.01
3	Masonry Wells	16245	21227	1.3	22.73
4	Tanks/ Reservoirs	74	1074	14.5	1.15
5	Others	Not specified	61,950	-	66.34
	TOTAL	-	93387	-	100
Reference: Report from Deputy Director- Agriculture –Panna District (2012)					

During past three decades expansion in irrigation has definitely been done but emphasis has been more on centralized systems like the Tube-Wells or Canals. It is surprising that Tube-wells despite heavy investment on them per unit are irrigating almost identical to masonry wells on average.

HORTICULTURE

Panna having been a densely forested area, inhabitants here always liked planting trees especially the fruit bearing like Mango, Tamarind, *JAMUN*, guava, and those of religious importance like *PEEPAL*, *BARGAD* along with most popular trees of *NEEM* etc. Large areas were covered by groves of fruit trees. During princely states' era the rulers always promoted shade bearing trees on the road sides to give comfort to pedestrian travelers.

The 1907 Gazetteer as well as the census hand-book do not mention any notable information on local horticulture. Probably this as an area covered by agriculture itself.

A recent report, however, contains detailed information about area and the trees/ plants or the garden crops which normally come under horticulture in government records . Relevant information is presented as follows:

TABLE- AREA UNDER HORTICULTURE

S.No.	Block	Area under Horticulture (ha)	Plants popularly planted
1	Ajaygarh	1,373	Mango, AONLA, Lime, Jatropha
2	Gunnaur	2,459	Mango, AONLA, Jatropha
3	Panna	30,139	Mango, AONLA, Lime, KAITH, Jackfruit, Teak, and Jatropha
4	Pawai	1,905	Mango, Lime, Jackfruit, Karaunda and Jatropha
5	Shah Nagar	2,749	Mango, Teak, Jatropha
Total : 38,625 hectare			
Reference: Report from District office of Horticulture Department (Panna) 2012			

Further information regarding production and productivity of fruits as reported by Deptt. Of horticulture , Panna for recent years is presented below:

TABLE- PRODUCTION & PRODUCTIVITY OF FRUITS (2011-12)

S.No.	Fruit-Plants	Area Covered (ha)	Production (m.ton)	Productivity (m.ton/ ha)
1	Mango	131	1408.3	10.8
2	Guava	166	1726.4	10.4
3	Lime	70	616.0	8.8
4	Plantains (Banana)	02	3.8	1.9
5	Papaya	41	192.7	4.7
6	Aonla	201	1929.6	9.6
Reference: Report from District office of Horticulture Department (Panna) 2012				

THE GARDEN CROPS:

Horticulture also covers the crops of vegetables, spices, flowers and medicinal plants . The report as referred above gives a list of such plants as follows:

- **VEGETABLES:** Potato, Sweet Potato, Tomato, Ladies' Finger (*bhindi*) , Brinjal, Cauli- flower (*Phool-Gobhi*), Cabbage, Green Peas, *arbee*, *lauki* , *kaddoo*, *Turai*, *Karela* (bitter gourd), *varbati* , Raddish, Spinach, *sem*-Beans etc.
- **SPICES:** Capsicum, Ginger, Turmeric, Coriander, Fenugreek, Onions, Garlic, Cumin, *saunf* etc.
- **FLOWERS:** Rose, Marygold, *gudahal*, *sevanti*, *chandni*, *rajanigandha*, and Gilardia etc.
- **MEDICINAL PLANTS:** Tobacco, Betel , *ashwagandha*, *tulsi*, *moosali* etc.

4. SAGAR

AGRICULTURE:

Major occupation in Sagar district had always been agriculture. Census records of 1951 reveal average 67% persons earning their livelihood from agriculture only. In Sagar Tehsil, however, other occupations did divert people resulting into lowest recorded dependence (just 52%) over agriculture. Other Tehsils obviously had over 72 % population while the maximum 83% were reported depending upon agriculture in Bandaa Tehsil of Sagar.

This district has been famous for its crops of *RABI*-season, particularly wheat and gram. Wheat had been principal crop closely followed by Gram . Other crops included linseed, *Masoor* , *Tevra* and *Batra* etc. In *KHARIF* variety of crops were taken here including paddy, *Jowar* , *Til* , *Ramtil*,Cotton ,*Kodo*, *Kutki* , *Saman* etc. and also sugarcane.

Popular varieties of major crops grown here were as follows:

WHEAT:	<i>KATHIA, HANSIA, JALALIYA, PISSI.</i>
GRAM:	<i>HALDIA (yellow) , IMALIYA (white) & PARBATIA (Red).</i>
LINSEED:	White and Red varieties ;
MASOOR:	Indigenous variety;
PADDY :	Several indigenous varieties depending upon their crop-duration as well as quality.
JOWAR:	<i>BANDAR BAITH, BASMATI, LEBHADH, JUGNU, BHOOS, & AINDANA.</i>
SUGARCANE:	<i>ANGREJ & PACHRANGI</i>

The oilseeds other than Linseed popularly cultivated here were *RAMTILI* (also named *jagani*). Its oil was used for cooking food as well as burning the earthen lamps. During last century sugarcane and cotton were quite important cash-crops but both these crops were de-popularized on the basis of its economics due to imports of cheaper sugar and other regions in India switching over to grow cotton as their main crop.

SITUATION OF IRRIGATION:

Sagar district , as mentioned before , had very few artificial irrigation sources in the past. People followed here mostly the dry-land farm- practices. But whatever irrigation was done , major sources were masonry wells each of which serving single farmer 's fields mostly used for irrigating garden crops or the Sugarcane. Embankment of fields was traditionally practiced by farmers for conserving rain water within their farms and supporting *RABI* - crops. The two crops in a year were only possible if there was good rain and especially if it rained in last leg of the season. The two-crop area in Sagar district used to vary from 2% to 6% depending upon the precipitation.

KAANS (*Saccharum spontaneum*) grass was another big obstacle here on smooth road of agriculture. Climatic factors forcing farmers to be unable to cultivate fields used to give space for this weed. The embanked fields where water retained till October were able to overcome menace of *KAANS* , but that was not possible everywhere . The obvious result was almost uncertain coverage of areas under agriculture in the district. Later mechanical cultivation with tractors did help to some extent in eradicating this weed .

LAND EROSION:

Land-erosion has been reported to pose severe problem in this district. Because of topology having sharp slopes strong currents of draining rain-water wash away

enormous top-soils. The systematic deforestation and land being kept fallow for certain years followed by deep ploughing through tractors aiming to eradicate *KAANS* grass contributed more and more to land erosion. The 1897 - land-settlement report had mentioned this menace and warned for immediate action to control this problem. But it could not be pursued and the problem remained serious as before.(ref: **District Gazetteer –Sagar 1970**).

CLASSIFICATION OF SOILS / LAND ACCORDING TO CROPS GROWN / LOCATION :

As in other districts of *Bundelkhand* people's classification of soils as well as the land in this district also had been on the basis of its location and the crops grown . Following table will give a glimpse of such classifications with local names :

TABLE- PEOPLE'S CLASSIFICATION OF SOILS

Crops Grown	s.no.	Location	Name given	% Available
Wheat	1	If the fields are low-lying , have good fertility and retain moisture	SASIRA (Gohari)	01
	2	If the land has been damaged due to rain—drains / floods	TAGAR (Gohari)	
	3	If water channels have destroyed the land and those which lie in valleys:	BHARKILA (Gohari)	13
	4	The land away from village and prone to be damaged by wild animals	UJAD (Gohari)	05
	5	Strongly embanked Fields	BANDHIA (Gohari)	01
	6	The irrigated field	AABPASHI (Gohari)	0.5
	7	The fields which do not come under any of above classification:	MAMULI (Gohari)	78
All crops Including Wheat	8	The fields adjacent to village-habitations	GEUNDA	02
Paddy	1	If situated at higher plane and the productivity is low during years of low precipitation :	TIKRA	
	2	If the productivity is good despite the low-precipitating situation :	SAMAN	
	3	Situated in low-lying area and giving good production even during the years of low precipitation	JHILAN	
	4	The fields irrigated from tanks/ ponds	AABPASHI	
Coarse Grains		The land capable of only producing less important coarse grains	PATRUA/ BHATUA	70

Garden Crops	1	If the land is irrigated	AABPASHI	
	2	If the land is non-irrigated	BARANI	
Reference: The District Gazetteer - SAGAR (1970)				

MAJOR CROPS AND THEIR AGRO-PRACTICE:

Time of sowing and harvesting always depends upon the crop and its variety. Timely sowing has been important, crops sowed at right time generally give better yields. Traditionally people used to follow astrological direction for entire process related to farming. Following is the list of major crops and the time of sowing and harvesting practiced here 5-6 decades ago when the seeds were indigenous.

TABLE- AGRO-CALENDAR

S.No.	Crops	Sowing Season	Harvesting Season
1	Wheat	1 st October to 1 st November	15 th March to 30 th April
2	Gram	1 st October to 15 th October	15 th February to 1 st March
3	Linseed	15 th October to 1 st November	15 th March to 1 st April
4	<i>JOWAR</i>	25 th June to 10 th July	15 th November to 15 th December
5	Paddy	25 th June to 10 th July	1 st October to 31 st October
6	Potato	1 st November to 1 st December	15 th April to 15 th May
Reference: The District Gazetteer - SAGAR (1970)			

CROP-ROTATION:

Farmers generally knew importance of right kind of crop-rotation. Taking same crop in a field continuously showed enormous decrease of its soil-fertility. Usual practice of traditional crop-rotation is presented below:

1. Rotation within a year:

- Wheat after *MOONG* (Green Gram)
- Wheat after vegetables
- Wheat after Maize
- Gram or Peas after Paddy

2. Rotation in Two Years:

- a) Wheat after Gram,
- b) Wheat after *TUAR* (the pulse)
- c) Gram or Ground-nut after *Jowar*

3. Rotation in Three Years:

- a) Paddy ---- Berseem -----Vegetables
- b) Wheat ----- *moong* ----- Maize
- c) Ground-nut --- Wheat ---- *chari-jowar* or Berseem
- d) Paddy-----Vegetables -----Maize.

Apart from appropriate rotation mixing two or several crops together was also a common practice. Wheat was invariably mixed with Gram and Linseed or sometimes Wheat + Gram and Wheat + Linseed .

PRODUCTIVITY OF MAJOR CROPS (1955 - 1986 PERIOD) :

This was the period of transition from traditional farming to the GR promoted modern methods using external inputs in form of chemical fertilizers and the hybrid seeds . Following table gives crop wise area-coverage from 1955-56 to 1985-86 (in gap of 4-5 years) along with the total production in those years just to see the situation changing with time. Also given is the calculated value of productivity of those crops in the years under study for reference and comparison later:

TABLE- PRODUCTIVITY OF CROPS

Crop	Particulars	1955-56	1961-62	1965-66*	1970-71*	1975-76*	1981-82*	1985-86*
Paddy	Area Covered (acre)	25503	35027	37065	37065	37065	37065	37065
	Production (tons)	7400	9700	4000	10000	10000	7000	12000
	Productivity (kg / acre)	290	277	106	270	270	189	324
Jowar	Area Covered (acre)	99043	59673	76601	76601	66717	74130	56833
	Production in tons.	14500	11100	27000	29000	26000	41000	26000
	Productivity (kg/acre)	146	186	352	379	390	553	457
Wheat	Area Covered (acre)	565471	624337	528794	669641	622692	597982	649873
	Production (tons).	115300	147700	126000	172000	198000	236000	245000
	Productivity (kg.acre)	204	237	238	257	318	395	377

Gram	Area Covered (acre)	88511	80704	88956	81543	106253	153202	165557
	Production (tons).	7700	15100	19000	15000	23000	45000	49000
	Productivity (kg./acre)	87	187	214	184	216	294	296

During 1994-95 The values of area* , production and productivity have been reported as under:

Paddy: 56747 acre: 19676 ton : **347 kg/acre.**

Jowar : 35120 acre : 9643 ton : **275 kg/acre.**

Wheat : 291029 acre: 241346 ton : **829 kg/acre.**

Gram : 66635 acre : 37739 ton : **566 kg/acre.**

* Area given here in hectares has been converted to acres using 2.471 multiplier.

Reference: The District Gazetteer - SAGAR (1970) and SAGAR- District Supplement 1992 Important Divisional Statistics (Divisional Statistics Office), Sagar 1996

LATER DEVELOPMENT:

Reports from district office of Agriculture Deptt. received in 2009 have given similar details of production and productivity of various crops for 2003-04 to 2007-08. The data related to major four crops as above are presented in the table given as under :

TABLE- CROP- PRODUCTIVITY

Crop	Particulars	2003-04	2004-05	2005-06	2006-07	2007-08
Paddy	Area Covered (acre)	23969	23475	21251	20756	21498
	Production (tons)	6000	5500	4600	4300	4700
	Productivity (kg / acre)	250	234	216	207	219
Jowar	Area Covered (acre)	16803	13838	9637	9143	10625
	Production in tons.	9200	6100	4100	4100	4900
	Productivity (kg/acre)	548	441	425	448	461

Wheat	Area Covered (acre)	399808	408703	404750	404503	-
	Production (tons).	183700	170300	174700	172600	-
	Productivity (kg.acre)	459	417	432	427	-
Gram	Area Covered (acre)	532253	483822	421700	-	-
	Production (tons).	176400	177600	219530	-	-
	Productivity (kg./acre)	331	367	521	-	-
Reference : Report provided by Dept. of Agriculture (Sagar District) 2009						

Above mentioned data makes it clear once again that overall productivity depends upon many factors and not only guided by application of chemical fertilizers and hybrid seeds as promoted by Green Revolution.

LIVE STOCK :

(Helpful In Traditional Agriculture)

Since bullocks were major work-force for ploughing as well as material transportation , it seems essential that their situation also be studied . The earlier reference as mentioned above gives number of ploughs and carts to be 63,000 and 22,000 respectively. A rough and minimum estimate of bullocks is double of number of ploughs i.e. 1,26,000.

Information regarding number of cows, bullocks and calves counted during last phase of eighteenth & second decade of nineteenth century is also available in the District Gazetteer of Sagar (1970). The available information is as follows:

TABLE- THE COWS' FAMILY LIVE-STOCK

S.No.	Period	Cows	Bullocks	Calves	Total
1	2 nd BANDOFAST of this area (years: Between 1890 & 1895)	1,43,886	1,39,668	1,51,653	4,35,207
2	3 rd BANDOFAST of this area (years: Between 1910 & 1913)	1,46,030	1,32,948	1,87,727	4,66,705
3	1921	4,19,278			4,19,278
4	1941	5,68,832			5,68,832
5	1946	5,53,910			5,53,910
6	1956	6,45,133			6,45,133
7	1961	6,76,382			6,76,382
Reference : District Gazetteer of Sagar (1970)					

Regular increase in the cow- related livestock till 1961 proves a fact that people had strong affiliation towards cows and bullocks possibly and emphatically as these were helpful in all aspects of farming operations.

AGRICULTURE MACHINERY AND IMPLEMENTS:

Being a traditional agrarian society people here were used to adopt indigenous practice in all aspects of agriculture and the implements which they used were mostly fabricated, made and repaired right within the village. Each village had presence of needed artisans like carpenters and blacksmiths. Local fiber (SANA) was used to make necessary ropes / twines or cords by farmers themselves. Rearing of cows always provided them calves to help ploughing, drawing water from wells or cart-transportation. In this way society was almost self dependent and contented.

Influence of foreign intervention in all spheres of life did try to change life of people making it more and more dependent on external sources & resources. Transformation of agricultural implements could be seen as a measure of such a change.

According to an account of village implements given in SAGAR-SAROJ (edited by R.B. Dr. Hiralal (1922) on the basis of Sagar-district Gazetteer (published around 1907), 63,000 bullock-driven wooden ploughs were in operation while there were

22,000 bullock-carts for easy transportation of men and materials. The District Gazetteer of Sagar (1970) and its supplement published later in 1992 give certain information as follows:

TABLE-:AGRICULTURE IMPLEMENTS/ MACHINERY)

S.No.	Year	Wooden Plough	Iron Plough	Bullock-cart	Disel pump	Electric pump	Tractors
1	1956-57	90,327	41	44,974	94	27	108
2	1957-58	89,612	51	46,172	82	24	112
3	1958-59	91,017	32	46,402	141	30	102
4	1959-60	94,092	n.a.	48,881	134	39	108
5	1960-61	98,760	118	51,812	178	63	169
6	1961-62	n.a.	n.a.	51,494	259	77	162
7	1966	85,570	965	55,926	382	172	270
8	1972	1,00,294	644	65,118	2,999	1,307	500
9	1977	94777	1,831	66,270	3,830	2,873	1,249
10	1981-82	1,00,449		70,026	5,397	5,378	1,753
11	1985-86	1,10,168		63,425	7,585	7,620	2,454
12	1986-87	1,01,128		62,026	7,921	8,298	2,580
Reference: District Gazetteer -Sagar (1970) & Sagar District Supplement (1992)							

HORTICULTURE:

Like in other *Bundelkhand* districts people wherever possible had been planting fruit bearing, medicinal and the trees religiously considered as important. Such trees were not damaged by anybody even if they were planted on road sides. Development and maintaining mango- groves was most popular practice / hobby of people.

The garden crops included all vegetables but potato was grown here in abundance. Sagar had been famous for its potato cultivation. In some areas betel-growers had settled coming from Rewa and Mahoba and had started producing betel-leaves. Sugarcane as mentioned earlier too was very popular producing good variety of jaggery (**GUR**) . Cotton was grown as a crop near villages which were inhabited by weaver communities. Essential spices were also grown to be traded and consumed locally.

ARBORICULTURE:

Along the road sides, earlier rulers of this region and even British Administrators preferred shade giving and fruit bearing trees as they also considered it helpful to pedestrians and bullock-carts transporting material from one place to other . On the

roadsides, **reunjha, arjun, sheesham, babul, karanj, neem, kachnar, akashneem, maharukh, bargad, goolar** and **mango** used to be commonly planted. Other naturally growing species like **palash, mahua, seja, bel, saaj, kaankar, and tendu** used to be protected if they grew on the roadsides.

In villages, **bargad, goolar, pipal, imli**, mango, **jamun, munga, bel, lasodha, neem** and **mahua** were normally planted. In the ruins or in the house-premises, **sitaphal** had been seen growing everywhere. There are many other varieties of plants, climbers, bushes, parasites, and grasses which grow or are grown within and outside the forest-areas in Sagar district.

Unfortunately concept of plantation of fruitful and shady trees on the road-sides was totally forgotten by the Indian generation of Forest Officers after independence who give priority to thorny trees alongside the roads these days.



.....

5 . TIKAMGARH

AGRICULTURE:

Agriculture has always been predominant occupation in this district , particularly in rural area irrespective of land being of poor quality. People were by and large, tradition- bound and hard working. They believed that farming as a profession was the best of all. Different census figures also support that majority in this district have been farmers , farm-workers and dependents.

Like in other *Bundelkhand* districts two cropping seasons *KHARIF* (*siyari or katka*) and *RABI* (*unhari or Chaiti*) were prominent. Crops in these two seasons are more or less the same as reported in case of *Bundelkhand* in general and the districts already covered viz. Chhatarpur, Damoh, Panna and Sagar, in particular. Choice of crops out of the comprehensive list presented earlier, depended upon soil-types , rainfall pattern and the availability of artificial irrigation facilities.

CULTIVATION CALENDAR:

Nakshatras played very important role in all agricultural operations. Position of moon on sky also governed many steps . For knowing auspicious day & time for certain operation farmers used to consult village-astrologer-cum-priest , who were mostly learned *Brahmins*. This aspect has been extensively presented in the general chapter on *Bundelkhand* (Chapter I) in this volume.

CROPPING PATTERN:

Cropping Seasons:

The *KHARIF* cropping season (running along with rainy months) was traditionally more popular here amongst cultivators because of lack of artificial irrigation available after rains. Other factor was the poor quality soils here which preferred coarse grains. Natural choice of farmers included , *jowar*, *kodo*, *rali*, *kutki*, *saman*, *lathara* (*phikar*), *moong*, *urad*, *arhar*, *paddy* (rice), maize & *til* (sesame) etc . Cotton was traditionally very popular crop as it produced yarn needed for working by large number of weavers present in the district. The *RABI* cropping season included several cereals & pulses viz. wheat, barley, *pissi* (a soft-red variety of wheat) , gram, *masoor*, *moth* , *matara* and linseed , an oil-seed .

Special crops :

Only in fields near water reservoirs or wherever farmers were able to dig a *katchcha* well or build masonry well by themselves other crops could be possible. These were garden crops (fruits, vegetables and spices), sugarcane & betel etc. These crops were popular because of their giving better returns. Also the fibre crops like *san* and *ambadi* were grown as these were used as raw material for making ropes, mats, & *pakhri* etc.

Dufasli Area:

These were selected fields where growing two crops in a year was possible one after another. Here mostly *KHARIF* crops were followed by *RABI* crops. The two-crop area known as *DUFASLI* , was quite limited.

References of some crops like *moong*, *urad*, and paddy being grown in both cropping seasons has also been reported in the Eastern States' Gazetteer (1907) discussing the then ORCHHA Princely State.

MIXED CROPPING AND CROP-ROTATION:

Most popular mixtures of crops sown together were: ***Jowar + Arhar ; Cotton + Jowar ; and Wheat + Gram.***

The benefit of crop-rotation were known to farmers . Usual rotation was as follows:

ONE CROP AREA : ***Jowar + Arhar + Urad*** in the first year followed by *Cotton + Arhar* or *Jowar alone*. Wheat was normally grown in the fourth year.

TWO-CROP AREA : Wherever second crop was possible *KHARIF* crops were followed by usual *RABI*-crops and vice versa.

PRESENT PATTERN OF CROPPING:

Major crops reported to be grown in this district in the years around eighties have been *Jowar*, *Urad* ,*Moong*, *Til* and paddy in *KHARIF* season and *Wheat* ,*Gram* & *Barley* during *RABI*. Sugarcane continued as a favourite crop in some areas. Other crops which continued to some extent were *Rape*, *Mustard* , *Groundnut* & the *Linseed* as oil-seeds and *Bajara* as a cereal-crop. *Rali* and *Kakun* too continued for some years.

During these years coverage of *RABI* –crops took over from those grown during *KHARIF* season because of expansion of artificial irrigation in the district. Simultaneously Soybean entered as an important cash crop which altered entire crop-cycle. This was the beginning of farmers getting some money but unfortunately region becoming dependent for essential food and proper nutrition which affected normal health of common people. Cultivation of Soybean needed fields where rain water was not allowed to stand ; this hit the usual natural phenomena of ground water recharging through farm fields during rainy season.

Following table shows crop-wise coverage for Tikamgarh for some years and the changes with time :

TABLE- CROP-WISE COVERAGE

Year	Area under principal crops (ha)						
	<i>Jowar</i>	<i>Paddy</i>	<i>Urad</i>	<i>Moong</i>	<i>Sesamum</i>	<i>Soybean</i>	<i>Sugarcane</i>
1955-56	41000	16000	N.A.	N.A.	20000	Not grown	1400
1965-66	37000	23000	N.A.	N.A.	10000	-do-	3100
1975-76	40000	26000	N.A.	N.A.	11000	-do-	900
1986-87	29000	31300	24200	5200	9500	7300	200
1988-89	49300	28800	25500	5400	11400	12100	1100
1990-91	31500	27400	28000	N.A.	19000	17500	600
1992-93	23400	25300	30100	N.A.	15900	34600	700
1994-95*	14213	22965	26762	N.A.	N.A.	50060	N.A.
Year	Continued-----						
	<i>Wheat</i>	<i>Gram</i>	<i>Barley</i>	<i>Linseed</i>	<i>Masur (Lintel)</i>	<i>Groundnut</i>	<i>Condiments / Spices</i>
1955-56	23000	1100	1200	800	N.A.	N.A.	1100
1965-66	24000	1200	900	900	N.A.	N.A.	1100
1975-76	60000	1700	1400	1600	N.A.	N.A.	N.A.
1986-87	80000	25500	6400	1300	3400	3400	1700
1988-89	87600	28700	6300	2600	N.A.	5300	1700
1990-91	97700	28100	6400	N.A.	N.A.	5700	1300
1992-93	108100	26600	N.A.	N.A.	N.A.	7400	1600
1994-95*	117778	26967	N.A.	N.A.	3164	N.A.	N.A.
Reference: -- District- Gazetteer (Tikamgarh) 1995							

Latest situation of major crops and its coverage as reported in District Statistics Handbook (2009) is presented as follows:

TABLE- CROP COVERAGE
(Status : June 2009)

Year	Area under principal crops (ha)							
	Wheat	Gram	Jowar	Paddy	Maize	Arhar (tuar)	Urad	Sugarcane
2004-05	106986	32901	5548	19891	2288	334	62978	530
2005-06	94444	29687	6226	18373	2207	374	64359	461
2006-07	58125	21284	11691	14485	2392	315	62193	394
2007-08	22748	7685	27003	11658	3075	485	69534	259
2008-09	107434	24218	20671	12907	3197	218	71483	198
Continued----								
Year	Area under principal oil-seed-crops (ha)							
	Sesamum (TIL)	Linseed	Groundnut	Mustard	Soybean	Fodder crops		
2004-05	18095	452	17531	13942	30686	22952		
2005-06	21935	416	17681	17006	28352	19290		
2006-07	22866	290	14852	13830	24869	18173		
2007-08	38907	144	15813	4949	32878	16535		
2008-09	33897	204	16471	24023	37068	16116		
Reference: District Statistics Booklet (Distt. Planning & Statistics Office, Tikamgarh) 2009								

Area under different major crops grown presently in Tikamgarh district as presented above gives some points worth-noting:

1. Area under wheat, gram and mustard diminished during the years 2007-08, which is understood as during this year *Bundelkhand* faced severe drought condition.
2. Soybean undoubtedly showed preferential interest of farmers but at the same time *TIL* (sesamum) and *Urad* have not shown any remarkable change in their coverage.
3. Fodder crops showed gradual decrease which can be linked to farmers reducing their cattle-population. This can be again verified later in this chapter while presenting preference of machines in farming operations .

IRRIGATION SITUATION:

Earlier reports mention chief sources of irrigation as masonry wells and tanks. Presence of large lakes in Baldeogarh, Jatara and Tikamgarh provided considerable irrigation to surrounding fields. Usual devices for drawing water from the wells were

TARSA , a leather bag and Persian wheel (RAHAT) , both worked by a pair of bullocks and three persons. DHONDI was employed for taking water from tanks/ ponds usually worked by ten to fifteen persons. This was very labour intensive device.

In the beginning small length canals were taken out from larger reservoirs like Madan-Sagar of Jatara and Bir-Sagar of Birsagar village. The ancient tanks built during *chandella* period provided direct irrigation in this district for a very long period of history and are still very much active and useful. Around 1961, such tanks with a capacity to provide irrigation for over 100 acre each were 65.

Around mid-fifties canals were promoted which soon became important sources occupying a place second only to dug wells in Tikamgarh district. This has been quoted as the most important gift to this district of post-independence progress in irrigation. Tube-wells and Lift-irrigation schemes too were popularized later .

District Gazetteer of Tikamgarh (1995) has given information of **source wise irrigation coverage** for number of years at different interval. Recent statistics available up to 2009 also gives such data for later years . These are included in following presentation :

TABLE- SOURCE WISE IRRIGATED AREA

S.No.	Year	Source-wise Irrigated Area (ha)				Sum of the area by all sources	
		Wells	Tanks	Canals	Others		
1	1955-56	31,293	7,621	3,115	-	42,029	
2	1960-61	31,648	7,010	4,080	91	42,829	
3	1965-66	35,447	2,998	5,179	141	43,765	
4	1975-76	57,690	5,887	13,854	2,349	79,780	
5	1986-87	85,800	7,100	13,900	3,600	1,10,400	
6	1988-89	89,900	4,900	13,400	3,400	1,11,600	
7	1990-91	95,100	5,700	16,300	6,200	1,23,300	
8	1992-93	1,07,300	7,900	17,000	7,700	1,39,900	
Total in quoted eight years		5,34,178 77.01%	49,116 7.08%	86,828 12.52%	23,481 3.39%	6,93,603	
Reference: District Gazetteer (Tikamgarh) -1995							
S.No.	Year	Source-wise Irrigated Area (ha)					Sum of the area by all sources (ha)
		Dug- Wells	Tanks	Canals	Tube- wells	Others	
1	2004-05	1,35,964	6,897	12,832	12,848	12,982	1,81,523
2	2005-06	1,23,574	10,513	13,480	8,873	6,586	1,63,026
3	2006-07	1,10,357	6,273	6,700	8,000	4,374	1,35,704
4	2007-08	42,941	473	2,943	4,149	2,413	52,919

5	2008-09	1,29,889	7,351	9,528	9,735	11,820	1,68,323
Total in quoted five years		5,42,725 77.37%	31,507 4.49%	45,483 6.48%	43,605 6.22%	38,975 5.56%	7,01,495
Reference: District Statistics Handbook (Tikamgarh) 2009							

Above table clearly indicates supremacy of the dug-wells (77%) in irrigation of this district. Although canals have gradually taken over more area as compared to tanks and tube-wells in recent years yet position of the wells has not been challenged.

GREEN REVOLUTION LED COMMERCIAL FARMING:

Green Revolution techniques and processes in agriculture were pushed in Tikamgarh also by governments' strong forceful intervention. The much advertised scientific agriculture was based on almost all external inputs giving lever of agriculture in the hands of growing imports and industrial houses. The measure of this intervention could be understood by growing use of hybrid seeds, chemical fertilizers , poisonous agro- chemicals as insecticides and pesticides and investment on machines, petroleum and electricity.

Though change in pattern of agriculture started in fifties with India's first five year development plan but the American intervention in agriculture started with PL480 which transformed the situation. Farmers' knowledge and experiences were downgraded and more & more external input oriented process in agriculture took over. Information available to us through District Gazetteer and other reports is presented as follows :

USE OF CHEMICAL FERTILIZERS AND HYBIDE SEEDS:

Chemical fertilizers promoted in agriculture were of three types known as Nitrogenous, Phosphatic and Potassic. Nitrogenous included Urea, Calcium Ammonium Nitrate, Ammonium Sulphate and Di-ammonium Phosphate (DAP) ; the phosphatic included mainly Super Phosphate and also the DAP. Potassic fertilizer was mainly Murate of Potash.

1995 report of use of fertilizers in this district goes on to say that Tikamgareh district progressed rapidly to move among the top users in the State of Madhya Pradesh. The data reported for some years in eighties and nineties are presented in the tables below:

TABLE- FERTILIZER- DISTRIBUTION
(in Tonnes)

Year	Nitrogenous	Phosphatic	Potassic
1973-74	2,138	1,208	342
1975-76	2,254	1,342	300
1979-80	1,912	1,154	185
1985-86	8,735	5,304	439
1987-88	6,679	4,394	310

TABLE- Per Hectare Use of Fertilizers (kg)

Year	Nitrogenous	Phosphatic	Potassic	Total
1980-81	9.64	6.49	1.38	17.51
1985-86	26.89	16.33	1.35	44.57
1986-87	16.74	12.06	0.77	29.57
1987-88	21.40	14.08	1.00	36.48
Reference; District Gazetteer (Tikamgarh) 1995				

Despite push in fertilizers' use farmers here continued their traditional practices of green manuring, crop-rotation and mixed cropping etc. for retention of soil's fertility. They also had basic understanding and widely recognized that legume crops like *URAD* & *MOONG* etc. help in building soil-health. Compost making had been promoted in initial years of First Five Year Plan but could not be sustained because of easily available ready made chemicals in the market.

THE SEEDS:

High Yielding Variety (HYV) - seeds promoted during those years were :

- WHEAT: Started with *sanora-64* & *Larma* varieties and jumped to *sarvati*, *Sonara*, *Kalyan Sona*, *Sonalika*, 308, R.R.21, S.D.M.-1553 and S.D.M.-1925 etc.
- PADDY : *padma*, *jaya*, *bala*, *Krishna*, *anupma*, *kavers*, *rutna*, & *lallu-14*.
- SOYBEAN: *Brag* & *Black* varieties
- SESAMUM: G-35, 128, and N-328.
- URAD: *Mesh-48*, *Type 55*, and *Type-79* .
- TUR: *sharda*, *Type-21* and *148*.
- MOONG: *Krishna*, *kopergaon*, and *pusa-baisakhi* .

and some others related to Maize and Sunflower crops etc.

Area-coverage of high yielding seeds (better to say the High Response Variety seeds to the use of chemicals) which were promoted during those years is presented in following table :

TABLE- COVERAGE OF H.Y. / H.R. SEED- VARIETIES (in hectare)

Year	Paddy	Wheat	Jowar	Maize	Total
1974-75	1,500	37,800	1,500	-	40,800
1975-76	1,500	42,400	1,300	100	45,300
1976-77	2,200	44,700	1,600	100	48,600
1980-81	5,100	48,000	5,000	100	58,200
1985-86	5,900	71,800	7,600	-	85,300
1986-87	5,000	63,500	7,000	-	75,500
1987-88	7,200	88,000	2,700	1,200	99,100
Reference; District Gazetteer (Tikamgarh) 1995					

LATEST SITUATION:

Latest situation with regards to use of hybrid (termed as improved) seeds, chemical fertilizers & chemical compounds as insecticides and pesticides.etc. as reported in district's latest Statistics Handbook (2009) showing the trend is presented in table as follows:

TABLE: SEEDS-FERTILIZERS –CHEMICALS ETC.
(Status : 30th June 2009)

Year	Improved Seeds		Chemical Fertilizers	
	Area of coverage (ha)	Amount (Quintal)	Area of Coverage (ha)	Amount (Tonne)
2004-05	3,33,900	12,014	2,67,000	30,865
2005-06	2,60,900	7,773	32,400	36,152
2006-07	27,900	23,480	27,900	5,990
2007-08	1,65,600	32,551	1,35,700	11,928
2008-09	78,100	55,628	50,000	21,743
CONTINUED---->>>>				
Year	Plant-Protection		Seed-Treatment	
	Area of coverage (ha)	Amount (litre)	Area of coverage (ha)	Amount (Quintal)
2004-05	3,100	2,600	186.30	62.10
2005-06	4,300	3,468	106.60	32.0
2006-07	7,250	1,919	58.76	29.34
2007-08	1,300	1,209	277.00	106.00
2008-09	2,700	2,739	52.00	130.0
Reference: District Statistics Handbook (Tikamgarh) 2009				

USE OF IMPLEMENTS IN AGRICULTURE:

Traditional agriculture in Tikamgarh like other districts was self-supporting itself at the village level. All wooden and some iron parts were fabricated and repaired right within every village by indigenous artisans. Introduction of so called “Scientific Agriculture” under Green Revolution brought not only new seeds and chemicals but also variety of implements and machines running on diesel and petrol and / or electricity. A trend in change of village life and farming operations could be understood by looking at the way machines were popularized & introduced.

The 1995-Gazetteer has given some information about agricultural implements being used and gradual change which occurred from the year 1951 to 1992 at the interval of 5 years, which is presented below:

TABLE- AGRICULTURAL IMPLEMENTS

Year	Ploughs		Carts	Irrigation Pumps		Tractors
	Wooden	Iron		Oil-engine	Elec. Motor	
1951	58,628	-	23,553	-	20	28
1956	65,627	17	28,464	46	05	19
1961	90,962	125	32,879	42	12	39
1966	71,531	174	36,135	79	17	24
1972	80,307	817	41,519	902	755	84
1977	84,452	185	45,793	1,980	2,068	185
1982	90,097	522	24,269	1,979	3,972	305
1987	97,553	690	57,284	2,867	10,413	970
1992	51,537	459	24,003	1,794	10,871	862
Reference: District Gazetteer (Tikamgarh) 1995						
EXTENSION OF ABOVE INFORMATION FOR THE YEARS 2004 TO 2009						
2004-05	85,276	1,383	38,632	34,101	67,595	4,330
2005-06	81,743	1,427	33,937	18,577	52,383	4,204
2006-07	81,358	1,406	33,260	18,876	52,593	4,222
2007-08	76,318	1,431	31,650	15,820	42,007	4,265
2008-09	67,732	2,374	25,009	18,497	43,328	5,597
Reference: District Statistics Handbook Tikamgarh (2009)						

Above figures are indicative of exponential growth in number of industrial machines like Iron-Plough, Oil-engines, Electric Motors and Tractors etc. Dependence over these

machines and subsequently on fossil fuel also made farmers more & more debt-ridden. This in later years became major reason of farmers' committing suicide or their new generation developing distaste towards agriculture and migrate to cities to earn basic livelihood.

LIVESTOCK USEFUL IN AGRICULTURE:

Bundelkhand region and especially its southern districts had dense forests and ample grazing land. Therefore, animal husbandry was very popular and also more remunerative than agriculture itself. Most agricultural operations also needed pair of bullocks and since traditionally cow's milk was considered healthy, these had earned great importance in life of people here. From religious point also cows were protected, their dung as well as urine were found useful because of its medicinal and insecticidal properties.

Deforestation followed by trend of commercialization in society hit this aspect and slowly animal husbandry took turn to give more importance to she- buffaloes because their fat rich milk fetched more money. From agriculture angle male buffaloes are not suitable for Tikamgarh as these found their use mainly in rice-cultivating regions.

THE CATTLE POPULATION:

Following is the information about cattle population (belonging to cow's family) as reported in 1995-Gazetteer and later in the 2009- Statistical Handbook:

TABLE- LIVE-STOCK (Cow-family)

S.No.	Year	Cattle (Cow-family)			Total	% of total live-stock
		Bullocks	Cows	Calves		
1	1951	No separate Data	No separate Data	No separate Data	4,49,756	61.35
2	1956	-do-	-do-	-do-	4,59,616	55.18
3	1961	-do-	-do-	-do-	4,88,840	55.02
4	1966	-do-	-do-	-do-	4,79,541	57.15
5	1972	-do-	-do-	-do-	5,14,366	58.38
6	1977	-do-	-do-	-do-	5,08,800	56.16
7	1982	-do-	-do-	-do-	5,18,500	53.97
8	1987	-do-	-do-	-do-	5,53,600	59.30
9	1992	-do-	-do-	-do-	5,17,600	54.89
Reference : District Gazetteer (Tikamgarh) 1995						

CONTINUING WITH LATEST INFORMATION:.....						
10	2004-05	2,16,936	1,36,341	1,13,856	4,67,133	47.77
11	2005-06	1,64,591	1,09,495	1,17,938	3,92,024	46.08
12	2006-07	1,62,601	1,05,281	1,11,989	3,79,871	45.02
13	2007-08	1,56,849	96,463	94,832	3,48,144	43.85
14	2008-09	1,35,211	87,104	93,912	3,16,227	40.90
Reference: District Statistics Handbook –Tikamgarh (2009)						

Above table clearly shows decrease in cattle population particularly of cows, calves and bullocks from 61% to 40% . Emphasis over machines for agriculture and the dairy-milk, for which she-buffaloes are preferred, have rendered historical neglect of cows. These could be seen now-a-days anywhere on roads , around garbage dumps, wandering in localities and farm- fields. People in rural as well as urban areas have developed a tendency to milk them and then let free to roam, feed themselves the rubbish and many times led to slaughter-houses.

HORTICULTURE:

Forests being dominant in *Bundelkhand* , people used to get variety of fruits from their surroundings. Landlords or the ruling families used to possess groves with fruit plants mainly of mango , guava, lemon , oranges , plantains , *khirni*, jackfruit, and pomegranate etc. The plants of custard apple, *Aonla*, *Jamun*, *Mahua*, *Imli* (tamarind) , *achar* & *Ber* etc. were found in forests or roadsides. Forest fruits were extremely helpful for people's survival during famines or droughts occurring in this region. Since fruits were not commercial items almost everybody had access to them . During famines or droughts even the reserved forests were left open for people to gather fruits from there free of any charge.

Farmers used to plant such trees in their fields. Other useful trees like *Peepal*, *Neem* and *Bargad* etc. were grown naturally or planted besides temples or tanks in almost all villages . Garden crops included vegetable such as potato, onion, garlic, ginger, brinjal, carrots, radishes, melons, several varieties of gourd and spices like turmeric, coriander, cummin, chillies, *methi*, *ajwain* & *rai* etc. Garden crops were mostly taken by specific caste families of *kachhis* who were experts in this farming. For irrigation they mostly used *katchcha* or masonry wells.

Another specific families known as *barai* (*Chaurasias*) used to grow betel crop . The betel-leaves were popular and fetched good market including exports to big cities. Several varieties of betel were grown here such as : *bilhari*, *kankeri*, *kapoori*, *bangla*, & *jinswar* etc. District Gazetteer of Tikamgarh (1995) informs that village Chandera of this

district was famous for the quality of its betel leaves. Jatara was famous for plantains grown there.

Lack of irrigation facilities up to the first quarter of 20th century had discouraged common farmers for taking up horticulture in any appreciable scale. Other big factor was lack of market-outlet for local fruits because of poor road conditions and appropriate transport within limited period to avoid rotting of fruits.

In the year 1950-51 total area under horticulture was 900 ha which increased with passing years as irrigation facilities expanded in this district. The area covered by horticulture for some years have been quoted there as follows:

TABLE- AREA OF HORTICULTURE

S.No.	Year	Area covered by Fruits/ Vegetables (ha)	Area covered by spices & condiments (ha)
1	1950-52	900	1000
2	1965-66	-	1100
3	1976-77	2000	1800
4	1977-78	2025	2177
5	1985-86	2500	1900
Reference: District Gazetteer (Tikamgarh) 1995			

Area covered by fruits, however, never exceeded 10% of the total under garden crops. Similarly turmeric & ginger's cultivation exceeded amongst the spices & condiments because soils and climate of Tikamgarh suited for its production.

Area of coverage and production of different items under horticulture and field-forestry as reported in Development Handbook of Tikamgarh for the year 2009 gives following information :

TABLE- HORTICULTURE PRODUCTS

Year	Area Coverage (ha)				Production (quintal)	
	Fruits	Vegetables	Spices	Flowers	Fruits	Vegetable
2004-05	2815	19881	2199	33	334670	27593
2005-06	2843	22377	2006	35	337740	310592
2006-07	7140	18407	1827	12	544530	364535
2007-08	1027	7131	1509	17	196840	831900
2008-09	1150	30270	2895	19	230200	372320
Reference: District Development Handbook (Tikamgarh) 2009						

Chapter - V

THE FORESTS

Bundelkhand region in all respects has been a densely forested area from ancient times. These forests engulfed several religious places, holy hills and *ashramas* of famous *RISHI / MUNIES* and birth/work place of ancient poets like *VYASA & VALMIKI* and *SANT TULSIDAS* of 16th century AD, the authors of great epics, *MAHABHARATA*, *RAMAYANA* & *RAMA-CHARIT MANAS* respectively.

Forests also had enormous wealth of valuable timber & fruit trees and innumerable important medicinal plants comprising almost all grown in central India zone. Apart from important wealth related to flora there was also good biodiversity in all spheres including the fauna. Available information related to forests and its present situation district wise for Chhatarpur, Damoh, Panna, Sagar and Tikamgarh is being presented in following paragraphs.

1. CHHATARPUR

Chhatarpur district in past had been under dense forests except for some northern area which possessed less vegetation. The 1907 Gazetteer describes the then forest not of much value. Most probably in British eyes only wood-mass of the forests might have been important. The common plants reported to be existing then and its uses have been briefly reported in aforesaid Gazetteer which is presented below :

TABLE- MOST COMMON PLANTS

S.No.	Local Name	Botanical Name	Uses
1	<i>ACHAR</i>	<i>Buchanania latifolia</i>	Fruits eaten; the kernel is called CHIRONJI
2	<i>AILA</i>	<i>Caesapinia sepiaria</i>	Timber made into charcoal which forms an important constituent of country gun-powder.
3	<i>AAM</i>	<i>Mangifera indica</i>	Fruits eaten; timber used as fuel; material for buildings and in making agri. Implements.

4	BABUL	<i>Acacia arabica</i>	Timber used in making Agri. Implements & buildings; leaves used in tanning leather.
5	BAHERA	<i>Terminalia belerica</i>	Fruits used in medicines and in dying.
6	BAANS	<i>Dendrocalmus strictus</i>	Used in buildings and making baskets & mats etc.
7	BARIA (BARGAD)	<i>Ficus indica</i>	Fruits eaten; tree worshipped.
8	BEL	<i>Aegle marmelos</i>	Sacred to Lord Shiva-leaves are offered to Him , Fruits used medicinally to treat several diseases.
9	BER	<i>Zizyphus jujuba</i>	Fruits eaten, timber used in buildings and agri. Implements.
10	AMRUD	<i>Psidium guava</i>	Fruits eaten
11	BIJO	<i>Pterocarpus marsupinum</i>	Timber very strong; its pith (saar) is used as medicine, its wood does not burn easily. Indian drums are made and also the agricultural . implements.
12	CHHIULA (DHAK)	<i>Butea frondosa</i>	Timber used as fuel, flowers (<i>tesu</i>) used for extracting colour; bark for rope making. It is a medicinal plant.
13	DHAMIN	<i>Grewia tiliaefolia</i> or <i>G. vestita</i>	Timber used in making carriage shaft and <i>kaanwars</i> (sticks carried on the shoulders with load at each end)
14	DHAWA	<i>Anogeissus latifolia</i>	Timber used in buildings; agri. Implements; leaves used as tanning leather. Flowers used in medicinal preparation.
15	GHONT	<i>Zizyphus xylopyera</i>	Fruits used in tanning leather; leaves as fodder for goats.
16	GUNJA	<i>Bridelia retusa</i>	Timber used in making agri. Implements & combs ; bark in making frames for sieves.

17	IMLI	<i>Tamarindus indica</i>	Fruits eaten; timber used in buildings.
18	INGUA	<i>Balanites roxburghii</i>	Kernel of fruit useful in colic
19	JAMUN	<i>Eugenia jambolana</i>	Fruits eaten ; timber as fuel. It is a medicinally important tree.
20	KAITHI	<i>Feronia elephantum</i>	As above
21	KARAUNDA	<i>Carrissa spinarum</i>	Fruits eaten
22	KARI	<i>Saccopetalum tomentosum</i>	Timbers used in making carriage shafts and <i>kanwars</i>
23	KHAIR	<i>Acacia catechu</i>	Used in preparing KATTHA; timber to make charcoal.
24	KIRWARA (amaltas)	<i>Cathartocarpus fistula</i>	Pods used as medicine
25	KOUHA (arjun)	<i>Terminalia arjuna</i>	Timber used in making boats
26	KUSAM	<i>Schleichera trijuga</i>	Used in dying
27	MAHUA	<i>Bassia latifolia</i>	Timber used in building and agri- implements; flowers used as food and for distilling country-liquor, seeds provide useful oil.
28	MAKOI	<i>Zizyphus aenoplia</i>	Fruits eaten
29	NIM	<i>Melia azadirachta</i>	Timber used in buildings, seeds provide oil, tree bears many medicinal properties.
30	OUNRI (aonla)	<i>Phyllanthus emblica</i>	Fruits eaten, timber used in roofing. Important medicinal plant.
31	PAPRO	<i>Gardenia latifolia</i>	Timber used in making combs, bark in making frames for sieves.
32	PIPAL	<i>Ficus religiosa</i>	Tree worshipped; fruits eaten; leaves form fodder for camels, lac is cultivated. An all round medicinal tree.

33	REONJHA	<i>Acacia leucophlea</i>	Wood for posts, pegs, young pods eaten as vegetables
34	SAGON (teak)	<i>Tectona grandis</i>	Timber used in buildings and in making chairs, tables, boxes etc. leaves and seeds are used as drugs.
35	SAIMAR	<i>Bombax malabaricum</i>	Pods produce a silky down, used in padding pillows and bedding. A medicinal plant.
36	SAJ	<i>Terminalia tomentosa</i>	Wood used in making agri- implements
37	SALAIA	<i>Boswellia serrata</i>	Timber used for making combs
38	SANDAN	<i>Ougeinia dalbergioides</i>	Leaves used for curing dysentery
39	SEJA	<i>Lagerstroemia parviflora</i>	Timber used in buildings and agri - implements
40	SHAHTUT	<i>Moros nigra</i>	Fruits eaten; timber used in buildings, leaves in silk-rearing
41	SITAPHAL (sharifa)	<i>Annona squamosa</i>	Fruits eaten
42	SIHARU (Harsingar)	<i>Boehemeria machrophylla</i>	Wood used for roofing; A yellow color is extracted from its flowers, A medicinal plant .
43	SIRSA	<i>Albizzia lebbek</i>	Wood used as fuel
44	TENDU	<i>Diospyros tomentosa</i>	Timber in making agri-implements; fruits eaten; Its pith gives ABONY, leaves for BIDI-making.
45	UMAR (gular)	<i>Ficus glomerata</i>	Tree worshipped; fruits eaten; Timber used as fuel.
Ref: GAZETTEER OF INDIA- -Eastern States (Bundelkhand) ; ed: Cap CE Luard (1907) (properties added)			
Note: Some more information about plants of <i>Bundelkhand</i> region will be presented in Volume 2 of this report under title “ POTENTIALS : PLANT WEALTH OF <i>BUNDELKHAND</i> ”.			

LATER STATUS OF FORESTS :

According to District Gazetteer (published in 1982) the total area of Govt. controlled forests (comprising Reserved and Protected Forests) in Chhatarpur district was 1999.64 km² (1,99,964 hectares), organized in 253 blocks and 733 compartments under six ranges viz. Bada Malhera, Bijawar, Buxwaha, Chhatarpur, Kishengarh, and Laundi. Mixed Forest (MF) occupied 33% of the area i.e. ca. 667 km² . According to revised survey of forests-types of India (1964) on ecological basis, forests within Chhatarpur district were classified as Southern Tropical Dry Deciduous (STDD) - Forests, sub-grouped under following types :

1. (5A/C3) STDD - Mixed Forests,
2. (5A/C1b) STDD - Teak Forests,
3. (5A / E1) *Anogeissus pendula* (**kardhai**) Forests, and
4. (5A/E2) *Boswellia serrata* (**salai**) Forests

From local consideration , however, forests in this district were classified on the basis of prevalence of species which used to be found in forest area and its preference of soil, slope and water retention capacity. These are Mixed Forests (MF), Teak forests (TF) , Bamboo Forests (BF) , Kardhai Forests (KF) , Salai Forests (SF), and Khair-Forests (KhF) . Regarding status of the forests around 1970's following information has been recorded in the District Gazetteer (1982) ::

TABLE- STATUS OF FORESTS TILL 70's

S.NO.	RANGE	BLOCKS	AVAILABLE FOREST TYPES					
			MF	TF	BF	KF	SF*	KH-F*
1	Bada Malhera	Bajna	Yes	Yes	Yes	-		
2		Baranad	Yes	Yes	Yes	-		
3		Sadwa	-	Yes	-	-		
4		Maharajganj	-	Yes	-	-		
5		Bhimkund	-	Yes	-	-		
6		Patan	-	Yes	-	-		
7		Palda	-	-	Yes	-		
8		Dalipur	-	-	Yes	-		
9		Bhagua	-	-	-	Yes		
10	Bijawar	Shahgarh	Yes	Yes	Yes	-		
11		Dilari	Yes	Yes	-	-		
12		Dilari A	-	-	Yes	-		
13		Bharatpura	Yes	Yes	-	-		
14		Kupia	Yes	Yes	-	-		
15		Deora	Yes	Yes	-	-		
16		Deora-A	-	-	Yes	-		

17		Saipura	Yes	Yes	Yes	Yes		
18		Pathar	-	-	Yes	-		
19		Amronis-A	-	-	yes	-		
20		Bakchur	-	-	yes	-		
21	Buxwaha	Dhanora	Yes	-	-	-		
22		Bhimgarh	Yes	-	-	-		
23		Jara	Yes	Yes	-	-		
24		Malar	Yes	-	Yes	-		
25		Samrachourie	-	-	Yes	-		
26		Bichhon	-	-	-	-		
27		Issarmau	-	-	-	-		
28		Kahanjani	-	-	-	Yes		
29		Sagoria	-	-	Yes	Yes		
30		Goranad	yes	-	yes	-		
31	Chhatarpur	Silon-						
32		Salaiyesha Pata	Yes	Yes	-	Yes		
			-	-	yes	-		
33	Kishangarh	Palkohan	Yes	Yes	Yes	-		
34		Raichur	Yes	-	-	-		
35		Matipura	Yes	Yes	-	-		
36		Kishangarh	Yes	-	Yes	Yes		
37		Raipura	Yes	-	-	Yes		
38		Jharkua	-	-	yes	-		
39	Laundi	Datla	Yes	-	-	-		
40		Patna	-	Yes	-	-		
41		Barigarh	-	-	-	Yes		
42		Akona	-	-	-	Yes		
43		Dongawa	-	-	-	yes		
* These forest types were reported to be found in all suitable locations preferred by relevant types of vegetation.								
Ref: M.P. District Gazetteer –Chhatarpur (1982)								

In order to have clear understanding of the nature and preference of **forests before 1980** , additional information from the same source is presented as follows:

Forest Type	Preferred nature of soils, rainfalls, and slopes etc	Associated Vegetation		
		OVER WOOD	UNDER WOOD	OTHERS
Mixed (MF)	All geological formations , Ill- drained soils except on the Traps ,	<i>Saja</i> <i>Dhaora</i> <i>Lendia</i> <i>Aonla</i>	<i>Achar</i> <i>Amaltas</i> <i>Jamrasi</i> <i>Papra</i>	<i>Karaunda</i> <i>Panwar</i> <i>Thuar</i> <i>Baikal</i>

	Rainfall: 1000-1600 mm	<i>Achar Mahua</i>	<i>Ber Bamboo</i>	<i>Neel Chhind Makor Chilati Gumchi</i>
Teak (TF)	Well-drained localities, Over the Trap-rocks, conglomerates or meta-morphics	As above ; TEAK being the prevalent species.		
Bamboo (BF)	Under-storey amidst the above types , On moist hill-slopes and upper reaches of <i>Nallas</i> where canopy of high forest is open.	This is associated with above forests		
Kardhai (KF)	On coarse , friable infertile , sandy soils on the exposed rocky and bolder stream areas over Vindhyaans and Archaeans	Reunjha Ghont Khair Ber Dudhi Thuar Lendia Salai	Ghont Dudhia Jamrasi amaltas	Baikal Makor Lumpa grass
Salai (SF)	Upper slope of hills with dry shallow and stoney soils	Moyan Kaim Dhaora	Ghont Thuar Makor	Shrubs climbers
Khair (Kh F)	Gravelly, eroded and barren sites under hard conditions	Thuar, Gadbu, Dhaora, Kardhai, Moyan, Seja, Ghont etc.		
The trees like Koha (<i>arjuna</i>) and Jamun were reported to be found normally along with the water course.				

UPDATED OFFICIAL REPORT OF FORESTS :

Reports provided by Divisional Forest Office, Chhatarpur in 2008 and later in 2012 give following information:

a. TOTAL AREA UNDER FORESTS:

S.No.	Forest Range	Area (ha) Report : 2008	Area (ha) Report : 2012
1	Buxwaha	36716.99	35717.10
2	Malhera	41414.03	40450.23
3	Bijawar	40772.31	39743.91
4	Kishangarh	35883.30	24499.45
5	Chhatarpur	28525.00	21752.57
6	Laundi	16654.85	13044.37
Total		1,99,966.48	1,75,207.63
<p>Note: There is difference in forest area reported for 2008 & 2012 which is probably because Chhatarpur Forest Division has ca. 17757.17 ha related to Panna Tiger Reserve, Crocodile Sanctuary , Upper Chandia Irrigation Project and some other purpose which have not been counted under forests of Chhatarpur district.</p>			

FOREST AREA ON THE BASIS OF FOREST-TYPES (2008):

Area covered by Forest-types (hectare)						Area under Plantation	Rarified Area	Denuded Fully	Encroached Area
Mixed Forest	Teak- Forests	Bamboo Forest	Salai Forest	Kar- dhai Forests	Khair Forests	(ha)	(ha)	(ha)	(ha)
26944.94	14972.76	-	8711.54	-	4714.44	11432.74	63359.31	39790.60	10111.47
TOTAL: 180037.80 hectare									
Ref: Report provided by office of DFO, Chhatarpur (2008)									

FOREST AREA UNDER DIFFERENT FOREST- TYPES -2008 (range wise) :

Forest Range	MF (ha)	TF (ha)	SF (ha)	OTHER TYPE (ha)	Sum Of the forest area Range wise (ha)
Bada Malhera	15442.09	6948.60	11137.27	7260.46	40788.42
Bijawar	15764.23	7669.49	5197.53	12002.23	40,633.48

Buxwaha	14349.74	10318.54	484.42	11,304.78	36,457.48
Chhatarpur	3562.12	5012.91	2398.14	16382.56	27355.73
Kishangarh	16121.69	1217.16	828.61	17579.36	35746.82
Laundi	1422.50	498.99	492.51	9881.30	12,295.30
TOTAL (ha)	66,662.37	31,665.69	20538.48	74410.69	193277.23
Note: Data in acres has been converted to hectares for comparison (1 ha=2.471 acre).					
Ref: Report provided by DFO, Chhatarpur (2008)					

AREA ON THE BASIS OF EXISTING FOREST SITUATION (2012)

Area covered under different category (hectare)				
Dens Forest	Rarified	Empty Area	Plantation Area	River/Nala Bed
55894.22	65410.62	37242.11	2920.16	792.56
TOTAL AREA: 162259.67 hectare				
Note: Mixed Forest in 98,481.43 ha and Teak Forest in 22,823.41 ha has been separately reported which may be a part of above.				
Ref: Report provided by office of DFO, Chhatarpur (2013)				

PLANTATION DURING 2012:

The data provided recently on the plantation is presented in a table which follows:

TABLE- PLANTATION IN FORESTS

Range	Location (area-ha)	Number of planted Species							
		Sagon	Bamboo	Aonla	Siras	Mahua	Neem	Khamer	Others
MIXED PLANTATION									
Chhatarpur	Patan (30)	12000	3000	3000	5000	200	-	3000	3800
	Hama (50)	20000	5000	5000	6000	200	0	5000	8800
	Patan (25)	10000	2500	2500	4000	200	0	2500	3300
Laundi	Jujhar Nagar (50)	20000	5000	5000	6000	200	0	5000	8800

	Bagmau (50)	20000	5000	5000	6000	200	0	5000	8800
Bada Malhera	Karki (25)	10000	2500	2500	4000	200	0	2500	3300
TOTAL:	(230 ha)	92000	23000	23000	31000	1200	0	23000	36800
BAMBOO PLANTATION									
Chhatarpur	Maharguwa (40)	0	25000	0	0	0	0	0	0
Laundi	Kharrohi (35)	0	21875	0	0	0	0	0	0
Bijawar	Kupia 355 (40)	0	25000	0	0	0	0	0	0
	Kupia 359 (35)	0	21875	0	0	0	0	0	0
Kishengarh	Jaitpur 473 (35)	0	21875	0	0	0	0	0	0
	Brajapura479 (40)	0	25000	0	0	0	0	0	0
Bada Malhera	Surajpur Kala 141 (35)	0	21875	0	0	0	0	0	0
	Maharajganj -80 (40)	0	25000	0	0	0	0	0	0
Buxwaha	Kairon 294 (35)	0	21875	0	0	0	0	0	0
	Gadhohi 295 (40)	0	25000	0	0	0	0	0	0
TOTAL	375 ha	0	234375	0	0	0	0	0	0
ENERGY FOREST (Departmental)									
Chhatarpur	Harrai (40)	10000	2500	2500	4000	400	1000	2500	2100
Laundi	Tatam (40)	10000	2500	2500	4000	400	1000	2500	2100
Bijawar	Badagaon (30)	7500	1875	1875	4000	-	1000	2500	0
Kishengarh	Jaitpur (15)	3750	925	925	2000	200	300	950	325
	Raipura (15)	3750	925	925	2000	200	300	950	325
Bada Malhera	Dhimarwa (30)	7500	1875	1875	4000	-	1000	1900	600
Buxwaha	Kairon (30)	7500	1875	1875	4000	-	1000	1900	600

TOTAL	200 ha	50000	12475	12475	24000	1200	5600	13200	6050
TOTAL	805 ha	5,89,375 (all the plants included)							
Ref: Information provided by office of DFO-Chhatarpur (2013)									

Plantation as above is only fruitful if plants are able to survive . With uncertain rainfall and erratic environment created by severe deforestation earlier and lack of congenial atmosphere in area the regeneration of forests looks almost impossible.

NORMAL MINOR FOREST PRODUCE COLLECTED BY FOREST DEPARTMENT:

S.No.	Product	Utilization
1	Tendu	Fruits as well as leaves are used. Tendu tops the list of MFP collection but unfortunately its use is in a non-healthy, cancer promoting products made with tobacco like BIDIS (indigenous smoking sticks).
2	Mahua-flowers	It is very nutritious product and had been one of the staple foods of people But presently used essentially for distilling country-liquor
3	Mahua-Fruits for seeds	Oil is extracted from seeds , used for variety of purposes including soap making
4	Achar	Fruits are collected (kernel is called CHIRONJI which is one of the important dry fruit)
5	Siharu (Har Singar)	This is a medicinal plant . Its branches are used for basket-making.
6	Aonla	Very important fruit, used for variety of preparations including medicines.
Reference: report from office of D.F.O. (Chhatarpur)		

The problem of collection of MFP is that there is so much competition in procuring it for industries that most products are plucked / collected prematurely which is neither good for preparation of medicine nor in fetching right price for the tribal people who collect it.

-----..

2 . DAMOH

EARLIER SITUATION:

Damoh has been quiet densely forested area in central India. The documented reference of forests as available in Damoh-District Gazetteer (1906) and the statistical tables compiled up to 1928 give following Information regarding status of the forest at that time:

In the year 1903-04, 792 sq. mile (2027.52 km²) area under Government Forest and 573 sq. mile (1466.88 km²) forest under *malguzars* (land-lords) was the total area of forests. All together Damoh district contained almost 48% of district area under forests including the grass-lands. Out of the area under land-lords 246 sq-mile (629.76 km²) were tree-forests while 327 sq. mile (837.12 km²) was covered by scrub jungle and grasses.

According to further reports forests of this region were classified by Champion & Seth as the South Tropical Dry Deciduous (STDD) forests (5A/C-3) which had variations from place to place. Local classification as detailed in District Gazetteer of Damoh (1980) for situation of the forests possibly during seventies, is presented as follows:

1. MIXED FORESTS, spread in Fatehpur (Hatta) , Damoh, Singrampur, and Sagoni ranges, nearby Taradehi and south-east of Tenukheda prefer low-lying areas with moist soils. The popular species in such forests had been *saaj, bija, dhaura, tendu, tinsa, jamun, baheda, mahua, sagon, rohar, palash, khair & lendia* as the trees and *anthoni, kodar, ail, & plamingia* as bushes and shrubs.

The medium type forests found in semi-deep soils and slopes away from the streams preferred dry varieties. The bushes included *ail, bharrati, jhilbil , karaunda, gangerua, & ghont* as underwood.

The inferior quality of mixed forests found in slopes and less deep sandy soils included *salai, gunja, dudhi, papra, kari, lendia, bhirra, ghont, tendu, aonla* and *achar* but lacked *sagon. Khair & kullu* , the trees with better commercial value. Bamboo had generally been absent in these forests and also grasses and shrubs which do not flourish under such soil-condition.

-
2. SAGON FOREST contains more than 20% *sagon* in a forest.. It prefers to grow in well drained *domat* and sandy- *domat* soils. There are locational differences as in case of the Mixed Forests. Associated vegetation with these forests had been of *tinsa*, *rohar*, *seja*, *dhaura*, *koha*, *lendia*, *dhaman*, *harra*, *gular*, *mahua* & *tendu* as trees. In the medium and inferior forests dry varieties like *salai*, *gunja*, *kachar*, *dhovin*, *semal*, *kari*, *kulloo*, & *bhirra* etc. used to be more dominant. Shrubs and bushes were similar as in Mixed Forests already discussed .
Sagon-forests were found as rich belts in eastern and western boundaries, on the hills south of Tejgarh, from south-west to Tendukheda upon southern border and also on the northern border. Such forests in small patches used to be found in Hatta, Damoh, Taradehi, Tendukheda and Singrampur ranges.
 3. THE GRASS-LAND: Clayey, hard , black and water resistant soils do not allow trees to grow in this type of forests. In these tracts shrubby ***saaj*** , ***ber*** , ***palash*** and *Ficus* species become abundant . Grasses usually had been found to grow here very dense and high . Such tracks were found scattered in this district. ***Barru*** and ***guner*** grasses have been dominating. Such areas are vulnerable to frost which also affects regeneration of any tree species trying to come up. In this district, grassland tracts had been found on bank of *lampti-NALLA* around Fatehpur (Hatta range) , near Nagra in Damoh range, on bank of *GORAIYA* river in Tendukheda range, near Khedi-devri and Kaliya-kutti in Taradehi range and near Singorgarh and Bhinaini in Singrampur range etc.
 4. SALAI FORESTS generally prefer dry, shallow and rocky soils and are associated with ***gunia***, ***aonla***, ***dhovin*** and others. In Damoh district such forests were found at Brijpani and Salapani in Hatta range, Pipariya in Damoh range and Unjari-kheda in Taradehi range.
 5. KARDHAI FOREST Grows in very poor, over-grazed and eroded tracts often as a mono-crop. Such forests of very good quality used to be found in some patches in Hatta range.
 6. GHONT FORESTS : Although ***ghont*** is found mixed in all types of forests , yet, in some places this is found individually dominating .
 7. KHAIR FORESTS also used to be found everywhere but generally prefer shallow, undulating and ravenous land. Such tracts have been found near Dudhia in Taradehi range and Manakpur in Hatta range.

8. BHIRRA FORESTS is normally grown well in dry and sandy soils. In this district these were not found well-developed. Such locations were found in some compartments of Tendukheda range.
9. INFERIOR FORESTS were found in vertical rocky area or on the plain plateau over hills known locally as *bhatari* and were found to include **ghont, ber, salai, lendia, kardhai, chichwa, bilsena, astu, bhirra** and **kari** etc. **Makor** was like a climber. **Thuar** was also found at many places. Such tracts had been near Damoh (Damoh range), near Batiyagarh (Hatta range) , in some patches in Tendukheda , Taradehi and Singrampur ranges.

LATER REPORTED SITUATION:

Situation of forests in Damoh district as reported in 2008 is as follows:

TABLE: AREA OF FOREST UNDER DIFFERENT RANGES
(Area in Hectare)

Forest Range >>	Damoh	Hatta	Sagoni	Singram-pur	Singor-Garh Sanctuary	Total
Area	42,746.72	65,151.52	30,126.44	35,990.22	2,397.30	1,76,412.20
Forest Range	Tendu-Kheda	Tejgarh	Taradehi		Jhalon	
Area >>	36,955.88	26,753.80	19,674.52		9,142.71	92,526.91
GRAND TOTAL (AREA UNDER FORESTS) Hectare						2,68,939.11

TABLE: UPDATED STATUS

Kind >>	Mixed Forest	Sagon Forest	Under Plantation	Encroachment	Rarified Forest	Denuded Area	Total Area
Area>> (ha)	28,099.07	11,94.30	1,197.00	3,737.62	1,40,121.91	92,150.90	2,66,500.80
% of total forest area	10.54	0.45	0.45	1.40	52.58	1.40	100
Reference: Report from Office of DFO, Damoh (2008)							

Above tables give highly disappointing situation of forests in this district . Out of total 2,66,500.80 (2,68,939.11 ha in the first table above) hectares of forests only 10.99% comprising of Mixed and Sagon –Forests have been recorded . The rarified forest area 1,40,121.91 (i.e. 52.58%) is almost a nil forest area and cannot be considered to be of any use. Plantation plan only in 1,197.62 hectares (i.e. 0.45%) looks like an eye-wash.

PROBLEMS OUTLINED BY FOREST DEPARTMENT:

A report , prepared probably as a part of proposal related to the working scheme for Damoh Forest Division for years 2004-05 to 2019 -20, points out some major problems on way to regeneration of forests. These are summarized below:

1. Forest area has extreme shortage of water specially during summer season,
2. Topography of the region and erratic distribution of rains do not allow any ground-water recharge,
3. Occasional fire break- out affects newly growing plants ,and also speeds up the soil erosion,
4. Over-grazing by animals from surrounding villages which destroys newly grown plants or consumed as the fodder,
5. Wild life of the forests also affects regeneration of forests etc.

The above proposal lists endangered / vanished plants of Damoh division as follows:

TABLE: ENDANGERED / VANISHED PLANTS

S.No.	Species	Plants
Endangered Species		
1	Trees	<i>Khamer, khair, kulloo, salai, bamboo, bhilawa, mainhar, bhirra etc.</i>
2	Bushes	<i>Jhau, bankapas</i>
3	Medicinal plants	<i>Kali tulsi, safed musali, punarnava, baakuchi, sooran</i>
4	Climbers	<i>Pippali, Shatavari</i>
5	Grasses	<i>Rusa , khus</i>
Plants vanished from this division		
1	Trees	<i>Safed chandan , jamalgota, kala shisham, safed semal</i>
2	Bushes	<i>Vacha, guggul , dikamali, akol, swetark</i>
3	Medicinal	<i>Bhringraj, brahmi</i>
4	Climbers	<i>Malkangani</i>
5	Grasses	<i>Savai</i>
<p style="text-align: center;">Reference</p> <p style="text-align: center;">Summarized proposal of Forest Working Scheme of Damoh (2004-05 to 2019-20) prepared by office of DFO, Damoh</p>		

PLANT – WEALTH OF DAMOH :

Although large number of plants have been listed in all reports cited above , yet these seem to have been copied from one to another. Present status of vegetation in forests is not up to mark and there are very few plants left from the lists which were reported in last quarter of nineteenth century up to the first half of the twentieth century. A comprehensive list of most plants will be presented and discussed in Volume-2 of this report in a chapter entitled “ **POTENTIALS : A. PLANT WEALTH OF *BUNDELKHAND*”**.

LATEST AVAILABLE DISTRICT REPORT :

District Development Handbook published by Department of Planning & Statistics, Damoh in 2011 has some information about forests and products of this district which could be shared here :

TABLE : FOREST AREA AND ITS PRODUCTS

S.No.	Particulars	2007-08	2008-09	2009-10	2010-11
1	Area under forests (hectare)	2688.98	2688.98	2728.28	2688.98
2	<u>Production</u>				
	Timber (c.m.)	178.649	20.975	118.981	259.544
	Fuel-wood (c.m.)	405.00	589.00	808.25	484.00
	Bamboo				
	Tendu Leaves	Nil	Nil	Nil	Nil
	(Standard				
	Sacks)		7122.42	Nil	Nil
	Kulloo Gum	24476.985	0	125.00	321.00
	(quintals)	95.00	72.67		
Reference: Damoh Jila Vikas Pustika (District Development Handbook) -2011					

-----..

3 . PANNA

Forests used to cover considerable area of the erstwhile Panna state which is now major part of Panna district. The 1907- Eastern States' Gazeteer mentions that Panna forests were largely consisting of stunted teak & thick small trees and scrub jungles; species being *Grewia*, *Zizyphus*, *Carissa*, *Woodfordia*, *Flueggia*, *Phyllanthus* and *Capparis* combined with *Acacia*, *Anogeissus*, *Terminalia*, *Boswellia*, *Butea*, *Bassia*, *Diosphyros* and others.

Earlier references drawn from medieval period mention Panna forests to be one of the best and also natural abode of elephants . Forests here being of Tropical Dry Deciduous nature had preferably grown several species of favourable trees. The most valuable trees found were **Teak**, occurring gregariously near the beds of rivers and in smaller valleys, sporadically on slopes of hills immediately above and occasionally on the plateaus, **Bamboo** which faced deterioration badly, **Tendu , Haldu, Kaim, Dhawa, Sejha, Sandan, Saaj** and **Khair** etc. **Mahua** had been very common all over, especially on moister soils. Trees were largely exploited for timber , fuel-wood and charcoal-making .

Some tree-species , however, were protected by people like the ones under SATKATHA comprising of Teak, *Shisham*, *Mango*, *Mahua*, *Saaj*, *Chheula (palash)*, and *Achar* because of their multiple utility. Some others of religious importance like **bargad** , **peepal** & **oomar** while trees like **neem** were saved because of its medicinal value.

Panna- forests could be classified in same category as in surrounding districts. According to Champion & Seth classification of these forests is as follows:

1. **5A/C1b : Southern Tropical Dry Deciduous Teak Forest,**
2. **5B / c2 : Northern Tropical Dry Deciduous Mixed Forest,**
3. **5D/ S1 or 5D/S1a : Dry Deciduous Shrub Forest.**

Panna forests fall under two divisions :

1. **South Forest Division**
2. **North Forest Division**

Following table gives salient features of these two divisions:

TABLE- IMPORTANT INFORMATION

Forest Division	Forested Area (Ha)	Type of Forest (Area (Ha))					
Total for Panna District:	289918.85	Teak	Mixed	Lower tree type	Denuded	Encroached	Plantation
<u>NORTH FOREST DIVISION</u> Ranges 1. Dharampur 2. Devendra Nagar 3. Vishramganj 4. Panna 5. Ajay Garh	97427.25 11552.17 29297.03 21176.29 24215.64 11186.12	7870.13	9039.10	39066.80	28819.22	7113.80	5518.20
<u>SOUTH FOREST DIVISION</u> Ranges: 1. Amanganj 2. Kalda 3. Saleha 4. Pawai 5. Mohindra 6. Raipura 7. Shahnagar	192491.60 16505.61 32608.18 23980.48 35342.57 30359.94 20771.67 32923.15	11625.23	166628.31	-	16792.00		
TOTAL:		19495.36	175667.41	39066.80	45611.22	7113.80	5518.20
Regference: Report from Divisional Forest Office, Panna 2009							

PLANT SPECIES FOUND IN PANNA FORESTS:

TREES: *sagon (Teak), saaja, bija, tinsa, haldu, kaimdhawa, mahua, seja, tendu, salai, gunja, khair, achar, baheda, aonla, kardhjai, palaash, ghont, reunjha, kullu, beri, baans, jaamun, koha, kasai, kumbhi, kusum, neem, papra, runjha, rohan, semal, bel, amaltas, babool, barh, bilsena, chilla, dhamun, oomar, jamrasi* etc.

SHRUBS: *Aak, Adusha, akol, Baikal, ban-tulsi, chakoda (pawar), chipti, chirchira, dudhi, gokhru, siharu, jangalighata, jangli mehndi, jharberi, karaunda, kali musali, kat-jaamun, lentana, naagfani, safed musli, and ghont* etc.

CREEPERS: *Ban-kumhara, dhimar-bel, dudhbel, phulkat, ghmchi, mahul, makor, palashbel, ramdaton, shatawari, kewach, amarbel & bandaa* etc.

GRASSES: *Baru, bhurvari, doob, kaans, khas, & kush* etc.

MEDICINAL PLANTS: Out of trees and the plants listed above most important ones having medicinal value are *Bija, Khai, Baheda, Aonla, Kullu, beri, koha, jaamun, neem, bel, semal, rohan, amaltas, aak, ban-tulsi, kali musali, safed musali, shatawari, kewach, phulkat, & oomar etc.*

THE ENDANGERED SPECIES:

1. Khamer, bija, tinsa, kullu, salai, bhilava
2. Jhau, Ban-kapas
3. Kali Tulsi, Safed Musali
4. Shatawari, pippali
5. Adusha, Khas

PLANTS WHICH HAVE VANISHED:

1. Safed Chandan, Jamalgota, kala shisham, safed semal
2. Vacha, Gugal, Dikamali, Akol, Safed AAK
3. Bhringraj, Brammi
4. Savai

An account of medicinal properties of available plants and its importance will be discussed further in chapter entitled “ **POTENTIALS : PLANT WEALTH OF *BUNDELKHAND***” of this report. .

PANNA TIGER RESERVE:

1. AREA: Nearly 57600 Hectare spread in Panna and Chhatarpur districts

RANGE WISE AREA:

- Panna : 87.93 Ha
- Hinota : 148.32 Ha
- Madla : 126.40 Ha
- Chandra Nagar : 146.09 Ha
- Ken Crocodile Sanctuary : 45.20 Ha
- Panna-Gangau Sanctuary; 78.53 Ha

Wild Life Normally Seen : Tigers (rare) , Tendua, Neelgaay, Chital, Saambhar, Chinkara, and Chosinga etc.

4 . SAGAR

THE EARLIER REFERENCES:

The SAGAR SAROJ (1922) * reports area of forests in this district to be 750 square mile (1,920 km²) under Govt. management and 1,240 square mile (31,744 km²) under land lords (*malguzars*). Govt. forest although spread all over, but occupied larger area in Rehli & Bandaa tehsils. On basis of principal vegetation it used to be termed as PACHARANGI as :

1. **SAGONIA** (Teak-forests),
2. **MILAWA** (Mixed Forests),
3. **SATKATHA** (Miscellaneous) ,
4. **BAANS** (Bamboo-forests)
5. **CHHEULA**- forests. .

In SAGONIA major trees found were **sagon** (teak) while in MILAWA , several trees were mixed including **sagon, saaj , tendu, mahua, achar** etc. The SATKATHA contained several useful trees like **dhourra, ghont, makoi, aonla, khair, gunja, jamrasi, saalhe, kulloo, hadua, & haldu** etc. **Bamboo-forests** used to have dominant species of bamboo while CHHEULA forests were full of **palash** only.

The earlier two forest types contained timber while the SATKATHA used to provide essential materials for people's livelihood. Bamboo was basically used in making roofs of village houses. Major product of CHHEULA (**palash**) forests was Lac (shellac). In some forest-areas like Jallandhar and Gadha naturally growing sandal-wood trees were also found

Other major products of these forests were : **gond** (Gum) , **shahad** (Honey), **chiraunji, khair, achar, tendu, mahua, harra & bahera** etc.

* SAGAR SAROJ edited by Rai Bahadur Dr. Hiralal (The Hindi Gazetteer of DAMOH district, published in 1922)

LATER SITUATION:

According to District Gazetteer of Sagar (1970) situation as reported for 1958-59 mention 2,999.19 km² as Govt. Forests Out of this 1,916.58 km² was Reserved Forest and 833.97 km² as Protected Forest . Rest 248.64 km² was under non-classified category. In 1951 village forests under land lords were also acquired and handed over to Department of Forests.

The classification by H.G. Champion termed Sagar forests as Northern Tropical Dry Deciduous Forests since this region receives rainfall from 1015.99 mm to 1969.99 mm. .The southern tract having Deccan Trap , assisted by climatic and biotic factors , had been favourable for growth of Teak . The sandstones provide *balua domat* which suited for mixed forests. In uncovered areas vegetation suiting to deserts used to be quite common.

CLASSIFICATION OF FORESTS :

Several forest types which were found around fifties' (~1950 AD) are described below:

TEAK- FORESTS:

These used to be found mostly in Sagar and Rehli tehsils, on flat top of the hills rather than on slopes. Later when soil cover of the tops was lost because of deforestation these were seen growing along with major water course. On hill-slopes these could be seen mixed with ***palash, moyan, gunja, salai, bel, reunjha, berga, papra, dhaman, khair, bhirra, mokha, ghont & mahua*** etc. On eroded soils with rocky outcrops, the species found were ***ghont, thuar, reunjha, lokhandi, khair, ber, bhirra, gongal, harua, kayankar & bel***. The over-wood in these forests were ***saal, bija, haldu, kalam, chirol***, and ***dhavara***. Others included ***kekad, moyan, dhovin, gumar, baheda, mahua, lendia, chichwa*** and ***karmata***.

The secondary trees which used to be found in abundance here were: ***achar, aonla, bargha, dhaman, kari, jamrasi, papra, bel, asta, lokhandi & amaltas*** etc. In marshy tract ***palash*** used to be common while by the side of streams ***arjuna (koha)*** had been the main vegetation. On banks of streams ***jamun*** used to be seen while ***jhau*** was found under the raised bed of the streams.

MIXED FORESTS:

Mixed forests were largely found in Bandaa & Khurai tehsils and in Mohli region, east of Rehli tehsil. These included ***saaj, tendu, seja, dhavara, aonla, tinsa, achar, bel, kari, kasai, mokha, semal, salai, reunjha, kem, harua, bhirra, khair, bhilawa, papra, amaltas, arjuna*** and ***kumbhi*** etc, ***kardhai*** used to be in abundance in Ramana and Dulchipur reserved forests.

On rocky and eroded soil-tract, growth of trees remains poor ; the trees mostly found here were ***seja, tinsa, reunjha, khair, ghont, ber, rohan, bhirra, papra, achar, and kaankar*** etc. ***kulloo*** with scant leaves in dry weather, also used to be seen at some places, rooted in steep slopes and the rocks.

GHONT AND KHAIR FORESTS:

In lightly eroded areas one could see presence of ***khair*** and ***ghont*** along with ***seja, tinsa, kaankar, reunjha, dhavara*** and ***kardhai***. In heavily eroded soils, e.g. near Dhamoni, where rocks are uncovered, forests comprising of vegetation like ***harua, gongal, thuar, ber, rohan & makor*** used to be found. These normally grow well by side of steams. In heavy soils ***palash*** grows very well which could be recognized from its beautiful flowers, ***flame of the forests***, during spring season. The denuded forests are left with shrubs and bushes in abundance.

PRESENT STATUS OF FORESTS IN SAGAR:

Information mentioned in a report from Divisional Forest Office of Sagar (2009) has been summarized in following table:

TABLE: STATUS OF FORESTS

Forest Division	Forested Area Ha)	Type of Forest (Area (Ha)					
		Teak	Mixed	Rarified	Denuded	Encro- ached	Planta- tion
SAGAR-NORTH RANGES	124804.63						
	<u>124804.63</u>						
Khurai	21916.05	23808.43	33870.51	36927.06	26083.25	751.00	2637.75
Bandari	42287.83						
Bandaa	35467.38						
Shahgarh	27135.37						

SAGAR-SOUTH RANGES	107034.63 <u>107034.34</u>	23327.32	5127.55	36223.79	29562.27	+ Other 542.52	12251.18
Sagar	19103.04						
Rahatgarh	19867.58						
Dhana							
Gadhakota]31376.20						
Kesli	13235.35						
Gaurjhamar	12677.65						
Deori	10774.52						
TOTAL		47135.75	38998.06	73150.85	55645.52	751.00 542.52	14888.93
Reference: Report from Divisional Forest Office, Sagar (2009)							

PLANT SPECIES FOUND IN SAGAR FORESTS:

A comprehensive list of plants found in forests of Sagar district is given and discussed along with those found in other districts further in chapter entitled “ **POTENTIALS : PLANT WEALTH OF *BUNDELKHAND***” in volume-2 of this report.

WILD LIFE:

The references found in regard to common wild life in Sagar forests mention following facts and figures:

SAGAR SAROJ reports last lion found in Sagar forests was killed in the year 1851. Others including tigers, leopards / panthers, hyaenas, wild cat, bears, wolves, civet cats, jackals and others with different local names were found here frequently. There used to be found innumerable herbivorous animals like deers : *sambhar*, *chital*, *chinkara*, wild pigs, *chausingha*, *kala hiran* (black bucks) & *neelgaay* (blue bulls) etc.

LATER SITUATION :

Several reports have been published on mammals, birds and fishes of Sagar district. Information about the mammals as reported in District Gazetteer of Sagar (1970) possibly for up to sixties is as given below :

CHINKARA (*Gazella bennetti*) and *CHITAL* (*Cervus axis*) were most common . *SAMBHAR* (*Cervus unicolor*) were normally found around the water sources *NEELGAAY* (*Boselaphus tragocamalus*) were common in the grasslands near Rehli

and Deori. Others included *CHAUSINGHA* (*Tetracerus quadricornis*) , Black buck and Wild pigs which were commonly found . The Tigers (*Felis tigris*) and *CHEETAH* (*Felis pardus*) were quite common . The Hyenas , Civet cats and Jackals were frequently seen but Wolves appeared less common. The bears normally like hills and thick forests which is rare now.

All together 37 species of mammals , 153 species of birds, and 53 species of fishes and large number of insects, butterflies and serpents have been extensively reported in afore-mentioned Gazetteer on basis of the studies published earlier by different researchers.

PRODUCE FROM FORESTS:

Forests give many different products but their major contribution is water , purified air and the humus which is priceless yet un-priced. Major produce in terms of its commercial value as recorded in District Gazetteer (1970) , though all of them may not be applicable today , are as follows:

Major Forest Produce: Timber, Fuel Wood, Charcoal.

Minor Forest Produce: Bamboo, Tendu Leaves, **khair**, **kulloo**-gum, Shellac , **mahua**-flowers & seeds, **chiraunji** , Honey, Wax, Leather & Horns, Herbs, Edible tubers, **palash**-bark, **mahul**-leaves, Fruits of **ghont**, Thorns, Spices, Clay & Stones.

PRESENT STATUS OF FORESTS:

Forest in Sagar district, like in other *Bundelkhand* districts is also in very bad condition now, confined to only some of the hilly areas where land is incapable of agricultural operations. The forests generally depend upon soils and draining pattern of the area which has been disturbed during past 5-6 decades. Most hills where forests were reported in the District Gazetteer of Sagar (1970) have become totally barren and there is no hope of its regeneration even in long future. The expansion of mining industry destroying the hills has added to this menace and future looks much darker than this day.

*****.

5 . TIKAMGARH

Forests in Tikamgarh as reported in 1907- Gazetteer had not been of great importance but were not so bad a few centuries ago. Historical accounts reveal very dense forest in this tract during middle age when Moghuls were rulers at Delhi. There are references of emperors visiting Orchha for hunting lions / tigers.

One of the famous *Bundela* kings , Rudra Pratap is reported to have died fighting a tiger while saving a cow from its clutches. Some rulers of Orchha state were quite serious about protecting forests. They also devised plans for protection and continuous regeneration of forests. Condition of forests, however, had turned miserable by the end of 19th century as mentioned in the Eastern States Gazetteer (*Bundelkhand*) 1907 as cited above.

MANAGEMENT OF FORESTS:

Following points will explain some features of forests' management around the first quarter of 20th century while it was totally owned and managed by rulers of the State..

1. The forests were divided in three categories:
 - a) First Class : With trees like *Sagon, Achar, Tendu, etc.*
 - b) Second Class: With trees like *Seja, Khair, Siras, Aonla & Dhawa etc.*
 - c) Third Class : With trees *Chheula* and *Salai* etc.
2. All timbers and fuel-wood from forests were to be sold,
3. The products like Gum, Bees' wax, Honey, and Medicinal plants were collected by contractors,
4. Cultivators were allowed to take wood for house as well as agricultural implements free of charge,
5. Villagers had no right to fell trees or let animals to graze in the Reserved Forest Area,
6. The naturally fallen trees were open for sale,
7. During famine or severe drought conditions villagers were allowed to pluck wild fruits such as *ber, tendu, karaunda, & makor* etc.,
8. Only *saharia* tribals were allowed to work inside forests for which they were paid in cash.
9. Grazing of goats and sheeps within forests were totally prohibited.

The hill forest that used to cover a considerable proportion of the State of Orchha consisted largely of brushwood interspersed with small trees . A list of most principal trees , plants and large variety of grasses found in this region are listed as follows:

PRINCIPAL TREES , PLANTS & GRASSES

S.No.	Hindi/ local names	Botanical Name (where known)
TREES AND PLANTS:		
1	Achar	<i>Buchanania latifolia</i>
2	Akol	<i>Alangium lamarekki</i>
3	Aam	<i>Mangifera indica</i>
4	Amaltas	<i>Cassia fistula</i>
5	Aonla	<i>Phyllanthus emblica</i>
6	Bakain	<i>Melia Azedarach</i>
7	Bahera	<i>Terminalia belerica</i>
8	Bambool	<i>Acacia arabica</i>
9	Baans	<i>Dendrocalamus strictus</i> <i>Bambusa arundinacea</i>
10	Barhat	<i>Atrocarpus lakoocha</i>
11	Bel	<i>Aegle marmelos</i>
12	Beri	<i>Zizyphus jujube</i>
13	Bijo	<i>Pterocarpus marsupium</i>
14	Chheula	<i>Butea frandosa</i>
15	Dhawa	<i>Anogeissus latifolia</i>
16	Ghont	<i>Zizyphus xylopera</i>
17	Gunja	<i>Abrus precatorius</i>
18	Hardu	<i>Adina cordifolia</i>
19	Harsingar	<i>Nyctanthes arbortristis</i>
20	Imli	<i>Tamarindus indica</i>
21	Jamun	<i>Eugenia jambolana</i>
22	Kaima	<i>Ficus infectoria</i>
23	Kaitha	<i>Feronia elephantum</i>
24	Karadi	<i>Sterculia urens</i>
25	Karaar	<i>Bauhinea purpurea</i>
26	Karaunda	<i>Carissa carandas</i>
27	Kauwa	<i>Terminalia arjuna</i>
28	Khajur	<i>Phoenix sylvestris</i>
29	Khair	<i>Acacia catechu</i>
30	Khirni	<i>Mimusops hexandra</i>
31	Kosum	<i>Schleichera trijuga</i>
32	Kumera	<i>Gmelina arborea</i>
33	Labheda	<i>Cordia myxa</i>
34	Mahua	<i>Bassia latifolia</i>
35	Makor	<i>Zizyphus aenoplia</i>
36	Maulsiri	<i>Mimusops elengi</i>
37	Mawali	<i>Spathobolus roxburghii</i>
38	Nim	<i>Melia indica</i>
39	Pipal	<i>Ficus religiosa</i>

40	Ramphal	<i>Anona raticulata</i>
41	Reonjha	<i>Acacia leucophlea</i>
42	Sagon	<i>Tectona grandis</i>
43	Semal	<i>Bombax malabaricum</i>
44	Salaiya (sarrai)	<i>Boswellia serrata</i>
45	Sejo (Sej)	<i>Lagerstroemia parviflora</i>
46	Shisham	<i>Dalbergia sissu</i>
47	Siras	<i>Albizzia lebbek</i>
48	Sitaphal	<i>Anona squamosa</i>
49	Tendu	<i>Diospyros tomentosa</i>
50	Tuna	<i>Cedrela toona</i>
51	Umar	<i>Ficus glomerata</i>
THE GRASSES		
1	sain	
2	parwa	<i>Andropogon pertusus</i>
3	gunar	-
4	kail	-
5	bhusaya	-
6	tolia	-
7	phula	-
8	kara	-
9	diwa	-
10	gondara	-
11	murjana	-
12	kaans	<i>Imperata spontanea</i>
13	vadakaas	-
14	maujuri	-
15	jhunsa	-
16	phulara (phulkara)	<i>Isiclema laxum</i>
17	kush	
18	daab or darbha	<i>Eragrostis cynosuroides</i>
19	doob	<i>Cynodon dactylon</i>
20	moonj	<i>Saccharum munja</i>
21	musayal	
22	junar	
Reference: Eastern States Gazetteer (Bundelkhand) 1907		

FORESTS DURING POST-INDEPENDENCE ERA:

The classification of forests according to Champion & Seth for Tikamgarh forests is as follows:

TABLE- CLASSIFICATION OF FORESTS

No.	Code	Forest Type
1	5A / C1b	Southern Tropical Dry Deciduous <i>Sagon</i> Forests
2	5B/ C2	Northern Tropical Dry Deciduous Mixed Forests
3	5B / DS1	Dry Deciduous Scrub-Forests
4	5B / DS4	Dry Grass Forests
5	5B / E1	Kardhai Forests
6	5B / E1D5	Kardhai Scrub-Forests
7	5B / E2	Salai Forests
8	5B / E-5	Palash Forests
9	6B / C2	Ravine Thorn Forests

Around 1950-51 when Tikamgarh was under Vindhya Pradesh , some decisions taken regarding management of forests resulted into considerable loss of vegetation here. This fact was revealed in the Techno-Economic Survey of Madhya Pradesh (1960) which described this district as “ very little forested “, only 1.3% of area of the district . Around 1955-56, however, forested area was reported to be 2.5% and later in 1960-61, to be of the order of 13%.

Forest was surviving only on hills during those days. Leading trees present in these forests belonged to the genera Bombax, Sterculia, Boswellia, Buchanania, Butea, Diospyros, Acacia, Anogeissus and Terminalia etc. The shrubs present belonged to Grevia, Zizyphus, Woodfordia, Cascaria, Phyllanthus, and Capparis etc. The herbaceous species present were : Crotolaria, Desmodium, Alysourpus, Haliotrepeium, Evolvulus etc. There used to be large variety of grasses, some of these have been listed earlier.

The 1995-Gazetteer gives information about land-use of the district which includes forest area reported for different years between 1950-51 and 1989-90 . The figures presented here show forest area having risen but it never exceeded 13.2% of total geographical area of the district during these years.

TABLE- FOREST AREA OF TIKAMGARH

Year	Total Geographical Area (ha)	Area under Forest (ha)	% of the total Area
1950-51	4,63,000	Negligible	-
1955-56	4,66,000	11,000	2.4

1960-61	5,08,000	56,000	11.0
1965-66	5,01,000	69,000	13.8
1971-72	5,03,000	65,000	12.9
1976-77	5,04,000	65,000	12.9
1985-86	5,04,000	62,800	12.5
1986-87	5,04,000	64,800	12.9
1987-88	5,04,000	64,300	12.8
1988-89	5,04,000	66,400	13.2
1989-90	5,04,000	66,700	13.2
Reference: District Gazetteer (Tikamgarh) 1995			

The available information related to some years reported during 2009 gives area under forests as follows:

TABLE- AREA OF THE FOREST (REPORTED IN 2009)

Year	Total Geographical Area (ha)	Area under Forest (ha)	% of the total Area
2004-05	5,04,002	30,077	5.97
2005-06	5,04,002	29,438	5.84
2006-07	5,04,002	29,061	5.77
2007-08	5,04,002	29,356	5.82
2008-09	5,04,002	29,470	5.85
Reference: District Statistics Handbook (Tikamgarh) 2009			

Apparent decrease in forests from 13.2 % to around 6% in 15 years' duration as observed in above table shows clearly the negligence towards forests. Treatment which forests met with , especially shaving off the hill-forests which could never be regenerated , is a extremely sad situation which is likely to affect everything related to human survival in the region.

The latest forest working plan reports total forest area including the non-classified one as 80,431.26 ha of which only 29,627.41 ha is actually forested. Rest area is under category of denuded forests , forest-villages, tanks & lakes etc.

The working plan admits that area under forest is much below the 33% which was set as minimum forests for any district according to India's Forest Policy (1988).

FOREST PRODUCTS

District reports regarding procurement of forest products for the years 2004 to 2009 give following information:

TABLE- PROCUREMENT FROM FORESTS

S.No.	Head	unit	2004-05	2005-06	2006-07	2007-08	2008-09
1	Area under Forest	ha	80436	80436	80436	80436	80436
2	Timber produced	c.m.	28.811	211.596	13.140	43.778	16.862
3	Fuel wood	c.m.	45.000	16.000	-	10	-
4	Bamboo	m.t.	-	-	-	-	-
5	Tendu leaves	Std. bag	28,662.640	12,321.683	18,743.00	18,163.00	19,032.00
6	Sal seeds	Qtl.	-	-	-	-	-
7	Harad	Qtl.	-	-	-	-	-
8	Gum	Qtl.	-	-	-	-	-
Reference: District Development Handbook (Tikamgarh) 2009							

.....

Chapter - VI

INDUSTRIOUSNESS OF PEOPLE & INDUSTRIES:

Human beings wherever they are try to manage their life according to local situation, environment and the available resources. Industriousness is inherent in human nature. Discovery of wheels or fire in human history was not researched by any institution or the universities. The needs are managed through continuous experience accumulated by human society

Agriculture being main occupation of this region, industry was limited to catering people's basic needs. These included coarse clothes, blankets, leather-shoes, earthen pitchers, herbal medicines and soaps etc. prepared by specific communities or families. Wood- and stone crafts using local resources by skilled artisans and iron smelting by some tribes formed common tasks showing industriousness of people here.

The industrial growth which came after availability of electric power was mainly in areas related to exploitation of natural resources. The mining coupled with stone-crushing, cement manufacture or forest based enterprises only damaged forests, hills, as well as affected rivers, rains and overall productivity of agriculture which had been providing livelihood for over 70 % population of this region.

The situation as regards to industries in districts of Sagar division under study has been included here district wise as follows:

1 . CHHATARPUR:

The household and other enterprises which served local population in villages as well as towns usually were mostly need oriented and agro-based. Products included various Oils, *Ghee*, Soap, Coarse cloth, *tat-patti*, country paper, carpets, rags, *Durries*, *Newar* and blankets. That also included Brass-vessels, pewter (a mixture of tin and lead), iron and coarse cutlery etc. Different communities had exclusive skills and these were spread all over the district. Apart from above printing on various fabrics, carving of wood or on stones, inlaying and lacquer work were practiced by private individuals. Some of these products and art-work were regularly traded and exported.

Manufacture as well as trade in several items as mentioned above decayed with new roads built and railways coming into scene. But some items despite odds continued being exported from this area to other places. These included *Til*, *Ghee*, Betel leaves, Linseed, *Sarson* (mustard), *Zera*, Raw Cotton, *Mahua*- flowers and fruits, Soap, *Chironji*, Lac, *tat-pattis*, Gum, Bees-wax and Honey etc. Chief centres of trade in Chhatarpur district were Chhatarpur, Raj Nagar, Laundi, Maharajpur and Malhera etc.

Information available on situation of industries operating in this district as reported in Chhatarpur District Gazetteer (1982) for up to early seventies is presented as follows:

1. Agriculture being the principal occupation of people in Chhatarpur industrial culture has not very much flourished here.
2. The earlier Gazetteer of Chhatarpur Princely State (1907) recorded no industry or art of any importance existing in the State.
3. An industrial concern was initiated in the year 1898 but it could not be continued beyond 1903.
4. Rich in mineral deposits, iron ore was found in Deora region (presently under Bijawar sub-division) and related industry was in flourishing condition once but by the first decade of 20th century it died out on account of foreign competition. (ref: Chhatarpur State Administration Report 1910-12)
5. Whatever industrial activity was noted was part and parcel of the socio-economic fabric of rural society, dominating this area. Thus production of oil, *ghee*, soap, *gazi*-cloth, *tat-patti*, rough paper, carpet rugs, *dari*, *nevar* etc. formed principal fields of industrial activity here.
6. A few individuals also carried on printing of various fabrics and carving in wood and inlaying & lacquer work.

SMALL-SCALE MINERAL-BASED MANUFACTURING :

IRON ORE : As already mentioned, manufacture of iron from ores died by the first decade of 20th century because of competition with foreign supplies.

BUILDING MATERIALS: Abounding in rocks, Chhatarpur had been a treasure of sand-stone, quartzite slates, kankar, granite, reef rocks (*dhaula patthar*) and white-stone (worked to make statues) etc.

MINERALS FOUND IN TRACES: A small occurrence of China Clay & Fire Clay, traces of Copper and some Diamond bearing rocks had been located in some parts of Chhatarpur. These, however, were not commercially viable.

LIME-STONE AND DOLOMITE : Impure lime-stone and dolomite were located in some place of Bijawar sub-division. Calcareous Tufa present in this district had been regularly worked for preparation of lime for local consumption.

OTHERS:

Chhatarpur till eighties seems to have had no large scale industrial units based on natural resources. Some units of manufacturing furniture from forest wood and soap using oils of *mahua*- seeds and others, along with processing of some agricultural produce had briefly been reported in District Gazetteer of Chhatarpur (1982).

Useful timbers (*SAGAUN*, *SAJA*, *TENDU*), fruit-trees (*MAHUA*, *KHAIR*, *PIPAL*, *JAMUN*, *ACHAR* along with *BER* , *MAKOR* and *GHONT* etc.) and several of minor forest produce (MFP) like flowers & fruits of *MAHUA*, fruits of *ACHAR* & *AONLA* , Gum, Lac, *khair* , *tendu*-leaves and various kinds of medicinal plants were obtained from forests but any big scale industry based on them was not located here in this district. These were probably mostly exported to other districts.

UTILIZATION - CHANNELS OF FOREST PRODUCE :

1. Furniture
2. Bamboo-work
3. Wooden toys
4. Wood for fuel
5. *siharu*-baskets
6. Medicines
7. Agriculture Implements
8. House-building

Teak (*SAGON*) and Bamboo have been the most popular wood under demand.

INDUSTRIAL PROFILE OF CHHATARPUR DISTRICT:

A recent report published by Ministry of Micro- Small and Medium Enterprises (MSME), Govt. of India for Chhatarpur district gives some relevant information which is presented as follows :

TABLE-INDUSTRY AT A GLANCE

S.No.	Head	Unit	Particulars
1	Registered Industrial Units	Number	7,296
2	Total Industrial Units (active)	-do-	7,296
3	Registered Medium & Large Units:	-do-	nil

4	Estimated Average No. of daily workers employed in Small-scale Industries	-do-	220
5	Employment in Large & Medium Industries	-do-	nil
6	No. of Industrial Area	-do-	03
<p style="text-align: center;">Reference: Brief Industrial Profile of Chhatarpur District (MSME) Govt. of India –2011-12 (www.msmeindore.nic.in)</p>			

EXISTING INDUSTRIAL AREAS IN DISTRICT CHHATARPUR:

S.No.	Name of Industrial Estate	No. of Plots	Allotted Plots	No. of units In production
1	Semi-Urban Areas Chhatarpur	31	31	11
2	Bailgadi Project Area Chhatarpur	89	30	12
3	Chandrapura Industrial Estate Chhatarpur	202	182	--
<p style="text-align: center;">Reference: Brief Industrial Profile of Damoh District (MSME) Govt. of India –2011-12 (www.msmeindore.nic.in)</p>				

DETAILS OF EXISTING MICRO- & SMALL ENTERPRISES (Based on Agro- , Forest- Produce and Minerals)

NIC Code No.	Type of Industry	Number of units	Employment
1	Agro-based	1841	4602
2	Wood/ Wooden based Furniture	567	722
3	Paper & Paper Products	01	06
4	Leather Based	106	112
5	Mineral Based	62	1119
<p style="text-align: center;">Reference: Brief Industrial Profile of Chhatarpur District (MSME) Govt. of India –2011-12 (www.msmeindore.nic.in)</p>			

PRESENT STATUS OF INDUSTRIES INVOLVING NATURAL RESOURCES:

The latest information provided by District Industry Centre regarding the working units based on extraction and crushing of stones, working on stone tiles and images (*murti*) , furniture-making and agro processing etc. with investment more than Rs. 500,000.00 are listed as follows:

INDUSTRIES BASED ON NATURAL RESOURCES

S.No.	Block	Location	Name of Unit	Function
1		Gadi-Malhera	M/s Shakti Stone-Crushers	Stone-crushing
2	Bada Malhera	Bada Malhera	M/s Mahesh Dal-mill	Agro-processing (Pulses)
3	Bijawar	Bijawar	M/s Jatashankar Dal-Udyog	Agro-processing (pulses)
4	Buxwaha	Buxwaha	M/s Paras Dal-Mill	-do-
5	Chhatarpur	Dhadari	M/s Khajuraho Minerals' Unit No. 6	Stone Crushing
6		-do-	M/s Khajuraho Minerals' Unit No.3	-do-
7		-do-	M/s Khajuraho Minerals' Unit No.4	-do-
8		-do-	M/s Khajuraho Minerals	-do-
9		-do-	M/s Khajuraho Minerals Pvt. Ltd.	Minerals grading
10		Chhatarpur	M/s Aakriti Sansthan	Stone-Articles
11		-do-	M/s Alok Industries	Agro-processing (Oil)
12		-do-	M/s Om Sairam Furnitures	Wooden furniture
13		-do-	M/s Shri Jatashankar Granite	Stone-crushing
14		-do-	M/s Vijai Industries	Agro-processing (pulses)
15		Saura	M/s G.K.Industries	-do-

16		Chhararpur	M/s Agrawal Pulse	-do-
17		-do-	M/s Puja Food Industries	Bread (Bakery)
18		-do-	M/s Bundelkhand Granite Unit No. 2	Stone-crushing
19		-do-	M/s Granite India	Granite-Tiles
20		Chandrapura	M/s Budholiya Stone Crushers	-do-
21		-do-	M/s Rajendra Granite Industries	Mineral Grading
22		Dhamora	M/s Poonam Industries	Washing Soap
23	Gaurihar	Sinchhari- Barigarh	Maa Alam Devi Crusher Gram- Udyog	Stone-crushing
24		Chandpura	Budholia Stone Crushers	-do-
25	Laundi	Pura	M/s Ajay Granite Stone Crusher	Stone-crushing
26		-do-	M/s Ajay Granite Stone Crusher	-do-
27		Madha	M/s Tripathi Crusher Udyog	-do-
28	Nowgong	Issanagar Crossing	M/s Bajrang Dal-mill	Agro-processing (pulses)
29		Nowgong	M/s Sai Granite	Stone- Crushing
30		Harpalpur	M/s Shanti Dal-Udyog	Agro-processing (pulses)
31		Nowgong	M/s Sanjay Dal-Industries	-do-
32		Sarsedh	M/s Shri Ram Granite	Stone-crushing
33	Raj Nagar	Ganj	M/s Agrawal Traders	BER-CHUN Powder of dried <i>BER</i> -fruits
34		Pahar Purwa	M/s Singh Stone Crusher	Stone-crushing
Information provided by District Industries Centre (Chhatarpur)				

Above table showing industrial expansion in this district possibly developed during past two decades has extreme pressure on destruction of hills for granite-crushing to supply materials for present hunger of construction of multi-storey buildings, RCC structures and the CC- roads. Looking above we find that out of 34 registered industries as many as 20 belong to granite-crushing and mineral grading only.

Let us look at following information also in this regard:

ACTIVE CONTRACTS FOR EXPLOITATION OF MINERALS :

A recent report from district office of department of mining lists 181 active as well as 267 .terminated contracts of different minerals being exploited ; some of these contracts have been issued for up to year 2041 . Following tables give some information on active contracts and leases , majority of these are only related to destruction of hills for stones/ granites mainly for crushing.

RIVER-SAND - LEASE CONTRACT

s.no.	Block	Kind of mineral	No. of contracts/ leases	Total Area (ha)	Validity Date
1	Bada Malhera	River-sand	02	7.795	31-03-13
2	Bijawar	-do-	04	8.573	-do-
3	Buxwaha	x	x	x	X
4	Chhatarpur (Issanagar)	River-sand	07	22.463	31-03-13
5	Gaurihar	-do-	09	31.487	-do-
6	Laundi	-do-	06	18.268	-do-
7	Nowgong	-do-	02	1.486	-do-
8	Raj Nagar	-do-	04	9.217	-do-
	TOTAL		34	99.289	
Ref: Report provided by Dept. of mines - district office Chhatarpur (2012)					

DIASPORE & PYROPHYLLITE EXTRACTION

s.no.	Block	Kind of mineral	No. of contracts/ leases	Total Area (ha)	Validity Date
1	Bada Malhera	Diaspore & Pyrophyllite	O1 01	0.783 8.193	2014 2016
2	Bijawar	-do-	01 02	1.378 10.104	20 years (date not specified) 2018
3	Buxwaha	-do-	-	-	-
4	Chhatarpur (Issanagar)	-do-	01 01 03	6.608 4.047 12.821	2017 2018 2019
5	Gaurihar	-do-	01	16.951	2012
6	Laundi	-do-	-	-	-
7	Nowgong	-do-	03 01 01	3.999 2.280 2.791	2016 2021 2033
8	Raj Nagar	-do-	01 02 01	7.157 1.791 5.000	2013 2017 2027
	TOTAL		20 units	83.903 ha	
Ref: Report provided by Dept. of mines - district office Chhatarpur (2012)					

EXTRACTION OF OTHER MINERALS

s.no.	Block	Kind of mineral	No. of contracts/ leases	Total Area (ha)	Validity Date
1	Bada Malhera	-	-	-	-
2	Bijawar	1. White Ochre 2 Red Ochre 3 Red Ochre 4 Soap-Stone 5 Rock Phosphate 6 Quartz -Felspar 7 Dolomite	01 01 01 01 01 01 01 01	12.840 4.581 13.794 5.360 48.758 6.101 7.264 1.000	2014 2022 Not specified 2016 2018 2016 2022 2017
3	Buxwaha	-	-	-	-
4	Chhatarpur	-	-	-	-
5	Gaurihar	-	-	-	-
6	Laundi	-	-	-	-
7	Nowgong	-	-	-	-
8	Raj Nagar	-	-	-	-
	TOTAL		08	99.698	
Ref: Report provided by Dept. of Mines - district office Chhatarpur (2012)					

CONTRACT LEASE OF HILLS FOR GRANITE EXTRACTION

s.no.	Block	Kind of mineral	No. of contracts/ leases	Total Area (ha)	Validity Date
1	Bada Malhera	Granite	-	-	-
2	Bijawar	-do-	-	-	-
3	Buxwaha	-do-	-	-	-
4	Chhatarpur	-do-	-	-	-
5	Gaurihar	-do-	01	4.000	2020
6	Laundi	-do-	01 01 01 01 01 01 07 06	1.000 5.000 1.400 5.000 3.000 5.000 47.236 55.750	2011 2013 2016 2023 2024 2027 2028 2029

			01 <u>02</u> 22	4.320 <u>9.997</u> 137.703	2030 2041
7	Nowgong	-do-	01	4.000	2023
8	Raj Nagar	-do-	-	-	-
9	Chandla	-do-	01	4.320	2030
	TOTAL		24 units	150.023	
Ref: Report provided by Dept. of mines - district office Chhatarpur (2012)					

THE APPROVED STONE CRUSHERS

s.no.	Block	Number of Units	Total Area Involved (ha)	Validity Year	Remarks
1	Bada Malhera	01	1.000	10 years	Date Not specified
2	Bijawar	01 03 04 02	3.443 3.696 8.782 4.000	2014 2016 2017 2018	
3	Buxwaha	-	-	-	-
4	Chhatarpur	03 01 02 01 02 02 02	17.000 2.151 5.000 3.000 8.000 5.650 4.000	2012 2013 2014 2018 2019 2020 2021	
5	Gaurihar	05 01 02 01 02 04	15.000 0.200 6.000 2.000 3.000 8.847	2012 2013 2015 2017 2918 2019	

		02 21	2.906 44.810	2020 2021	
6	Laundi	02 02 02 01 02 01 01	6.800 1.730 4.120 4.000 7.000 2.000 4.000	2009 2011 2013 2014 2016 2018 2020	<u>Still shown</u> <u>active</u> -do-
7	Nowgong	01 04 01 01 05 02	2.000 5.800 2.000 4.000 15.950 2.970	2012 2013 2017 2018 2019 2021	<u>Still shown</u> <u>active</u>
8	Raj Nagar	01 02 01 02 01 01	3.600 13.545 4.000 8.000 4.000 4.000	2012 2013 2017 2018 2019 2020	
	TOTAL	95 units	248 ha		
Note: It is also worth noting that Mining Office of Chhatarpur has not reported anything about extraction of diamond in Buxwaha block by international companies like M/s Rio Tinto.					
Ref: Report provided by Dept. of mines - district office Chhatarpur (2012)					

-----..

2. DAMOH

Apart from availability of industrial raw materials it is industriousness of people which makes a place congenial to spread of industries. Damoh on that aspect does not give a very good picture. Like other traditional societies this region also had popular household enterprises dealing with cotton, metals, wood and stones etc.

SITUATION UP TO NINETEENTH CENTURY :

As reported in District Gazetteer (1906), working on cotton and wool weaving, Metal-smithy for making ornaments of gold, silver, copper & bell-metal, house-hold vessels of copper, brass and bell-metal and black-smithy to make knives, hatchets and nut-cutters etc. were common in this district too.

COTTON AND WOOL- WEAVING :

Weaving of coarse cotton from home-spun and later with mill-spun thread was spread in Damoh district at several places. Notable amongst such centres were Hatta, Raneh, Hindoria, Mariadoh, Patera, Sitanagar and Damoh. Bansa-kala a village in Damoh Tehsil, however, had been the largest centre with about 150 houses of weavers. The art of weaving was exclusively practiced by *KORI* community. *KOSHTIS* were another group of weavers who used finer counts of thread and also coloured threads.

Coarse cloth used to be dyed locally using indigo and *AL* (Indian Madder) as dyeing agents before imported aniline dyes were brought in with arrival of railways. Indigo as well as *AL* were locally produced plants in farm-fields around Hatta and other villages. The cotton dyers' community was known as *CHHIPAS* who also used red-ochre, myrabolans and turmeric as dyeing agents. Bansa Kala was the main centre of cloth-dyeing although others too mentioned above were equipped with dyers. Woolen blankets used to be woven by shepherds (*GADARIA/ PAUL-Community*) who used to rear goats and sheep.

THE METAL WORKING:

Coarser ornaments from gold, silver, copper and the bell-metals were made by the exclusive community of Goldsmiths (*sonars*) traditionally expert to work on such metals. These were located mainly at Damoh, Pathariya, Hatta and one or two other villages. All kinds of eating and drinking vessels used to be made in Hatta where the workmen (the *thatheras*) had developed considerable skill of making as well as

imparting a peculiar polish to the metal. Vessels of bell-metal used to be brittle but these could be used for keeping acids and acidic preparations intact.

Use of English iron had begun, though blocks of country-iron was popular which was brought from the adjoining district Chhatarpur. Brass was imported and also made within district using Zinc & Copper. Bell metal was made locally : for vessels the material was made by mixing ca.30% Tin with Copper but for ornaments this ratio was 40 to 50 % . In Jabera, the black-smiths used to make knives, hatchets , and the nut-cutters (*Sarautas*) .

OTHER SKILLS:

WOOD WORKING:

The *kunderas* used to make wooden toys, pipes, bedsteads, and lacquer them. The district contained considerable number of bamboo-workers (*basors*) who made all kinds of baskets and fans. Mats and brooms of palm leaves used to be made and also *kuchis* (*munj* grass- brushes) by the community of *kuch-bandhias* .

CLAY-POTTERY:

Pottery of Damoh had its own reputation. Clay found near Damoh was smooth and malleable . Pipe-bowls were made of a terra-cotta colour with clay brought from Betul ; a light silver appearance was given to them by use of mica. These were ornamented with open work patterns and liked very much by local people as well as those in other districts. The products were exported to surrounding districts. A peculiar vessel was made here known as *potla* having round shape with flat belly and narrow neck . Two holes were made at the neck in order to fix a rope so that this vessel filled with water could be carried on shoulders by farmers , labourers and *banzaras* etc. In Hatta some families used to make clay-toys and images also.

GLASS & LAC-BANGLES were made by *kacheras* at Damoh, Hindoria, Patera, Deodongri and Khanderi . The *lakheras* at Damoh , Pathariya and other places used to make bangles of lac mixed with earth.

LEATHER WORKING industry had been a strong one in Damoh district supporting ca. 9000 persons. Ordinary and fine shoes and other items needed in agriculture were made by them.

COUNTRY PAPER used to be made at Panchamnagar using hemp as raw material . This paper was popular amongst bankers/ *SAHUKARS* for keeping their account-books.

On the whole Damoh district was full of various communities involved in different industries which largely served the needs of local people. As mentioned some items were attractive enough to be traded outside also.

INDUSTRIES DURING TWENTIETH CENTURY::

HOUSE-HOLD INDUSTRY as discussed above engaged nearly 15 % of total workers and stood second to agriculture . In 20th century *BIDI*-making came out to be principal house-hold work in which many families of Damoh got engaged. Local agro-processing i.e. *ATTA-CHAKKI*, oil-exPELLERS, pulse-mills etc. had always been essential enterprises which fulfilled people's needs. Wood-working including carpentry engaged families in each village and towns.

SMALLER ENTERPRISES UNDER FACTORY ACT:

In this district whatever established under factory act -1948 has been based on agriculture or the forest produces. These were basically related to *BIDI*- manufacturing, Oil-mills and *DAL*- mill (remained active as a private concern for some time, later brought under cooperatives).

Apart from it a few small units of raw soap making, saw-mills, units using non-ferrous metals, printing press, Ayurvedic pharmacy and some units for making agriculture-implements etc. were recorded.

There could not be any great achievement from the new ventures, yet traditional crafts and workmanship were downgraded & made to starve while markets were filled with products from outside and also from foreign countries .

INDUSTRIAL PROFILE OF DAMOH DISTRICT:

A recent report published by Ministry of Micro- Small and Medium Enterprises (MSME), Govt. of India for Damoh district gives some relevant information presented below:

INDUSTRIES AT A GLANCE

S.No.	Head	Unit	Particulars
1	Registered Industrial Units	Number	7,672
2	Total Industrial Units (active)	-do-	41
3	Registered Medium & Large Units:	-do-	02
4	Estimated Average No. of daily workers employed in Small-scale Industries	-do-	18,258

5	Employment in Large & Medium Industries	-do-	1,816
6	No. of Industrial Area	-do-	03
<p align="center">Reference: Brief Industrial Profile of Damoh District (MSME) Govt. of India –2011-12 (www.msmeindore.nic.in)</p>			

EXISTING INDUSTRIAL AREAS IN DISTRICT DAMOH:

S.No.	Name of Industrial Estate	No. of Plots	Allotted Plots	No. of units In production
1	Semi-Urban Industrial Estate, Damoh	39	39	27
2	Industrial Area- Gandhi Ashram Damoh	18	18	08
3	Industrial Area-Marutal Dist. Damoh	133	10	06
<p align="center">Reference: Brief Industrial Profile of Damoh District (MSME) Govt. of India –2011-12 (www.msmeindore.nic.in)</p>				

EXISTING MICRO- & SMALL ENTERPRISES (Based on Agro- , Forest- Produce and Minerals)

NIC Code No.	Type of Industry	Number of units	Employment
1	Agro-based	69	88
2	Wood/ Wooden based Furniture	74	78
3	Paper & Paper Products	02	07
4	Leather Based	07	07
5	Mineral Based	13	07
<p align="center">Reference: Brief Industrial Profile of Damoh District (MSME) Govt. of India –2011-12 (www.msmeindore.nic.in)</p>			

LARGE SCALE INDUSTRY:

- | |
|--|
| <ol style="list-style-type: none">1. Diamond Cement Factory Pvt. Ltd. Narsingharh Dist. Damoh2. Diamond Cement Factory Pvt. Ltd. Imlai Dist Damoh |
|--|

MINING:

Mining of sand-stones, lime-stones, basalt and Flagstone etc. started lately here which was seen as the only potential industry of this district. This gave foundation to only one big industry here viz. M/s Diamond Cements initiated by Birla-group near Damoh at Narsingharh. Some more information about this factory is given below:

DIAMOND CEMENT FACTORY : This is based on lime-stone deposits of Narsingharh, Pathariya, Mahuna, Safa-Barkera , Madia, Kumaria and Barkhera – Nahar etc. villages. The lime stone production from Narsingharh and Patharia mines during 2002-03 was 1896457 tons. In that year cement produced at Diamond Cement Factory was 1702743 tons .

OTHER EFFORTS: One mini cement plant (M/s Abhishek Cements Ltd) was established at Patna-kua near Singrampur in Jaberia tehsil based on deposits of limestone in Ramsalaiya –Danababa area. This plant could not sustain and has been reported as closed. A number of stone-crushers rendering road metals and for use in RCC constructions have become active.

A report published in District Statistics Handbooks issued by the District Planning & Statistics Department for 2007 and 2011 regarding extraction of minerals from this district is presented below:

TABLE: EXTRACTION OF MINERALS IN DAMOH DISTRICT

S.No.	Mineral	Production			
		2005-06	2006-07	2010-11	2011-12
1	Lime-stone (in m.tonne)	2205326.00	2074752.20	1499581.00	2189720.00
2	MURAM (in cubic metre)	27400.00	13935.29	78018.00	343144.00
3	Sand (in cubic metre)	13692.00	22811.82	46733.00	70220.00
4	Flagstone (in cubic metre)	2265 .00	2512.96	3836.00	6381.00
Reference: District Statistics Handbook -Damoh District - 2007 and 2011					

3 . PANNA

In this region of *Bundelkhand* , traditional society was structured, specific communities had developed the crafts and refined gradually with their accumulated experience through generations. Basic needs like food, cloth, shelter , day-to-day living and medicines all were managed locally with available resources. Concept of providing necessities dominated over any commercial enterprises involving industries and trades. The blind commercialization is a modern day concept which has disturbed not only the natural environment but also created imbalance in human inter-relations.

Agriculture being major occupation and forests being rich in fruits, fodder, and medicinal plants a number of secondary occupations had developed here. Most important of all had been the animal husbandry. Food-processing was almost confined as a domestic task. Since cotton was grown here in all parts, cloth weaving developed as an independent occupation . Similarly need based products like winter blankets, earthen pots & leather-shoe were items needed by everybody. The arts like wood-crafts, carpentry, black-smithy and some knowledgeable persons adopting physician's task and preparing herbal medicines etc became basis for common occupations serving society in villages as well as towns.

District Census Handbook (1981) quoting situation of 1979 , reports manufactured, imported and exported commodities to and from Ajaygarh and Panna towns of this district as follows:

TABLE- INDUSTRIAL PRODUCTS

S.No.	Particulars	Ajaygarh	Panna
1	Important Manufactured Items	Furniture, Leather Shoes Bamboo Articles	Wooden Furniture Steel Furniture
2	Important Imported Items	Cloth Sugar Kerosine Oil	Cloth Rice Mineral Oils
3	Important exported Items	TUAR Pulse Timber Charcoal	Diamond Timber Stones
Reference: District Census Handbook (1981) Part-XIII-A (Village & Town Directory)			

INDUSTRIAL PROFILE OF PANNA DISTRICT:

A brief industrial profile of Panna district (2011-12) has been prepared by MSME-Development Institute (Indore) under Ministry of Micro,Small & Medium Enterprises, Govt. of India. Some salient features are presented as follows:

INDUSTRIES AT A GLANCE

S.No.	Head	Unit	Particulars
1	Registered Industrial units	number	2723
2	Total Industrial Units	number	3243
3	Registered Medium & large units	number	Nil
4	Estimated Average no. of daily workers employed in small scale industries	number	2.50
5	Employment in large & medium industries	number	Nil
6	No. of Industrial Area	number	01
7	Turn over of small scale industries	(Rs. In Lakh)	5264
Reference: Brief Industrial Profile of Panna district (MSME) Govt. of India –2011-12 (www.msmeindore.nic.in)			

The only Industrial Area in Panna district is SUIE (Semi-Urban Industrial Estate) which has 06 plots , all of them have been allotted where 11 units are active in production.

DETAILS OF EXISTING MICRO & SMALL ENTERPRISES :

(Particularly based on Agro-, Forest Produce & Minerals etc.)

NIC Code No.	Type of Industry	No. of Units	Employment
20	Agro-based	No figure	No figure
27	Wood-Wooden Furniture	60	250

28	Paper & Paper Products	nil	Nil
29	Leather Based	67	117
32	Mineral Based	08	94
<p style="text-align: center;">Reference: Brief Industrial Profile of Damoh district (MSME) Govt. of India -2011-12 (www.msmeindore.nic.in)</p>			

MINING AS AN INDUSTRY:

As reported earlier Iron extraction was common here before British arrival. Diamonds had been known here for ages and have been regularly mined. This is the main mineral being extracted even during present days. A recent report giving information regarding Diamond extraction for last five years is presented below:

TABLE- DIAMOND EXTRACTION

s.no.	Year	Mineral	Extraction by	No. of mines	THAN found	Total Carrots	Income From Royalty
1	2008-09	Diamond	NMDC Ltd.Hyderabad	01	nil	nil	2,66,978.00
2		-do-	CHHEELA mines	856	806	552.39	6,72,937.00
3	2009-10	-do-	NMDC Ltd. Hyderabad	01	29790	16,492.40	18,37,439.00
4		-do-	CHEELA mines	457	587	401.89	6,21,780.00
5	2010-11	-do-	NMDC Ltd Hyderabad	01	23950	10836.99	3,70,67,579.00
6		-do-	CHEELA mines	557	510	387.75	9,69,003
7	2011-12	-do-	NMDC,Ltd. Hyderabad	01	36075	18623.80	1,01,35922
8		-do-	CHEELA mines	915	599	490.83	11,56,888.00
9	2012-13 (up to Nov. 12)	-do-	NMDC Ltd. Hyderabad	01	7542	3758.07	1,86,24,164.00
10		-do-	CHEELA mines	534	671	460.46	5,90,347.00
<p style="text-align: center;">Reference: Report from Diamond Officer, Office at Panna (December 2012)</p>							

FEEDBACK FROM DIC, PANNA:

The G.M. DIC , Panna has listed only 11 small scale industries located at Industrial Estate ,Giri Puraina and the units running in private sector. These are

TABLE- SMALL SCALE INDUSTRIES

S.No.	Unit	Location
1	M/s Sharda Dall Mill	at I.E. Giri Puraina (Shanagar)
2	M/s Shri Guru Carbide & Chemicals	-do-
3	M/s Katni Minerals Pvt. Ltd.	-do-
4	M/s Shiva Exim Enterprises	-do-
5	M/s Bala Ji Wire	-do-
6	M/s Sharda Coke Mfg. Pvt. Ltd.	-do-
7	M/s Rajaram Neurochemicals	-do-
8	M/s Kurghnath Stone-Crushers	Luhargaon, (Gunnaur)
9	M/s Kaka Mines Company	Tidunhai (Gunnaur)
10	M/s Dharatidhan Pipe	Tidunhai (Gunnaur)
11	M/s Aarju Cement Pipes	Vill/PO: Janwar (Panna)
Reference Report from DIC, Panna		

The total employment to people in all the above units are : 148 only . There are no medium or large scale industry which could employ more people in industrial sector here.

THE PROBLEMS AS EXPRESSED BY SMALL ENTERPRISES

1. Considerable delay in approval and issue of licenses etc.
2. Poor infra-structure ,
3. Unavailability of information regarding industries and possibilities .

.....

4 . SAGAR

Like in other *Bundelkhand* districts Sagar too had an agrarian society mostly based in villages . The crafts which helped people's day to day life were spread all over.

Following is a brief account of the available information :

CLOTH-WEAVING,DYING AND PRINTING:

Most important industrial production based on cottage level enterprises was of woven coarse cloth. The main centre was Gadhakota where several hundred weavers' families were involved in this profession. Those who helped to dye and print on these cloths were also in sizable number. It was a community based occupation. The shepherds used to make blankets popular amongst rural population especially the agriculturists.

LEATHER TANNING AND UTILIZATION:

Leather of dead animals in villages were tanned by exclusive communities who also used to make shoes strong enough for rural work . The leather and meat were exported too. The goat-leather had many different uses within the village.

GOLD/ BRASS WORK:

Gold smiths traditionally had good trade within Sagar district but slowly came down because of pressure of outside products. They turned towards brass making ornaments which were popular amongst poor people. Also some communities used to make several types of utensils using brass metal.

CARPENTRY & BLACK-SMITHY :

Almost each village had its own artisans helping farmers by making agriculture-implements for them. The frying pans (KADHAI) made of iron at Barayatha & Hirapur were very famous. Nut-cutters (SARAUTA) and locks were made at Deori. In addition to that wood-working and bamboo-working had been very common and thousands of people were involved in this work.

GLASS / SHELLAC -WORKING:

Glass bangles, being a popular item , had high demand and several communities had developed art of making bangles of glass . Some people also made bangles of shellac which were sold during SHRAVANA month of traditional Indian Hindu calendar.

INDUSTRIAL PROFILE OF SAGAR DISTRICT:

A brief industrial profile of Sagar district (2011-12) has been prepared by MSME-Development Institute (Indore) of the Ministry of Micro, Small & Medium Enterprises, Govt. of India. Some salient features are presented as follows:

INDUSTRIES AT A GLANCE:

S.No.	Head	Unit	Particulars
1	Registered Industrial units	Number	12,886
2	Total Industrial Units	Number	6,304
3	Registered Medium & large units	Number	02
4	Estimated Average no. of daily workers employed in small scale industries	Number	30868
5	Employment in large & medium industries	Number	544
6	No. of Industrial Area	Number	07
7	Turn over of small scale industries	(Rs. In Lakh)	5,445.04
8	Turnover of Medium & Large scale Industries	-do-	10,630.00
<p style="text-align: center;">Reference: Brief Industrial Profile of Sagar district (MSME) Govt. of India – 2011-12 (www.msmeindore.nic.in)</p>			

INDUSTRIAL AREAS OF SAGAR DISTRICT

S.No.	Name of Industrial Area	Land Acquired (ha)	Land Developed (ha)	No. of Plots	No. of allotted Plots	No. of Vacant Plots	No. of Units in production
1	Subhash Nagar	6,458	3.38	45	45	nil	43
2	Semi-Urban	6,275	3.12	110	110	nil	20
3	Rural Work-shed Rehli	1.39	0.55	12	12	nil	02
4	Soirai (Bandaa)	91.50	45.79	262	01	261	01
5	Chhevla (Deori)	158.58	-	-	-	-	-
6	Karampur (Khurai)	20.00	-	-	-	-	-
7	Dalpatpur Raiyatwari (Khurai)	10.00	-	-	-	-	-
8	Belai (Bina)	40.00	-	-	-	-	-
	TOTAL	334.203	52.84	429	168	261	66

Reference :
Brief Industrial Profile of Sagar district (MSME) Govt. of India –
(www.msmeindore.nic.in)

DETAILS OF EXISTING MICRO & SMALL ENTERPRISES :

(Particularly based on Agro-, Forest Produce & Minerals etc.)

NIC Code No.	Type of Industry	No. of Units	Employment
20	Agro-based	1303	2606
23	Cotton Textile	13	17
25	Jute and Jute-based	01	04
27	Wood-Wooden Furniture	639	918
28	Paper & Paper Products	11	19
29	Leather Based	12	22
32	Mineral Based	111	207
	Total	2090	3793

Reference:
Brief Industrial Profile of Sagar district (MSME) Govt. of India – 2011-12
(www.msmeindore.nic.in)

LARGE SCALE INDUSTRIES AND PUBLIC SECTOR UNDERTAKINGS:

M/s Bina Refinery This is the only Public Sector Undertaking set up in this district as a Large Scale Industry. This is situated at village: Agasoid, Tehsil: Bina , SAGAR .

-----..

5. TIKAMGARH

As in traditionally agrarian society, villages in Tikamgarh district also were like republics having self-supporting clustered structure equipped with necessary production of foods and fodder through cultivation assisted with forests. Villagers never had to go very far for essential needs. For weaving of coarse-cloths and blankets, making of leather-shoes, pottery, carpentry and black-smithy, gold/silver/copper-smithy as well as working on iron/ brass- metal for making utensils etc. local artisans / communities of artisans used to be present almost in villages and nearby towns.

Weekly markets gave opportunity to buy or sell excess products of villages and also essential external products through traders visiting and setting up their stalls. Since iron smelting was done locally even country guns and other items were manufactured right here within this district. **Badagaon** (Dhasan) was a famous centre. At Tikamgarh there was also a state-run workshop performing all essential fabrications etc. run by steam-engine (Ref: Eastern States' Gazetteer-1907) .

Although low-capacity electrical power generation had started at Tikamgarh in thirties, its consumption for industrial activities remained very minimum. By 1980, however, Madhya Pradesh Electricity board had managed to upgrade and 16 distribution centres had started with a total capacity of 132 MW. Record as shown in District Gazetter (1995) reveals maximum consumption of electricity in commercial & industrial sector to be 13,823,000 KWh as compared to the domestic consumption of 18,554,000 KWh. in the year 1990-91.

STATUS OF INDUSTRIES IN THE DISTRICT:

Available records up to 1995 do not mention any large-scale industrial unit in Tikamgarh district. Four medium scale units reported in the year 1991 are as follows:

1. M/s K.P.Solvex Ltd. Niwari (est.1984-85)
2. M/s Eastern Refractory Ltd., Harshmau (est.1990)
3. M/s sahu Flour Mill, Pratappura (est. 1990)
4. M/s D.P.Cam Pvt. Ltd. , Pratappura (est. 1991)

Report for the year 1994 gives following information :

LARGE AND MEDIUM SCALE UNITS

S.No.	Industry	Year of establishment	Item of production	Ave. annual capacity	Average daily employment
1	M/s K.P.Solvex Ltd. Niwari	1985	Vegetable Oil Refined Oil	30,000 MT 30,000 MT	110
2	M/s Eastern Refractory Niwari	1992	Fire Bricks	8,400	46
3	M/s Apolo Stone Ltd. Pratappura	1994	Stone tiles	-	50
Reference: District Gazetter Tikamgarh (1995)					

SMALL SCALE INDUSTRIES:

There were many small industrial units in un-organized sector (those which could employ 5-9 workers if using power , and 5-19 workers if not using power) supported by the State Govt. but by the year 1970 only one unit was reported registered under the Factories' Act 1948. This number rose to five by 1975. Besides , five other units mainly producing cloth, oil, paddy– dehusking and *papad - badi* etc. were active in cooperative sector. Following table provides information about registered small scale (SS) units for some years between 1975 and 1994.

REGD. SMALL SCALE UNITS

Year	No. of units	Average employment	Year	No. of units	Average employment
1975-76	200	500	1989-90	553	690
1980-81	227	700	1990-91	409	1,129
1985-86	300	537	1991-92	259	631
1986-87	308	815	1992-93	354	730
1987-88	350	656	1993-94	211	664
1988-89	336	603	-	-	-
Reference: District Gazetteer (Tikamgarh) 1995					

Cooperative sector handling small industries also progressed during this period . The 1974-75 figure gives in all 826 members involved in societies as weavers, khadi-gramodyog workers and others. These societies were centred around Tikamgarh, Prithvipur and Khargapur.

WOODEN TOYS:

The 1995 report mentions about four specific wooden-toys- units run at Bairawar and Muhara villages (registered with the M.P.Handicrafts Board) as follows:

- | | |
|----------------------------|-----------------------------|
| 1. Ratiram Kundera, Muhara | 3. Liladhar Kundera, Muhara |
| 2. Kuiyan Kundera, Muharan | 4. Zalim Kundera , Bairawar |

PRESENT INDUSTRIAL PROFILE OF THE DISTRICT:

A brief industrial profile of Tikamgarh district (2011-12) has been prepared by MSME-Development Institute (Indore) of Ministry of Micro, Small & Medium Enterprises, Govt. of India. Some salient features are presented as follows:

INDUSTRIES AT A GLANCE

S.No.	Head	Unit	Particulars
1	Registered Industrial units	Number	9,339
2	Total Industrial Units	Number	9,339
3	Registered Medium & large units	Number	01
4	Estimated Average no. of daily workers employed in small scale industries	Number	18,943
5	Employment in large & medium industries	Number	125
6	No. of Industrial Area	Number	06
7	Turn over of small scale industries	(Rs. In Lakh)	621.095
8	Turnover of Medium & Large scale Industries	-do-	-
Reference: Brief Industrial Profile of Tikamgarh district (MSME) Govt. of India – 2011-12 (www.msmeindore.nic.in)			

INDUSTRIAL AREAS OF TIKAMGARH DISTRICT

S.No .	Name of Industrial Area	Land Acquired (ha)	Land Developed (ha)	No. of Plots	No. of allotted Plots	No. of Vacant Plots	No. of Units in production
1	Tikamgarh	4.668	3.143	21	21	-	20
2	Jatara	3.333	3.333	06	06	-	05
3	New Ind. Area Tikamgarh	0.546	0.319	08	08	-	02
4	Niwari	7.000	4.060	41	34	13	04
5	Kitakheda	1.191	1.131	12	01	11	01
6	Khargapur	15.000	14.000	39	-	39	-
	TOTAL	31.738	25.986	127	70	63	32

Reference :

Brief Industrial Profile of Tikamgarh district (MSME) Govt. of India – 2011-12
(www.msmeindore.nic.in)

EXISTING MICRO & MALL ENTERPRISES :

(Particularly based on Agro-, Forest Produce & Minerals etc.)

NIC Code No.	Type of Industry	No. of Units	Employment
20	Agro-based	75	225
23	Cotton Textile	135	405
25	Jute and Jute-based	-	-
27	Wood-Wooden Furniture	389	770
28	Paper & Paper Products	-	-
29	Leather Based	-	-
32	Mineral Based	48	136
	Total	647	1,536

Reference:

Brief Industrial Profile of Tikamgarh district (MSME) Govt. of India – 2011-12
(www.msmeindore.nic.in)

LARGE / MEDIUM SCALE INDUSTRIES/ PUBLIC SECTOR UNDERTAKINGS:

- M/s K.P.Solvex Ltd.
Village : Harshmau Tehsil: Niwari ,Distt. Tikamgarh (MP)
Producing vegetable oil from Solvent Extraction Process.

INDUSTRIAL ACTIVITIES BASED ON MINES-MINERALS:

The records of production of major minerals and related employment for different years between 1980 and 1992 give the following facts & figures :

Year	Production (M.Tonnes)		No. of mines	Average Employment
	Diaspore	Pyrophyllite		
1980	4,290	14,334	-	-
1985	445	16,022	-	-
1986	1,821	36,447	20	101
1987	3,560	21,617	20	210
1988	4,438	19,421	20	200
1989	4,550	32,957	24	86
1990	4,754	33,284	24	270
1991	5,959	25,965	24	605
1992	4,590	24,532	23	355
Reference: District Gazetter (Tikamgarh) 1995				

MINERALS EXPLOITED IN RECENT YEARS:

The District Statistics handbook of 2009 reports following information regarding production & sales of the minerals from different places of Tikamgarh district.:

TABLE-PRODUCTION & SALES OF MINERALS

Mineral ↓	Amount Produced (m.tonne)				
Year →	2004-05	2005-06	2006-07	2007-08	2008-09
Diaspore	71.4	319.6	228.0	195.28	-
Pyrophyllite	2,265.5	1,829.6	2,052.0	1,757.52	34,233.0
Stone	99,516.4	60,212.0	70,695.4	20,087.29	11,51,857.08
Muram	-	-	-	1,18,187.36	-
Sand	10,707.0	-	6,780.68	48,024.87	5,75,928.54
Flagstone	-	-	-	-	--
Reference: Directorate of Economics & Statistics (Distt. Handbook-2009)					

.....

IMPORTANT REFERENCES:

- 1 . EASTERN STATES (BUNDELKHAND) GAZETTEER Volume VI-A-Text : Captain C.E. Luard (1907)
- 2 . Central Provinces District Gazetteers- DAMOH DISTRICT : R.V.Russell (1906)
- 3 . SAGAR SAROJ (Saugar District Gazetteer- Hindi) : Rai Bahadur Hiralal (1922)
- 4 . DAMOH DEEPAK (Damoh District Gazetteer – Hindi) : Rai Bahadur Hiralal (1919)
- 5 . BUNDELKHAND KA ITIHAS (Hindi) Part-1: Deevan Pratipal Singh (1929)
- 6 . ANCIENT BUNDELKHAND : K.K.Shah (1988)
- 7 . BUNDELKHAND KA SDAMAJIK ARTHIK ITIHAS (Hindi) : Dr. K.P. Tripathi (2006)
- 8 . DISTRICT-GAZETTEER (Chhatarpur) : S.D.Guru (Govt. of M.P.) 1982
- 9 . DISTRICT GAZETTEER (Damoh) : Premnarain Shrivastava (Govt. M.P.) 1980.
- 10 . DISTRICT-GAZETTEER (Sagar) (Hindi) : V.S. Krishnan (Govt. of M..P.) 1970
- 11 . DISTRICT-GAZETTEER (Tikamgarh) : Dr. N.P.Pandey (Govt. of M.P.) 1995
- 12 . DISTRICT CENSUS HANDBOOK (Chhatarpur) : K.C. Dubey (Govt. of M.P.- 1981)
- 13 . DISTRICT CENSUS HANDBOOK (Panna) : K.C.Dubey (Govt. of M.P. -1981)
- 14 . DISTRICT CENSUS HANDBOOK (Tikamgarh) : K.C.Dubey (Govt. of M.P.-1981)
- 15 . GAZETTEER OF INDIA- MADHYA PRADESH SAGAR DISTRICT SUPPLEMENT : K.R.R.C.Nair (Govt. of M.P.) 1992.
- 16 . THE GLORY THAT WAS BUNDELKHAND (Mahendra Kumar Manav- Felicitation Volume) : Professor K.D.Bajpai (1993)
- 17 . BUNDELI ITIHAS AUR SANSKRITI (Hindi) : Kapil Tewari (M.P. Sanskriti Parishad) 2005
- 18 . CENSUS DATA (Online) < www.censusindia.gov.in >
- 19 . <www.uponline.in >
- 20 . < www.Indiawater.gov.in >

-
- 21 . JAL BICH MEEN PIYASHI (Report of Jhansi Seminar held on 10-12 March 1996) Ed. Dr. Bharatendu Prakash (Vigyan Shiksha Kendra-publication)
 - 22 . PROBLEMS AND POTENTIALS OF BUNDELKHAND WITH SPECIAL REFERENCE TO WATER RESLOURCE BASE : B.Prakash, Santosh Satya, S.N.Ghosh & L.P.Chaurasia (IIT Delhi-Vigyan Shiksha Kendra) 1998
 - 23 . Technical Report of the Pilot Study of the Land-use and Water Resources for equitable distribution of water in Hydrometeorological subzone 1 'C' : IN-RIMT (Hyderabad) 1994
 - 24 . IMD Climatological Tables of observatories in India (Indian Meteorological Department (Govt. of India) Nagpur & Pune.
 - 25 . INDIA WATER PORTAL (www.indiawaterportal.org).
 - 26 . Survey Report of Tanks of *Bundelkhand* : Hindi: (Nivari Block of Tikamgarh) : Dr. R. Krishnagandhi & Dr. Sunanda Kirtane (1998)
 - 27 . < www.synergyenviron.com > through INDIA WATER PORTEL
 - 28 . District Ground Water Information Booklets (Chhatarpur, Sagar & Tikamgarh) : Ministry of Water Resources (CGWB) North-Central region , Govt. of India (2009)
 - 29 . GEOLOGY AND MINERAL RESOURCES (Damoh) Directorate of Geology and Mining , Mineral resources Dep[artment (Govt. of M.P.) 2004
 - 30 . Brief Industrial Profiles (Chhatarpur, Damoh, Panna, Sagar, Tikamgarh) : MSME-Development Institute (Min. of MSME, Gopvt. Of India) Indore 2012-13 (www.msmeindore.nic.in).

.....