PREPARED FOR – FORUM FOR POLICY DIALOGUE ON WATER CONFLICTS IN INDIA

HASDEO SUB-BASIN REPORT

THEME- ENVIRONMNETAL FLOWS

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Human Interaction is the best source of knowledge acquisition, one which cannot be surpassed by all the combined knowledge available on the internet. Learning from a fellow human's own vivid personal experiences is unmatched by any other till date. In search of information we dive deep into the domains of the internet, and yet the most profound form of information is the one that you receive from an unanticipated respondent. All these interactions, key information from secondary sources have helped me in compiling this report in this form today. This report is one tangible output of the 2 month internship that I had an opportunity of doing with the Forum for Policy Dialogue on Water Conflicts in India. The entire reading and secondary source gathering was done from the SOPPECOM office based in Pune.

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CONTENTS

SUMMARY

Forum for Policy Dialogue on Water Conflicts in India (Forum) is a conglomeration of 150 individuals and organisations which came up to document and map conflicts over water. As part of its work it has also undertaken outreach campaigns involving media and the civil society to attract the attention of the mainstream towards regional and local cases of water conflicts. Society for Promoting Participative Ecosystem Management (SOPPECOM), Pune anchors and co-ordinates forums work.

The research on the Mahanadi Basin is being done under 4 thematic heads: right to water and sanitation, groundwater, agricultural and industrial use and environmental flows and river basin management. A sub part of the Mahanadi Basin, Hasdeo Sub Basin was chosen for study under the E-Flows component. Spanning across 5 districts of Chhattisgarh, it shows a clear amalgamation of conflicting water uses. From the origin to the point where it surrenders itself to the Mahanadi River, it serves a variety of functions. Rivers are ecosystems in themselves performing vital ecological and evolutionary functions including providing basic and livelihood needs of millions. They cannot be merely treated as drains. But at present rivers have lost their natural functions due to anthropogenic interventions.

To combat this head on crisis, one needs a comprehensive inventory of all the vital functions that the river performs and how in this constantly changing world, the nature of these functions is getting altered. This minute change then initiates a series of changes in the ecosystem, because everything works as a response. The exploitation of natural resources taking place in the Hasdeo Sub Basin is now taking a toll on the people and terrestrial and aquatic ecosystems of the region. Conflict has reached an altogether new level which makes it all the more important to study it.

LIST OF TABLES

LIST OF FIGURES (Figure Template at the end)

CHAPTER 1: ENVIRONMENTAL FLOWS – UNFOLDING THE CONCEPT

From its origin to the point where the river surrenders itself to the sea, it performs innumerable functions and homes one third of the global vertebrate biodiversity. As they drain 75% of the earth's land, they leave behind the most conducive environment for countless habitats to flourish. Currently rivers are the central concern of a wide range of environmental issues.

The fact that rivers serve us in innumerable ways is an established fact. But on the contrary the way we view our rivers in this rapidly "progressing" world is a matter of contention. Rivers have transitioned from being the arteries of this life supporting system to becoming the stagnant storehouses of our development waste which has led quite a few rivers to even cease flowing. Environmental Flows as a concept evolved for this very crisis management which brings in the voices of the voiceless backed by the developments in the scientific understanding of our ecosystem. It poses a very direct question to all of us who are in some way responsible for the filth flowing in our rivers. It is up to us to decide what state do we want to keep our rivers in and if we are at all ready to compromise our arterial strength for long term development objectives that live a short life. This necessarily means a very strong adherence to trade-offs in the decision making process which will leave behind a bunch of losers and winners which will then in a way spark off a very differently constructed inequality.

Reverting back to this enormous entity called river, there are a few nuanced understandings that modern scientific research has given us. Rivers own their identity to an amalgamation of three key factors: flow, water quality and sediment transport. A simultaneous alteration in these three factors can create different ecosystems and all unique in nature. This is primarily because the associated biodiversity shows a very strong response to alterations in the above features. It is now an established fact that animals and plants found in riverine ecosystems are largely controlled by physical rather than biological processes[1]. Infact the riverine species have evolved primarily in response to natural flow regimes. This is because rivers are highly variable and unpredictable especially with respect to the flows. One could easily demarcate the periods of low and high flows in a river which thereby has an influence on the ecosystem. So out of the three factors, flows have been regarded as the master variable. High flows provide shape and texture to the channel they flow into. Moreover they aid in the transportation of sediments. During high flows, fast moving creatures are in their full form and gradually as low flows set in; the more sedentary ones are given way. It forms a natural resetting mechanism in the words of Jay O'Keeffe and Tom Le Quesne.

[1] Jay O'Keeffe; Tom Le Quesne; 2009; Keeping Rivers Alive: A Primer on environmental flows; WWF Water Security Series; Pg -8.

In this age where we have caused more harm to our rivers than repair, Environmental Flows intend to mimic this natural variability of flow in rivers. But increasing flows is not always the best resort. Maintaining the natural variability of the flows in the river is a very context specific endeavour. To artificially replicate this earlier natural behaviour in rivers, one needs a well structures flow regulation regime. Increasing or decreasing flows in a river not suited for the same can create havoc in the ecosystem.

To provide a global picture of the level of alteration of the world's largest river systems, a River Fragmentation and Flow Regulation indicator[2] was developed in the year 2005. The prime purpose behind the development of this indicator was to study the degree to which the flow regime and connectivity of the rivers had been altered. Laterally dams disconnect the rivers from the adjacent floodplains and longitudinally it blocks the flow of sediments and nutrients that nurture the downstream ecosystems. This fragmentation impedes the ecological functions which are indispensable for supporting life dependent on freshwater. Flowing water when suddenly rendered stagnant, leads to disappearance of fish species adapted to riverine habitats and the proliferation of other often exotic species adapted to still waters[3]. Globally, 2/3rd of all large river systems are moderately or highly fragmented by dams and reservoirs. Industrialized regions such as USA and Europe and heavily populated countries like China and India encompass the most fragmented rivers[4].

Environmental Flows as an area of study envisages arriving at that point where we can decide on the quantum of change that we are prepared to accept. How much of the flow regime are we willing to modify before we reach a threshold beyond which our actions just backfires.

In order to acknowledge this right of the river to flow, various institutions have come up with definitions regarding environmental flows. As per the International Union for Conservation of nature (IUCN) environmental flow has been defined as the water regime provided within a river, wetland or coastal zone to maintain ecosystems and their benefits, where there are competing water uses and

[2] Fragmentation Rankings (i.e., highly affected, moderately affected and unaffected) are assigned to each large river system using its location, storage capacity, proportion of free flowing miles of river length and annual runoff that is stored behind the dam throughout the year.
Highly Fragmented and regulated rivers include those with less that 1 quarter of their main channel left without dams, where the largest tributary has at least 1 dam, and where the reservoirs retain a considerable portion of a year's flow.
Unaffected rivers are those without dams in the main channel of the river and if tributaries have been dammed, the flow of the river has not changed substantially (less than 2% of the natural flow has been affected).
[3] www.bipindicators.net/riverfragmentation
[4] www.bipindicators.net/riverfragmentation

where flows are regulated[5]. International Water Management Institute (IWMI) describes environmental flows regime as discharges of a particular magnitude, frequency and timing which are necessary to ensure that a river remains environmentally, economically and socially healthy.

Environmental Flowss are a regime of flow in a river or stream that describes the temporal and spatial variations in quantity and quality of water required for freshwater as well as estuarine systems to perform their natural ecological functions (including sediment transport) and support the spiritual, cultural and livelihood activities that depend on these ecosystems was the definition proposed by the National Ganga River Basin Management Plan. And as per Forum the definition speaks as the flow regime to be left for the environment, right from the 1st order stream watersheds to the main river basin, denotes the water for environmental needs at a river basin level[6].

Although the term "Environmental Flow" has other names or variants like "Environmental Water Requirements", "Environmental Water Demand", it should not be mixed up with terminologies like In stream Flow Requirement (IFR)[7] or Drought IFR or even for that matter Minimum Flow[8]. The concept of minimum flows was floated in order to reserve an amount of water to help sustain the in stream water ecosystem and was essentially borrowed from the Western water law. The concept gained momentum amidst rising concerns for the protection of fish that suffered most due to the low summer flows in the river. But Stalnaker in his paper "Minimum Flow is a Myth[9]" written way back in the 90's made an outright criticism of the concept. The myth here denotes the single minimum discharge value that is assigned to the river which in the long run fails to "move bed load, flush sediments, rejuvenate the floodplains and thus maintain the structural characteristics of the stream channel."

Amidst all the different articulations on the subject, there are some key concerns that are kept beyond the domain of the E Flows. Problems like pollution that is caused by poor land management needs to be addressed at the source itself. Overgrazing, water quality problems due to sewage effluents released into the river stream and increased input of sediment into the river due to erosion needs monitoring and mitigation at the source. All these concerns if brought under the ambit of E Flows will

[5] D.Megan, B.Ger, S.John; Flow, The Essentials of environment flows; International Union for Conservation of Nature and Natural Resources, Pg. v.

[6] Joy K.J., S.Priya, A.Latha, D. Shripad, K.P.Soma, 2011, Life, Livelihoods, Ecosystems, Culture : Entitlements and Allocation of Water for Competing Uses, Position Paper by the thematic subgroup on Water Entitlements and Allocations for Livelihoods and Ecosystem Needs, Forum for Policy Dialogue on Water Conflicts in India.

[7] The term "Instream Flow" is used to designate a specific stream flow, measured in cubic feet per second (cfs), at a particular location for a defined time, and typically follows seasonal variations. In-stream flows are needed to protect and preserve resources, such as fish, wildlife and recreation, in a waterway. (http://www.dfg.ca.gov/water/instream_flow.html)

[8] http://www.eoearth.org/view/article/152624/

[9] Stalnaker, C. B.; 1990; Minimum Flow is a Myth; Ecology and assessment of warm water streams: workshop synopsis; US Fish and Wildlife Services; Biological Report; 31-33.

make an already difficult endeavour even more difficult to analyse and implement. Allocation of high flows for the artificial dilution of pollutants will be at odds with increased extraction.

A huge gap lies between the assessment and implementation of E Flows which comes as a major limitation in the endeavour of improving the status of rivers in the world. Achievement of the predicted ecological state of the river is a farfetched idea and the decision making revolving the same is one that is laden with a lot of trade-offs and also possible conflicts. An integrated effort on the part of the scientific and social community will help in arriving at a consensus. Undermining the importance of even a single stakeholder will perish this noble undertaking.

One needs to understand that there is a very fine line between development of the resource and exploitation of the same. And the very base of knowledge that is required to determine or rather take a decision to forge ahead with the project is absent in our country. There is dearth of quality river flow data and a very weak documentation of the biodiversity that has evolved in millions of years as a response to the flows in the river. Only when an inventory of all the relevant data is made available can one actually assess the real consequences of a project.

CHAPTER 2: INTRODUCTION TO THE HASDEO SUB BASIN

2.1 HASDEO SUB BASIN PROFILE

Mahanadi River Basin occupies 4.3% of the total geographical area of the country of which 7.35% is made up by the Hasdeo Basin. Mahanadi is drained by its 14 major tributaries of which 12 join it U/s of the Hirakud Reservoir and 2 D/s. The rivers Sheonath, Hasdeo, Mand, Ib, Kelo and Boras drain in the U/s portion.

Hasdeo River Basin is part of the Mahanadi middle sub basin (400-750 m above mean sea level) and is the 2nd largest branch of Mahanadi after Sheonath River. It originates from the hill region of Deogarh in Sonhat Taluka at an elevation of 1052m above msl in Koriya district of Chhattisgarh and then flows through Korba and Janjgir Champa districts of Chhattisgarh before joining Mahanadi near Seorinarayan which is a famous pilgrim centre.

The River Hasdeo Contributes 5389 MCM of water to the Mahanadi River. The total length of the Hasdeo River is 333 Kms. The total catchment of this river is 10535.96 sq. Kms, thus the contribution is 13.9% to the Mahanadi Basin within Chhattisgarh state[10]. The rivers Gej, Bamni and Atem meet Hasdeo U/s of the Minimata Bango Dam whereas Tan and Ahiran meet it D/s.

It flows from North to South direction and has 8 watersheds located between 21°45' N to 23°37' N latitude and 82°00' E to 83°04' E longitude. The eight different watersheds are upper Hasdeo, Gej Nala, Bamni Nadi, Tan Nadi, Chornai, Ahiran Nadi, Lower Hasdeo and Lower Basin Mahanadi[11].

Table 2.1: Sub Watersheds of the Hasdeo Sub Basin

S.No.	Sub Watershed	Area (sq. Kms)	Percentage of the Hasdeo Basin
1.	**Upper Hasdeo**	1448	13.9%
2.	**Gej Nala**	2109	20.3%
3.	**Bamni Nadi**	1567	15.1%
4.	**Tan Nadi**	870.44	8.4%
5.	**Chornai**	1792	17.2%
6.	**Ahiran Nadi**	905	8.7%
7.	**Lower Hasdeo**	998	9.6%
8.	**Lower Basin Mahanadi**	768	7.4%

[10] Water Year Book 2013, Water Resource Department, Government of Chhattisgarh
[11] Source – Central Ground Water Board, India

Table 2.2: Land Characterization in the Bamni, Upper Hasdeo, Tan and Chornai Sub Watershed[12]

Sub Watershed	Bamni Sub Watershed		Upper Hasdeo Sub Watershed		Chornai Sub Watershed		Tan Sub Watershed	
	Actual area	% of the total watershed	Actual area	% of the total watershed	Actual Area	% of the total watershed	Actual area	% of the total watershed
Area(Sq. Kms)	1567.09	15.1%	1448.52	13.92%	1792.30	17.22%	870.44	8.4%
Dense Forest (Sq. Kms)	401.01	25.59%	426.867	29.48%	656.668	37.97%	308.81	35.48
Open Forest (Sq. Kms)	363.49	23.19%	219.255	15.13%	192.59	11.14%	186.406	21.42
Scrubland (Sq. Kms)	8.80	0.56%	1.768	0.13%				
Water Bodies (Sq. Kms)	257.74	16.44%	255.055	17.61%	662.657	38.32%	156.869	18.02
Non Forest Area(Sq. Kms)	536.03	34.20%	549.322	37.65%	217.385	12.57%	218.357	25.09
Agricultural Land without Crop (Sq. Kms)	288.658	53.85%	78.204	14.34%	135.983	62.56%	164.738	75.44
Agricultural Land With Crop (Sq. Kms)	247.381	46.15%	467.118	85.66%	81.402	37.44%	53.619	24.56

[12] This table is a compilation of information from 3 research papers namely and 1 presentation.

1. Ajay K. Singh & S. S. Singh, Upper Hasdeo Watershed Status in Hasdeo River Basin at Chhattisgarh, India, FIG Congress 2010, Facing the Challenges- Building the Capacity, Sydney, Australia.
2. Ajay K. Singh & S. S Singh, FLULC Mapping and assessment of a typical sub watershed of Central India using IRS- P6 LISS 3 data, Journal Of Biodiversity and Environmental Sciences, Vol. 2, No. 9, pg 26-32, 2012.
3. Ajay K. Singh, S. S. Singh & Vandana, Forest Land Cover Variation and Catchment status in the Bamni sub watershed of Hasdeo River Basin in Central India, Journal of Biodiversity and Ecological Sciences, No. 1, Vol. 1, Issue 1.
4. Ajay K. Singh, Forest Vegetation Analysis and Land Cover Assessment in Tan Sub Watershed of Hasdeo River Basin, Chhattisgarh, India.

2.2 CONTOUR CHARACTERISTICS OF THE HASDEO SUB BASIN

Hasdeo River and its tributaries originate from the high elevation zone and flow in small drainage channels. These drainage channels gradually increase in width at the lower elevations as they begin to deposit more sediment. Most of the mines and industrial area lies in the high to medium height zone whereas the agricultural areas lie on the plains which make up the low elevation zones.

Table 2.3: Contour Characteristics of the Hasdeo Sub Basin

Height above msl	Area (sq. Kms)	% area	Remarks
142-282	1040.06	10	Very Low
283-422	1768.06	17	Low
423-562	2384.13	23	Medium
563-702	4547.28	44	High
703-1052	666.28	6	Very High
Total	10405.99	100	--

2.3 TRIBUTARIES OF THE RIVER HASDEO

1.	Halphate	2.	Kauriya	3.	Puraur	4.	Anjan
5.	Gej	6.	Manasi	7.	Bisrar	8.	Chornai
9.	Gudguda	10.	Borai	11.	Belgari	12.	Dhengur
13.	Kochandi	14.	Dom	15.	Kholarnalla	16.	Khar
17.	Gogi	18.	Soi	19.	Baniya	20.	Dhunethi
21.	Hasia	22.	Bamani	23.	Katai	23.	Phulsar
24.	Tan	25.	Ahiran	26.	Nauwnar	27.	Gongdei
28.	Bakai	29.	Chutaia	30.	Lilaghar	31.	Barr Nalla
32.	Atem	33.	Jhumka	34.	Saudham Nalla	35.	Korea Nalla
36.	Balijhar Nalla	37.	Bisrar Nalla	38.	Gagechorai	39.	Ganjar Nalla
40.	Gokrai Nalla	41.	Gokrai Nalla	42.	Patni Nalla	43.	Rapakara Nalla
44.	Laxman Nalla	45.	Hathi Nalla	46.	Karra Nalla	47.	Tuma Nalla
48.	Sundhara Nalla	49.	Jhinks	50.	Bhandargarh Nalla	51.	Dhardhoi Nalla

2.4 CLIMATE

Temperature varies from location to location with the upper reaches being relatively cooler due to good forest cover. January is the coolest month of the year with temperature ranging from a maximum of 28.3 to a minimum of 13 degree Celsius. May is the hottest month with a maximum of 42.5 and a

minimum of 26.3°C. Relative humidity ranges from 93% to 25%. Average rate of evaporation (mm/day) ranges from 2.5 in the month of December to 7 in the month of April.

The average rainfall in the Hasdeo Sub Basin's catchment is around 1400 mm, ranging from 900 – 1500 mm over the last 10 years. 80% of the rainfall is received from the months of June to August. Monsoon enters the state slowly and makes its way slowly to the north, while leaving it quits at once from the state. So the onset of monsoon at different stations in the state is mostly delayed but the withdrawal date remains constant throughout the state. Thus there is a decrease in the length of monsoon. The average period of monsoon is 116.87 days which is less than the normal period of 123 days[13]. The rainfall stations[14] in the Hasdeo Sub Basin are located in Pendra Road (Bilaspur), Baikunthpur , Manendragarh (Koriya), Gharghoda (Korba), Janjgir, Champa, Sakti (Janjgir Champa), Pali, Katghora (Korba), Ambikapur (Sarguja).

2.5 SOIL

The predominant soil type is loamy as above 62% of the area consists of fine loamy to loamy soils followed by different types of clayey soils and coarse skeletal loamy varieties. Chhattisgarh plains are composed of Bhata (lateritic), Matasi (Sandy Loam), Dorsa (Clay Loam) and Kanhar (Clay) while the northern hills are composed of hilly soils, tikra, Goda Chawar and Bahara. Among these, the Bhata, Matasi hilly soils and tikra are very light type of soils with very low water retentive capacity. So if ever there is a break in the monsoon for 5 to 7 days or just after the monsoons withdraws, a water stress like situation occurs in the soil thus making it difficult for the plants to extract water.

2.6 STATUS OF AQUIFERS IN THE HASDEO SUB BASIN

As per the report "Aquifer systems of Chhattisgarh" released in the year 2012, 14 blocks have been declared as semi-critical. Out of these 14, 1 lies in Bilaspur which clearly indicates that caution has to be exercised while planning ground water development in the block[15].

Hasdeo River forms the tributary of the largest river basin in Chhattisgarh, The Mahanadi. The Hasdeo River is part of the middle sub basin of the Mahanadi.

[13] Water Year Book 2013, Water Resources Department, Government of Chhattisgarh.
[14] The places in parenthesis indicates the district.
[15] Aquifer Systems in Chhattisgarh- Report prepared by Central Groundwater Board, North Central Chhattisgarh Region, Ministry of Water Resources, Government of India, 2012.

Table 2.4: District Wise Distribution of Principal Aquifer Systems[16]

District Name / Aquifer System		Koriya	Surguja	Korba	Bilaspur	Janjgir Champa
Alluvium	Area					
	%					
Laterite	Area		622.91		26.60	
	%		3.95		0.32	
Basalt	Area	11.35	219.74		62.68	
	%	0.17	1.39		0.75	
Sandstone	Area	**6460.17**	**6859.87**	**4115.70**	409.10	180.66
	%	**97.24**	**43.48**	**62.15**	4.90	4.66
Shale	Area			81.47	1467.48	**2213.72**
	%			1.23	17.59	**57.09**
Limestone	Area				2345.00	1126.43
	%				28.11	29.05
Granite	Area					
	%					
Schist	Area		8.47	23.48		
	%		0.05	0.35		
Quartzite	Area				35.79	
	%				0.43	
Charnockite	Area					
	%					
BGC[17]	Area	29.95	**6782.96**	2270.85	**3021.62**	75.27
	%	0.45	**42.99**	34.29	**36.22**	1.94
Gneiss	Area	142.37	1283.98	130.25	974.65	281.56
	%	2.14	8.14	1.97	11.68	7.26
Total	**Area**	**6643.85**	**15777.93**	**6621.75**	**8342.91**	**3877.63**

Table 2.5: A Summary of the Ground Water Condition in the Hasdeo Sub Basin[18]

District Name	Area (Sq. Kms.)	Condition
Koriya	6643.8	Major Part of the district is covered with semi-consolidated shale and sandstone aquifer of the Gondwana Formation. Due to argillaceous nature, these formations are less productive
Surguja	15777.9	Major part of the district is covered with semi consolidated shale and

[16] Aquifer Systems in Chhattisgarh- Report prepared by Central Groundwater Board, North Central Chhattisgarh Region, Ministry of Water Resources, Government of India, 2012.
[17] BGC – Banded Gneissic Complex
[18] Aquifer Systems in Chhattisgarh- Report prepared by Central Groundwater Board, North Central Chhattisgarh Region, Ministry of Water Resources, Government of India, 2012

		sandstone aquifer of Gondwana formation. Due to argillaceous nature, these formations have low productivity.
Korba	6621.8	Major Part of the district is covered with semi-consolidated shale and sandstone aquifer of the Gondwana Formation. Due to argillaceous nature, these formations are less productive
Bilaspur	8342.9	District is partly covered by crystalline aquifer and sedimentary aquifer. Sedimentary aquifer mainly consists of limestone and shale. Discharge potential of this aquifer is very high (upto 20lps). Groundwater gradient is very low.
Janjgir champa	3877.6	About 50% area of the district is covered with sedimentary formation and remaining part by crystalline aquifer. Yield potential of sedimentary formation is moderate.

Groundwater samples collected from Korba, Janjgir Champa, Surguja and Koriya only show Nitrate contamination (Nitrate > 45ppm). Samples from Surguja and Koriya have also shown fluoride contamination above the permissible limit (Fluoride > 1.5 ppm).

Table 2.6: District Wise Area Prioritised for Artificial Recharge[19]

District Name Aquifer System	Koriya	Surguja	Korba	Bilaspur	Janjgir Champa
Total Area Prioritized for artificial recharge	1164.7	2597.9	292.3	2401.6	126.2
Actual Total Area	6643.85	15777.93	6621.75	8342.91	3877.63
% of area being prioritized for artificial recharge	17.53	16.47	4.41	29.79	3.25
Total area delineated for Water conservation and Harvesting	4372.1	6303.3	2779.0	2187.7	96.2
Area suitable for groundwater development	3771.1	12493.8	6621.8	8342.9	3877.6

[19] Compilation of data from different tables from Aquifer Systems in Chhattisgarh- Report prepared by Central Groundwater Board, North Central Chhattisgarh Region, Ministry of Water Resources, Government of India, 2012

CHAPTER 3: DISTRICTS AND DEMOGRAPHY

The Hasdeo River passes through 5 districts namely, Koriya, Surguja, Korba, Bilaspur and Janjgir Champa. The river acquires a variety of forms and serves different purposes as it flows through these areas. From its origin in the Sonhat Mountains to its final surrender to the Mahanadi in Janajgir Champa, the river supports an enormous variety of livelihoods and creates a conducive environment for the establishment for different ecosystems.

Table 3.1: Administrative Division (Hasdeo Sub Basin)[20]

District Name	Area (sq. Kms)	Number of Tehsils	Number of Development Blocks	Number of Towns
Koriya	6643.8	4	5	7
Surguja	15777.9	9	19	7
Korba	6621.8	4	5	4
Bilaspur	8342.9	8	10	14
Janjgir Champa	3877.6	8	9	8
Total	41264	33	48	40

3.1 DISTRICTS

3.1.1 KOREA

Korea, a north western district of Chhattisgarh was earlier a princely state. Korea is composed of 5 tehsils and 653 villages. The earlier resource rich region's exploitation history is nothing but a 100 year old story. Under the leadership of Raja Ramanuj Pratap Singh Deo, the princely state was merged with Independent India and the treasury expanded from 2.25 lakh to 44 lakh. It also marked the construction of the Bijuri Chirmiri Railway lines that then aided in the colliery works of Khurasia, Chirmiri and Jagarkhand. According to the Korea government portal, 59% of the total district is under forest cover, but this figure has to be seen in association with the resource exploitation that is occurring at a rapid rate in the region.

Korea is home to a very complicated biodiversity that encompasses the Guru Ghasidas National Park, Amritdhara Ramdhaha and Gaurghat waterfalls. Apart from Hasdeo which actually finds its origin in the dense forests of the region, Banas and Gopad rivers also flow. The region is predominantly tribal and hence one could easily witness the celebration of the Karma festival, which marks the completion

[20] Censusindia.gov.in (Census 2011)

of the agricultural operations. It signifies the celebration of hard labour in which the Karam Tree is worshipped. Saila and Suga dance are performed in its full splendour. Tribal life is one that defines cooperation rather than competition. Sarhul, Navakhai, Charta and Ganga Dusshera are among the other festivals that one could witness in Korea which still shows a sense of cultural responsiveness in sync with the place humans hold in the species evolution graph.

The original inhabitants of the region are the Pando's whose population in the last one decade has reduced to half due to the activities that were meant to bring progress to the nation. Rest others are migrants of their own accord and include cherwa, rajwars, sahu, ahir, gwala, oraon, gadaria, koir, bargah, basod, kahar, muslim, kunbi, kewat, gupta, jaiswal, agarwal, jains and other scheduled castes.

What really is the remarkable feature of the region is the practice of hunting by the Pando's. These traditional hunters used poisoned arrows along with musical sounds to divert the attention of the animals. The Jhumka which produced this hypnotic music often attracted much more than just rabbits. Its music brought tigers and panthers in their vicinity. Their way of life was one in which a sense of harmony existed between man and nature.

The Hasdeo River flows in the form of an upturned S for about 95 Kms in the district. It receives water from the rivers Gej and Chornai on the left bank and the Tan and Ahiran on the right bank before meeting the Mahanadi. Forests and coal play a very important role in the economy of the district.

3.1.2 SURGUJA

Surguja which forms the northern part of the Chhattisgarh state has a rich historical background which is evident from the presence of various temples and stone carvings. It is said that Lord Rama had visited Surguja during his period of exile hence one can find places named after them like Ramgarh, Sita Bhengra and Laxmangarh. The most prominent tribes in the region are the Pandos and the Korwas which are thought to be the members of the Pandavas and the Kaurava clan. The district falls in the Tropical thermal belt. The high altitude region of Surguja are characterised by "pat" formations. The major peaks are:

Table 3.2: Peaks of the District[21]

Peak	Height in Feet
Mailan	4024
Jam	3827
Parta Ghasra	3804

[21] http://surguja.nic.in/historical_background.htm#top

Kanda Dara	3770
Chutai	3713
Karo	3628
Bamlan	3505
Gungru	3491
Benda	3473
Bhunsa	3424
Bhura Murio	3390
Bijatili	3215
Ambera	3183
Maragarh	3027

The lower portions of the basin comprise of three river basins namely the Hasdeo, Rihand and the Kanhar. The Hasdeo basin encompasses the Gej, Jhink and the Atem basins.

The Saila, Suwa and the Karma dance speak volumes about their culture and ways of enjoyment. These dances are performed in a variety of occasions. After the performance of the Suwa dance, a boy intending to get married puts up a proposal before the girls' family to get things rolling. Karma dance is performed to revere the Karam tree that saved a young couple by hiding them in its hollow trunk. Overnight dancing marks the celebrations. Moreover they are performed by forming a human chain which symbolizes their unified community setup and way of living.

Nearly 58% of the area is under forests which occupy 10849.079 sq Kms while the rest is either under agriculture or habitation. Soil here is of 4 major type's namely red, alluvial, laterite and medium blue. Surguja also boasts of rich bauxite reserves which are mostly concentrated in the pat formations. It contains nearly 57% of the total bauxite reserves in the state. Rich deposits of coal can also be found here cocooned by the rich forest cover. The district is also home to two wildlife sanctuaries Semarsot Wildlife Sanctuary and Timor Pingla Wildlife Sanctuary.

A study[22] taken up in Dhanwar in the Surguja District brought into light the following facts:

1. Tribal's reside in the forests and hilly region with scattered houses. Although they do like to live in a united setup with land, water and forests. Only in the absence of basic amenities do they migrate. There is a precedence of Kachhaa and semi pacca houses over pacca houses.

[22] Dr Seraphinus Kispotta, A Socio Economic miserable condition of the tribals in Chhattisgarh (A Case Study of Dhanwar, Surguja District, CG, Journal of Humanities and Social Sciences, Vol. 19, Issue 6, Ver 1, Pg 26-29.

2. The literacy rate is very low and consequently a very high dependence on moneylenders. Their asset formation is very limited.
3. Occupations vary from food gatherers to landless to agriculturists. But most of all they are dependent on the forest produce for their livelihood. They are highly involved in the collection of Non Timber Forets Produce (NTFP) eg. Tendu (fruit and leaves), mahua flowers, mahul patta, chironjee, harra, bheda, amla, Gond, honey, tamarind, chalroot, sal. A major portion of the produce is sold in the local village markets.
4. Tribals are animists and celebrate festivals like hariyali, naya khani and karma.
5. Malaria is a common health problem among the people along with others such as cold, cough, pneumonia and diarrhoea for which they prefer to visit the quack doctors instead of private or government hospital doctors.
6. One reason for the above is the poor connectivity of their settlements through transports.
7. Local markets are within a range of 10 Kms.
8. They mostly depend on dug wells for drinking water. Later on comes hand pumps ponds, jharnas and lastly rivers. Pure drinking water availability has become a serious problem with the depletion or pollution of resources. Sanitation facilities are absent

3.1.3 KORBA

The city of Korba forms the district Headquarters of the district and lies on the confluence of the Hasdeo and the Ahiran River. It has been accorded the name of the power capital of Chhattisgarh as maximum number of thermal power plants is situated in this district due to its closeness to the Hasdeo River. Moreover the Darri Reservoir in Korba aids in the easy extraction of water. Earlier this district was home to huge expanse of forests but now is shrouded in fly ash.

It falls in the hot temperate climatic zone with an average rainfall of 1506.7mm. Hasdeo is the main river flowing through the district on which are dependent a large number of thermal power plants that accord the name power hub to it. Korba is further divided into 4 constituencies namely Rampur, Korba, Katghora and Pali- Tanakhar.

Korba is known for its Gevra coal mines which are the biggest in Asia. Moreover the Kusmunda and the Dipka mines are also located in the Korba coalfields.

But despite all this exploitation, there are places like Ratanpur, Lafagarh, Chaiturgarh, Tumhan and the Kendai Waterfalls that still hold up its rich heritage.

3.1.4 BILASPUR – Bilaspur is famous for a set of very different reasons now as compared to its rich past. Currently the only 2 things that define its presence in the nation is the Kosa industry and the contribution that it has to the production of rice so thoughtfully named as the “Dhan Ka Katora.” The

city which is some 400 years old has been named after a fisherwoman named Bilasa. But fishing no longer defines the very importance of the city on the map.

Bilaspur Nyayadhani, is the second largest city in the state and is divided into 8 tehsils namely Bilaspur, Pendra Road, Kota, Takhatpur, Bilha, Marwahi and Masturi. The total number of villages in the district is 898. The Arpa River originates in the Pendra sub division and makes up the largest river in the district. It contributes to the flow in the Mahanadi River. A part of River Hasdeo also flows through the district and later joins the Mahanadi further downstream. Moreover the river Leelaghar flowing through the district joins Hasdeo directly thus adding to its water and sediment quantity.

Bilaspur more commonly termed as the "Pride of Chhattisgarh" has a historically rich backing. This is evident from the very fact that Ratanpur (25 Kms away from Bilaspur Headquarters on Katghora Road) was a key epicentre in all the four Yugas (ages) that the world has witnessed. Statues of Lord Brahma, Vishnu, and Shiva adorn this very key tourist destination. Just 10 Kms away a dam has been constructed in Kuthaghat ravaging forests and hills and now serves as a tourist location. Indeed an irony that we destroy nature and then pay to see an artificially built up conglomerate of stones. On the Bilaspur Raigarh route lays the remnants of a civilisation that dates back to 1000 BC. The presence of a Kabir Chobutara embodies the fact that people have evolved amidst rich philosophical thoughts. Even now one could easily find, along the rivers, people of the Kabirpanthi origin. But this is one phenomenon that keeps itself confined to the rural areas as the urban settlements have been more influenced by the western air. Chhattisgarh was once famous for the innumerable presence of ponds. Most of them could not pass the test of time but the one in Belpan has survived. It is located some 11 Kms away from Takhatpur.

3.1.5 JANJGIR- CHAMPA – Situated in the heart of Chhattisgarh, Janjgir Champa is a major producer of rice in the nation owing its production to the natural precedence that it has over land and water resource availability. It makes up the flatter portions of the state apt for rice cultivation and gets its water from the Hasdeo Bango Project situated 2 districts (Bilaspur and Korba) away. So any mismatch in water distribution that takes place high up in the Hasdeo Bango has direct and severe implications on the lives of the food producers of the nation. The total irrigated area is 2.7 times the total forested area.

Janjgir Champa has 10 tehsils namely Janjgir, Akaltara, Baloda, Nawagarh, Champa, Pamgarh, Jaijaipur, Malkharoda and Dabhara and a total of 915 villages. Rivers have always held an unexplainable importance for the region not just economically but also culturally. Madanpurgarh and Pithampur located on the banks of the river Hasdeo are very famous for the temples that remind one of the facts that we remain in this world for just a moment compared to the innumerable ages that have already gone past us. It reminds one that we are just like any other entity and that day won't be far when we return to dust thus giving way to a new generation. Kanhara and Dewarghata are still

other places located on the banks of the river Leelaghar which do the same. All these places which have now become tourist destinations were settlements in a time gone by.

The river Hasdeo bisects the district into two parts[23]. About 98% of the district is covered by plain land. The Hasdeo Bango Project brings water all the way to Janjgir Champa to irrigate its plains. The irrigation intensity in the district is the highest in the state[24]. Only about 2% of the total area is covered by alluvium.

3.2 DEMOGRAPHY

As per the Census of India 2011 Chhattisgarh on a whole has 18 districts with 182 towns and 20126 villages.

Table 3.3- Population Statistics 2011 – Census of India[25]

District	Population			Males			Females		
	Total	Rural	Urban	Total	Rural	Urban	Total	Rural	Urban
Koriya	659039	453476	205563	334336	228004	106332	324703	225472	99231
Surguja	2261329	2116312	245017	195145	1068423	126722	1166184	1047889	118295
Korba	1206563	760360	446203	612158	380997	231161	594405	379363	215042
Janjgir Champa	1620632	1395433	225199	816057	701632	114425	804575	693801	110774
Bilaspur	2662077	1983255	678822	1349928	1001592	348336	1312149	981663	330486
TOTAL	8409640	6708836	1121982	3307624	3380648	926976	4202016	3328188	873828
Chhattisgarh	**25540196**	**19603658**	**5936538**	**12827915**	**9792514**	**3035401**	**12712281**	**9811144**	**2901137**

Among the five districts encompassing the Hasdeo Sub Basin, Bilaspur shows the maximum population whereas Koriya shows the least. One can also conclude from the above data that, Surguja has the maximum proportion of their total population living in the rural areas which is nearly 93% and then comes Janjgir Champa with 86% of its population living in the rural areas. Since a huge population lives in Rural areas, they are predominantly consumed up in rural sources of livelihoods. While Janjgir Champa, accorded the status of Dhan Ka Katora, gets water for irrigation via the Hasdeo Bango Dam, located 2 districts away, the ones residing in the uphill regions of the Surguja district are at the mercy of the Governments PDS. No irrigation facility plus rampant exploitation of

[23,2] Groundwater Brochure of Janjgir Champa District, CGWB, North Central Chhattisgarh Region, Ministry of Water Resources, Governmnet of India, 2010.

[25,2 –] Provisional Population Totals, Paper 2, Volume 1 of 2011, Data on Rural and Urban Areas, Chhattisgarh Series 23. Census Of India 2011.

coal from the forest region, they survive in the bare minimum, ie., subsistence agriculture and income generation activities like collection of tendu leaves which is very short lived. The irony lies in the fact that this development equation is destroying one ecosystem for flourishing another. The very region is responsible for the maximum contribution in terms of tributaries to the Hasdeo River. All this flow being contained in the dam and then changing an ecosystem Kms downstream means that the original characteristics of this D/s ecosystem have been altered. All this being done is a manner that in the long run will not attribute any sustainability.

Table 3.4- Percentage Decadal Growth 2001-2011[26]

District	Percentage Decadal Growth (Persons) 2001-2011			Percentage Decadal Growth (Males) 2001-2011			Percentage Decadal Growth (Females) 2001-2011		
	Total	Rural	Urban	Total	Rural	Urban	Total	Rural	Urban
Koriya	12.40	10.19	17.61	10.98	9.20	15.00	13.90	11.21	20.53
Surguja	19.74	15.34	78.61	19.51	15.13	75.90	19.97	15.55	81.60
Korba	19.25	17.91	21.59	18.83	17.69	20.77	19.68	18.14	22.49
Janjgir Champa	23.01	19.05	54.97	23.76	20.04	52.84	22.27	18.08	57.24
Bilaspur	33.21	31.20	39.48	33.15	31.44	38.29	33.28	30.95	40.74
Chhattisgarh	**22.59**	**17.75**	**41.83**	**22.47**	**17.88**	**40.09**	**22.71**	**17.63**	**43.69**

On computing ratios of urban to rural percentage decadal growth, it can be seen that in Surguja, for every 1% growth in rural population, there is an almost simultaneous 5% growth in the urban population. While for Koriya, Korba and Bilaspur the percentage decadal growth has been going hand in hand in the last 1 decade.

Table 3.5- Percentage share of Total Population and Sex Ratio[27]

District	Percentage Share of Total Population 2001		Percentage Share of Total Population 2011		Sex Ratio (No. Of Females per 1000 males) 2001			Sex – Ratio (No. Of Females per 1000 males) 2011		
	Rural	Urban	Rural	Urban	Total	Rural	Urban	Total	Rural	Urban
Koriya	70.19	29.81	68.81	31.19	946	971	890	971	989	933
Surguja	93.04	6.96	89.62	10.38	972	977	904	976	981	934
Korba	63.73	36.27	63.02	36.98	964	992	917	971	996	930
Janjgir	88.97	11.03	86.10	13.90	998	1005	941	986	989	968

[27 ,4-] Provisional Population Totals, Paper 2, Volume 1 of 2011, Data on Rural and Urban Areas, Chhattisgarh Series 23. Census Of India 2011.

Champa										
Bilaspur	75.65	24.35	74.50	25.50	971	984	932	972	980	949
Chhattisgarh	**79.91**	**20.09**	**76.76**	**23.24**	**989**	**1004**	**932**	**991**	**1002**	**956**

Table 3.6 - Sub Districts, Towns and Villages[28]

Districts	**Koriya**		**Surguja**		**Korba**		**Janjgir Champa**		**Bilaspur**	
	2001	2011	2001	2011	2001	2011	2001	2011	2001	2011
No. Of Sub Districts	4	5	9	19	4	5	8	10	8	11
No. Of Towns	6	8	7	16	4	7	8	15	14	20
No. Of Villages	661	636	1774	1750	719	719	900	892	1612	1599

Back in the year 2007-08, Chhattisgarh had a human development index[29] of 0.358 and a gender development index[30] of 0.542 in the year 2006. In the year 2011 the human development index deteriorated to 0.291 when adjusted for inequality. The overall literacy rate of 71.04% is less than the national value of 74.04%. 3% of India's poor are homed in Chhattisgarh. As per the 2005 figures it shows a multidimensional poverty index[31] of 0.367 and a global hunger index of 26.63[32].

The change in population statistics has an important role to play in the utilization of resources in the region. Although population growth in the region alone does not define this resource utilization. Since the concentration of resources is high in the region, the benefits of its exploitation are crossing the administrative boundaries. But the very people within those administrative boundaries are being gradually alienated from access to the resources. The usage of the water of the River Hasdeo is not only creating intra-regional inequality but also contributing to inter regional inequality. The benefits of the utilization of resources are being distributed to the indirect stakeholders.

[29] Human Development Index - http://hdr.undp.org/en/content/human-development-index-hdi
[30] Gender Development index - http://hdr.undp.org/en/content/gender-development-index-gdi
[31] Multi dimensional Poverty Index - http://hdr.undp.org/en/content/multidimensional-poverty-index-mpi
[32] Chhattisgarh, Economic and Human Development Indicators, Policy Brief by UNDP.

CHAPTER 4: LIVELIHOODS IN THE HASDEO SUB BASIN

The economy of the tribal people revolves around 3 spheres: Forests, Agriculture and Migration. Forests form a sort of sustenance employment mainly by the collection and consumption of roots, tubers and fruits. Employment is generated by the collection of Non Timber Forest Produce as well. The second sphere is agriculture which the tribal people either practice on their own lands or disputed forest lands on which they claim titles. This form of agriculture is mostly rain fed. The third sphere is of post harvest migration for work. This migration occurs to distant agricultural land or as casual labourers. The level of technology ranges from primitive extensive cultivation in the upper districts to intensive irrigated agriculture in the lower portion of the basin.

4.1 Agriculture in the Hasdeo Basin

Agriculture is predominantly rainfed in the upper reaches and seasonally irrigated in the lower areas. In the upper districts of Surguja and Koriya there are dense forests and very little agriculture. People usually cultivate rice and that too is at a subsistence level. Jeera Phul is one of the unique rice varieties grown in the upper reaches but due to the rampant mining activities and depletion in the quality of water the variety has lost its inherent flavour and aroma. On moving further south, one can find large scale rice production aided by irrigation water from the Hasdeo River catchment. The area under "Whole Year" crop such as sugarcane, onion, sweet potato and chillies is very low in the Hasdeo Basin.

In Chhattisgarh about 73% area make up the plains and 95% area in the northern hills are rain fed:

Table 4.1: Agro Climatic Zones of Chhattisgarh

Agro Climatic Zone	Districts
Chhattisgarh Plains	Raipur, Mahasamund, Dhamtari, Durg, Rajnandgaon, Kabirdham, **Bilaspur, Korba, Janjgir,** and parts of Kanker District
Northern Hills	**Surguja, Koriya**, Jashpur andRaigarh

Chhattisgarh has often been dubbed as the rice bowl of Central India with the main crop being paddy. Apart from paddy, cereals like maize, kodo-kutki and other small millets, pulses like tur, kulthi and oilseeds like groundnut, soybean, niger and sunflower are also grown. The major fruit crops grown are mango, cashew nut, guava, banana, papaya, lime, jackfruit, litchi etc. Apart from these sitaphal, bael, ber, anola, sapota are also grown both as a cultivated and wild crop.

The northern hilly areas of Surguja and Jashpur districts are suitable for production of Litchi. Chilli, ginger, garlic, turmeric, coriander and methi are the major spices grown in the state.

In a study undertaken to assess the production potential of wheat varieties under changing climate in rice based cropping system in Chhattisgarh, it was revealed that the growth and yield showed considerable reduction when the sowing was delayed to December. Hasdeo Bango command area is under assured irrigation and there is a predominance of rice based cropping system. As a result of which the sowing of wheat is often delayed and influenced by short winters and high fluctuation of temperatures, the wheat crop becomes adversely affected. Research is being done to create thermal stress tolerant varieties for optimum production[33].

In an FGD conducted in the Ghatbarra Village in Surguja District, it was found that agriculture was practiced twice a year, once in the rainy season and the other in the summer season. During the rainy season rice, maize and pulses like arhar and urad were grown. Since there was no irrigation facility available in the village, supplemental water requirement was fulfilled by the wells. Rice was so abundantly grown in the region that it was given in return for a day's labour. But now there has been a drastic reduction in the cultivation of rice mainly due to the Government's scheme of rice provision at Rs. 1 for 35 Kl to the tribal populace of the region and due to non availability of a clean source of water. Currently "Jethwa Dhan" or "Jethi Dhan" is being grown. The Jethi Rice was not grown in the rainy season as it gets damaged and contaminated with excess water pressure. Along with all this other versions of rice called "Harihar Patti," "Ten Ten" and "Kalinga" were also being grown. These varieties first had to undergo seed treatment by the agriculture department and were then available for Rs.450 for 25 Kgs in Udaypur. Agriculture in the village at least ensured an income of Rs. 25000 a year but due to the disruption of forests for mining, and disappearance of the local nallas, the livelihoods dependent on agriculture are at great risk.

The people involved in the cultivation of rice usually make small huts near their fields and stay there temporarily till the crop has been harvested. The produce is just enough for the family's personal consumption and is not sold in the market for commercial gains. So the farmers U/s of the Hasdeo Bango Dam are clearly involved in subsistence agriculture.

The Barr Nalla passed through this village which was earlier used to water the crops but due to release of coal laden water, it has now been rendered useless. The people who used to earlier cultivate along the nalla have stopped cultivating. The only alternative source of natural water left is a "Dhori."

[33] S. R. Patel, A. S. R. A. S. Sastri, R. Singh & D. Naidu; Production Potential of Wheat Varieties Under Changing Climate In Rice Based Cropping System In Chhattisgarh, India, ISPRS Archives XXXVIII-8/W3 Workshop Proceedings, Impact of Climate change on Agriculture, 404.

Vagetables like bottle gourd, cucumber, bitter gourd, potato and cauliflower are grown in the rainy season. Apart from these items collected from the forest are chirco, kumha, bhoru, patiyari, putu, lal badal, patra, jithi, dhal, dhalwa, bhaisa, dobri dobara, dug dauwa (treats snake bites) and keva kanda (treats dog bites) which is then further bought from the village people by the local traders and the forest department. The average landholding in the area is less than 7 acres

In another FGD held at Devarmal Village, but this time D/s of the Hasdeo Bango Dam, 600 families were dependent on agriculture for atleast 1 season. Devarmal village was close to the city of Korba. Here also people predominantly cultivated rice. The local varities being Swarna, HMT, Vishnu Bhog and Dubraj. Watering was done mainly by pumps that lifted water from the river. Since the water table was low in the region, borewells were not a very successful venture. Each family had an average land holding of 1.5 to 2 acres. During summers, the crops were watered once in a week. In extreme summers, people do have to face drinking water shortage. The river flowing along this village contains fly ash but in a much diluted form so the people have not perceived and changes in yield due to the use of contaminated water.

One major problem faced by the people of this village and the adjacent ones is the opening fo dam gates, which submerges their crops for a continuous period of 3 days and sometimes even more. This comes as a lethal blow to their sole source of livelihood.

4.2 Tendu Patta Collection & Saw Mills – It is collected for 15 to 20 days in a year. It forms one of the main sources of income for the local tribal population. They begin collecting the tendu leaves from 4 o'clock in the morning and continue till 12noon. Thereafter they spend their time packing them in bundles of 50 for which they get Rs 1.35 from the middleman. These leaves receive the tobacco to be filled in from West Bengal and then finally processed to make "Beedis."

The tribals also collect sal seed from the forests of Surguja which is sold in the Market for Rs.200/sack. The oil extracted from the seeds is used to make chocolates.

In the year 1975-78, there were around 150-200 saw mills near the mountainous regions of the Basin. Later on in order to stop the practice, the auctioning of forest wood was stopped. The people who derived their livelihood via this medium gradually migrated to other regions or took up a different kind of job. At present only 25-50 saw mills are present in Ambikapur. The most important depots where the cut wood was stationed were Tara, Ambikapur and Balrampur. The jungles were also rich in Saguan which was constantly under the pressure of theft for the furniture industry as it can be carved into any shape very easily when compared to sal. Saguan fetched nothing less than Rs. 3000-3500/feet. Even the remnants (Bhusi) were sold at Rs 150/sack.

In order to sustain the livelihoods of the people who were dependent on the forests directly for their livelihoods, the government began distributing "Van Patta Adhikar" but in the long run it only became a medium to capture the lands of the tribal populace. It was analogous to buying land from the tribal and handing it over to the corporate. So in one hand the government put an end to the livelihood generation activities of thousands of people in the region and transferred this right to the corporate in the name of conservation. So a region which was earlier conservation centric now became a prey to the throwaway culture.

4.3 River Bed Cultivation and Flood Plain Farming

When the flow in the river decreases post monsoon, large parts of the river beds open up. People on the banks of the river then cultivate the river bed, the sand beds, growing large number of crops like water melons, musk melons, cucumber, vegetables pumpkins etc. This is a very important source of livelihood and incomes, especially as many of those engaged in such cultivation are landless families. Nearly 5000- 6000 families are dependent on the riverbed cultivation.

People who are involved in River bed cultivation suffer from gastric, cancer, asthama and TB. Moreover flood plain agriculture si usually done with polluted water. They use it to grow cucumber, watermelon and other allied vegetables.

4.4 Fisheries:

The fishermen community and the fishes move and live together. If this movement is in a sustainable manner, then fish diversity flourishes adding to the species richness of the region. This then brings a continuous source of income as well as fish protein to the most vulnerable group of the fisheries sector that is the fishermen community. A high socio economic standard of living is a direct indicator of the rich biodiversity in the river. Tamboli and Jha reported some 58 species of fish in the Mahanadi river in Janjgir Champa district of Chhattisgarh. Moreover a network of 3573 Kms length of the rivers Mahanadi, Indrawati, Hasdeo and Sheonath is available for capture fisheries. In a study conducted by Tambilo in the Bilaspur Division 45 species of fish were observed in the Hasdeo River during 2008 to 2012. Tilapia mossambicus were reported in rare numbers in the Hasdeo River. Gudusia chapra fish was found in abundance in the Hasdeo River amounting to 87. In the year of study some 1223 fish of different species were caught from the river Hasdeo depicting the rich piscine diversity.

Excerpts from the FGD conducted with the Fishermen Community in Korba

1. The fishermen only catch food fish and there are no ornamental fishes found in the river. They include Catla, Rohu, Mirgal, Singhar, Balm, Bata, Cheetal, Sarangi, Chinati, Kari, Ghorcha, Kulsi, Kotiya, Dengna, Mangur, Singhi, Parhan, Munda, Patola, Chingri, Puthi, Pacheri, Revcha.

2. Cheetal fetches a high price in the market.
3. Location- Kalmedu Ghat. There are 8 to 10 such ghats where fishing contracts have been given. Some of these locations are Roomgara, Dandpara, Nawagaon, Terai Daand, Songura, Jhaaku.
4. Women are mostly involved in selling the fish whereas the men are mostly involved in catching them.
5. During the monsoons the fish catch is high amounting to 20-40 Kg a day. But in the other seasons it is just 5 – 6 Kl. In summer it reduces to 1 – 2 Kg or even none.
6. Some 10 years back there were incidences of bumper fish weighing up to 100 Kg.
7. There are instances of dead fish due to the polluted water and the extreme water temperature.
8. The people have been involved in fishing for more than 2 generations.
9. The Revcha, Shilang and Bacheri fish is not found today. This is primarily because they require fast moving water to lay their eggs. Due to the construction of the dam the water which has now been rendered stagnant does not provide a conducive environment for it to survive.
10. Because of the dam the water has been rendered stagnant and proper fishing can be done only in the monsoon season. And because of the accumulation of fly ash on the river bed, the effective depth of the river has also reduced.
11. The indigenous fish of the river was catla and Rohu, but after the damming operations, the fishery department put a fish called Kulsi Bata in the river. The former fetched them much more money in the market than the latter. This is primarily due to the difference in taste.
12. At present a major portion of the fish that is sold in the market comes from Andhra Pradesh or from the private ponds where fisheries have been developed.

CHAPTER 5: ECOLOGY OF THE HASDEO SUB BASIN

5.1 Plant Diversity:

Chhattisgarh covers an area of 135191 square Kms which makes up 4.1% of the land area of the country and can thus be divided into three climatic zones namely Chhattisgarh plains, the Northern Hills of Chhattisgarh and the Bastar Plateau.

The data below has been extracted from the Forest Survey of India 2011. The forest cover assessment is done on a two year cycle. Forest cover is defined as an area more than 1 Ha in extent and having tree canopy density of 10 percent and above[34].

Table 5.1- District wise forests cover (Area in square Kms)[35]

District	Geographical Area	2011 Assessment				Percentage of geographical area	Change	Scrub
		Very Dense Forest	Moderately Dense Forest	Open Forest	Total			
Koriya	6604	79	2605	1423	4107	62.19	0	3
Surguja	15731	320	4836	1977	7133	45.34	0	16
Korba	6599	203	2306	840	3349	50.75	0	6
Janjgir Champa	3852	4	26	125	155	4.02	0	2
Bilaspur	8270	338	1623	533	2494	30.16	0	6

Traditionally the tribal populace has thrived in the forests as it plays a very important role in their economy providing them with a source of livelihood. They are the ones who have always lived in harmony with nature and protected the forests. Hence assessment of forest cover has a special significance in this regard. As per the FSI survey data only Bilaspur and Surguja have been marked as tribal dominated. But apart from these two, Korba and Koriya also form a part of the tribal belt.

Table 5.2- Forest Cover and their corresponding canopy density

Forest Cover	Canopy Density Range
Very Dense Forest (VDF)	>70 %
Moderately Dense Forest (MDF)	40-70 %

[34] Forest Cover Methodology, Forest Survey Of India.
[35] Change figures are based on comparison of 2011 assessment with that of 2009 after incorporating interpretational changes. Source – Forest and Tree Resources in States and Union Territories, Forest Survey of India.

Open Forest (OF)	10-40 %
Scrub[36]	<10%

In the forests of Sarguja, Dr. Ashok Kumar Shukla had earlier identifies 118 different species of plants which have now reduced to 84. More than 30 different kinds of mushrooms have been found in the region which is effective against 200 different types of cancers.

Table 5.3: Plant Diversity of the Hasdeo Sub Basin

S.No.	Local Name	Scientific Name
1.	Sal	Shorea robusta
2.	Teak	Tectona grandis
3.	Haldu	Adina cordifolia
4.	Saja	Terminalia tomentosa
5.	Salai	Bosewellia serata
6.	Mahul	Bauhinia vahlii
7.	Semal	Bombax ceiba
8.	Mahua	Madhuca indica
9.	Aonwla	Phyllantus emblica
10.	Harra	Terminalia chebula
11.	Ber	Zizyphus zuzuba
12.	Bamboo species	Dendrocalamus strictus & Bambusa bambos & Bambusa arundinaceae
13.	Kikar/abul	Acasia Arabica
14.	Goriar	Acasia caesia
15.	Khair	Acacia catechu
16.	Bel	Aegle marmelos
17.	Akol	Ailangium salvifolium
18.	Siris	Albizzia lebbek
19.	Chhatrak	Alstonia scolaris
20.	Dhawada	Anogeissus latifolia
21.	Sheetaphal	Annona squamosa
22.	Ramphal	Annona reticulate
23.	Kadamb	Anthocephalus cadamba
24.	Neem	Azadirachta indica
25.	Kachnar	Bauhinia variegate
26.	Samel	Bombax ceiba
27.	Chironjee	Buchania lanzan
28.	Chhoela	Butea monosperma

[36] Highly degraded forest or wastelands with stumped trees having canopy density less than 10% are classified as scrubs, which is a category of non forest cover.

29.	Kumahi	Careya arborea
30.	Flem	Caesalpinia bonducella
31.	Kusum	Carthamus tinctorius
32.	Amaltas	Cassia fistula
33.	Nimbu	Citrus medica
34.	Lasoda	Cordia mixa
35.	Unjain	Celastrus peniculata
36.	Sisham	Dalbergia sisso
37.	Dhobin	Dalbergia paniculata
38.	Tendu	Diospyrus melanoxylon
39.	Makar Tendu	Ciospyrus ebenum
40.	Amla	Embilica officinalis
41.	Munga	Erythrinia indica
42.	Neilgiri	Eucalyptus grandis
43.	Jamun	Eugenia heyneana
44.	Bargad	Ficus bengalensis
45.	Pipal	Ficus religiosa
46.	Anjeer	Ficus carica
47.	Rubber	Ficus elastic
48.	Pakri	Ficus infectoria
49.	Gular	Ficus glomerata
50.	Piprol	Gardenia latifolia
51.	Khenkara	Garur pinnata
52.	Khamer	Gmelina arborea
53.	Koriya	Holarrhena hantidysenerica
54.	Anjan	Hardwikia binata
55.	Rattanjote	Jatropha curcus
56.	Nana	Lagestoromea lanciota
57.	Subabul	Lauceenea leucocephala
58.	Litchi	Litchi chinensis
59.	Maida	Litsea chinensis
60.	Mahua	Maduca indica
61.	Aam	Mangifera indica
62.	Mulberry	Morus alba
63.	Senjhra	Moringa oleifera
64.	Bachain	Melia azadirachta
65.	Mithineem	Murraya koenigii
66.	Tilsa	Ougenia dalbergia
67.	Chinar	Plantanus orientalis
68.	Katanj	Pongamia pinnata
69.	Almond	Prunus amygdalus
70.	Guava	Psidium guyava

71.	Bija	Plerocarpus marsupium
72.	Menda	Randia duetorum
73.	Chandan	Santalum album
74.	Ashoka	Saraca indica
75.	Bhelwa	Semecarpus anacardium
76.	Sarai	Shorea robusta
77.	Rohina	Soymida febrifuge
78.	Lodh	Symplocos racemosa
79.	Imali	Tamarindus indica
80.	Kahua	Terminalia arjuna
81.	Baihra	Terminalia bellerica
82.	Saj	Terminalia tomentosa
83.	Asan	Terminalia aliptica
84.	Sagwan	Tectona grandis

In the interview with the local doctor it was found that he went once a week to the forests to collect the required plants. He particularly mentioned that earlier i.e., 14 to 15 years back he used to get most of the plants within half an hour but at present it takes the whole day sometimes to find just one plant. That severe has been the level of forest degradation.

Table 5.4: Medicinal plants obtained from the forests of the Hasdeo sub Basin

S.No.	Name of the Species	Local Name	Scientific Name	Useful part	Nature
1.	Bel	Bel, Bild, Shree Phal	Aegle marmelos	Fruit	Tree
2.	Chironjee	Char, Chironjee, Reka, Aachar	Buchanania lanzan	Seed	Tree
3.	Amaltas	Amaltas, Raela, Dhan Bahar, Sonrali, Bhalu Masruli	Cassia fistula	Fruit	Tree
4.	Aavla	Aavla, Aunra, Aamliki	Phyllanthus emblica	Fruit	Tree
5.	Mahua	Mahua, Idukamra, Moda, Mauha	Madhuca indica	Flower and seed	Tree
6.	Karanj	Karanj	Pongamia pinnata	Seed	Tree
7.	Bhilwa	Bhilwa, Kohka	Semecarpus anacardium	Fruit	Tree
8.	Imli	Imli	Tamarindus indica	Fruit	Tree
9.	Bahera	Bahera, Tanka	Terminalia bellirica	Fruit cover	Tree
10.	Harra	Harra	Terminalia chebula	Fruit cover	Tree
11.	Palash	Palash, Dhak, Teshu	Butea monosperma	Flower, seed	Tree
12.	Aak	Fudhar, Aakvan, Jiludih, madaar	Calotropis gigantea	Flower	Shrub
13.	Baybiding	Baybidding, Dulli	Embelia tsjerium	Fruit	Shrub

			cottam		
14.	Marorfalli	Aenthi, Marorfalli, Aatan	Helicteres isora	Fruit	Shrub
15.	Indrajow	Kuranchi, Dudhi, Koriya, Kutaj, Kuda	Holarrhena antidysenterica	Seed	Tree
16.	Jatropha	Jatropha, Ratanjyot	Jatropha curcas	Seed	Shrub
17.	Kateri	Katri, Bhojra, Koi, Kantkakkari, Bharkatiya, Bhatkataiya	Solanum surattense	Root	Herb
18.	Nirgundi	Nigur, Sandor, Shivari	VItex negundo	Leaf, seed	Shrub
19.	Dhavai Phul	Dhavai, Dhaaru, Dhaav, Dhaay	Woodfordia fruticosa	Flower	Shrub
20.	Apamarg	Chirchira, Latjeera, Bichauti	Achyranthes aspera	Root and seed	Herb
21.	Bach	Bach, Bacha, Ghurvach	Acorus calamus	Rhysome	Herb
22.	Kaal megh	Bhui Neem, Kadu chiraita, chiraita	Andrographis paniculata	Root	Herb
23.	Punarnava	Punarnava	Boerhavia diffusa	Root	Herb
24.	Mandukparni	Brahmi	Centella asiatica	Dry leaves	Creeper
25.	Safed Musli	Safed Musli	Chlorophytum tuberosum	Tuber	Herb
26.	Kali Musli	Kauwa Kanda, Kanva, Kauwapaar	Curculigo orchioides	Tuber	Herb
27.	Giloy	Giloy, Gurchi, Gulbel	Tinospora cordifolia	Bark	-
28.	Mahul Patta	Mahul Patta, Mohline, Siyari	Bauhinia vahlii	Leaf	-
29.	Vanjeera	Vanjeera	Vernonia anthelmintica	Seed	Herb
30.	Bhui Aavla	Hazardana, jarmala, Junglee aavla	Phyllanthus amarus	Root	Herb
31.	Makoy	Makoy, Kakamachi	Solanum nigrum	Fruit	Herb
32.	Sarphonk	Sarphonk, Bajradanti	Tephrosia purpurea	Root	Herb
33.	Laal Gunja	Ratti	Abrus precatorius	Seed	-
34.	Tikhur	Tikhur	Curcuma angustifolia	Tuber	-
35.	Salparni	Chipi, Latkan	Desmodium gangeticum	-	Herb
36.	Bhringraj	Bhengra, Kankiphul, Bhringraj	Eclipta alba	Root	Herb
37.	Shikakhai	Cheel, shikakhai	Acacia sinuata	Dry fruit	Shrub
38.	Satavar	Satavar, Dashmool, satavari, Chedavari	Asparagus racemosus	Tuber	-
39.	Maalkangni	Peng, Khujuri	Celastrus paniculatus	Seed	-
40.	Hatjor	Harjuri	Cissus quadrangularis	-	-
41.	Gurmaar	Gurmaar	Gymnema sylvestre	Leaf	-
42.	Anantmool	Khaprijari, Pitt Bela, Sugandhi jari	Hemidesmus indicus	Root	-

43.	Kevanch	Kevanch, Kaunch, khajohra	Mucuna pruriens	Seed	-
44.	Van Tulsi	Van Tulsi, Kali tulsi	Ocimum gratissimum	Seed	-
45.	Bechandi	Bechandi	Dioscorea	Tuber	-
46.	Bidari Kand	Van Kumhanda, Bhui Kumhanda, Patal Kumhanda, Bidari Kand	Pueraria tuberosa	Tuber	-

5.2 Wildlife

Chhattisgarh is blessed with some of the most endangered and rare wildlife species. They include wild buffaloes, hill myna, wild boar, Indian gazelle, chital, nilgai, sloth bear, sambars, guars, barking deer, bison, four horned antelope, chinkara, muntjac, dhole, jackal, striped hyena, porcupine. Birds found in the region are parrots, green pigeons, storks, darters, wood peckers, jungle fowls, quails, peacocks, gray partridges.

As per Meetu Gupta, a wildlife conservationist, increased mining in Jharkhand and Odisha has forced a large number of elephants to migrate to the forests of Surguja, Jashpur and Korba in Chhattisgarh. A proposal for an elephant reserve of over 384 sq. Kms in Hasdeo Arand Forests was sent to the centre in the year 2002 by the state forest department but in the year 2006 it was found that a coal block of 100 sq. Kms fell within the elephant reserve. And thus the elephant reserve could not see the light of the day[37].s

[37] filse:///D:/WCF%20E-Flows/dam%20weblinks/ArtWin.asp.html

CHAPTER 6: HUMAN INTERVENTIONS: DAMS

In accordance to the latest report of the National Register of Large Dams, there are 4857 large dams[38] that have been completed and other 345 large dams which are under construction in India. As per the report the data for Chhattisgarh (updated 8/2014) says that there are 248 dams that have already been completed and 10 are under construction and this nearly comprises 5% of the total dams present in India. Chhattisgarh saw its peak dam building phase from 1971 – 1991 where 150 dams were sanctioned and completed. During this phase Chhattisgarh was part of Madhya Pradesh.

[39]As of now Chhattisgarh has one dam of National Importance[40] which is the Minimata (Hasdeo) Bango, 128 dams whose height lies between 10m – 15m and 130 dams whose height is greater than 15m. In the state wise distribution of large dam, Chhattisgarh ranks 4th.

The result of the formation of dams and barrages on the River Hasdeo has created a number of deep pools known as "dahars.' As of now the Government of Chhatisgarh is planning to come up with 3 barrages in Basantpur, Mironi and Saradih, all of them in the Janjgir Champa District that too without any Environmental Impact Assessment. One may argue that since barrages do not cause any submergence then why they at all need to conduct EIA's[41]. After monsoons when the flow of the river recedes, then large portions of the river bed are used by the people to cultivate water melons, musk melons, cucumber, pumpkins and other allied vegetables which make up a considerable source of their income. This becomes all the more important for the landless families. Impounding of water converts the flowing river to "dahars" which impacts the fish population and in turn the people who rely on it for nutrition and income generation[42].

In its 333 Km long stretch, the River Hasdeo has been blocked twice. The first being the Hasdeo Bango Dam and the second being the Darri Reservoir.

[38] International Commission on Large Dams (ICOLD) – A Large Dam is classified as one with a maximum height of more than 15m from its deepest foundation to the crest. A dam between 10-15 m in height from its deepest foundation is also included in the classification of a large dam provided it complies with one of the following conditions : a) length of crest of the dam is not less than 500m or b) capacity of the reservoir formed by the dam is not less than 1Mcubic m or c)the maximum flood discharge dealt with by the dam is not less than 2000m^3 /sec or d) the dam has specially difficult foundation problems or e) the dam is of unusual design.

[39] Data Source – National Register of Large Dams

[40] Dam of National Importance is such dams with height 100 m and above or gross storage capacity of 1 Billion cubic meters and above.

[41, 20] D. Shripad, Powerful Forces get water for Power, Dated 5th December, 2013. http://indiatogether.org/barrage-environment

Table 6.1: Dams and Barrages on the River Hasdeo

Features	Minimata (Hasdeo) Bango	Hasdeo Barrage (Darri Reservoir)
Code	CG03HH0173	CG03MH0025
Year of Completion	1990	1967
River	Hasdeo	Hasdeo
Type	TE- Earthwork	TE- Earthwork
Height above the lowest Foundation	87 m	17.15 m
Length of the Dam	2509 m	283.76 m
Volume content of the Dam	NA	NA
Gross Storage Capacity	3420 MCM	80.1 MCM
Reservoir Area	188.47 Sq Kms	25.9 Sq. Kms
Effective Storage Capacity	3050 MCM	81.1 MCM
Purpose	I/H- Irrigation & Hydel	I- Irrigation
Designed Spillway Capacity	42842.00 m^3/sec	19820.00 m^3/sec

The catchment area of the Minimata Bango Dam is nearly 6730 sq Kms and the average annual precipitation is 1505 mm (Maximum 1920 mm and minimum 940mm).

The Hasdeo Bango Multipurpose Project comprises of Hasdeo Project Phase I and II. They include a 4.40 Kms long left bank canal to supply water to the TPP's and a right bank canal for supplying irrigation water . Phase III and IV included the construction of the Minimata Bango Dam 42 Kms upstream of the barrage for hydropower generation and additional water for irrigation and industries. At present the project is declared complete although the lining of the canal and development of field channels remains incomplete[43]. As per the India WRIS website, all 4 phases of the project has receives investment clearances from the planning commission.

Table 6.2: The total estimated water requirement for various needs is as follows:

Irrigation	2578 MCM
Industrial & Municipal	455 MCM
Reservoir Losses	229 MCM

In the course of a discussion with Alok Putul (BBC News Reporter), it was revealed that earlier the provision of drinking water was the priority for water distribution. After drinking water, irrigation and then industries assumed importance. But then back at a point in time when Ajit Jogi was the chief Minister of Chhattisgarh, then a request was made to the farmers to not take up rice cultivation in summer as they would not be able to provide them with water.

[43] Hasdeo Sub Basin Agriculture Theme- Craig D'Souza

Apart from the above two mentioned impoundments, there are more than 50 anicuts/check dams that have been constructed in the catchment area at different places from its origin to the confluence with Mahanadi. But the exact number of dams and the nalla on which they have been constructed is still unclear.s

Table 6.3: Other anicuts/ check dams in the catchment area of the Hasdeo Sub Basin[44]

S.No	Name of the Dam	Year of Completion	River	District	Type	Height	Length	Purpose	Status
1.	Agaria Dam	1977	Local Nalla	Bilaspur	TE	16.89	1080	-	C
2.	Amachuwa Dam	1917	Local Nalla	Korba	TE	11.88	223	-	C
3.	Amakhokhra Dam	1985	Local Nalla	Korba	TE	10.8	744	-	C
4.	Badesathi Dam	1987	Local Nalla	Korea	TE	17	450	Irrigation	C
5.	Badra Dam	1988	Local Nalla	Korea	TE	20.58	288	Irrigation	C
6.	Badrika Ashram Dam	1986	Local Nalla	Suarguja	TE	10.5	690	Irrigation	C
7.	Banjaridand Dam	1982	Local Nalla	Korea	TE	17.92	780	Irrigation	C
8.	Barat Sagar Dam	2004	Local Nalla	Bilaspur	TE	13.5	1600	Irrigation	C
9.	Bardar Dam	2004	Local Nalla	Bilaspur	TE	18.3	810	Irrigation	C
10.	Barkela Dam	1999	Local Nalla	Korea	TE	17.6	610	Irrigation	C
11.	Barpara Dam	1980	Local Nalla	Korea	TE	12.4	840	Irrigation	C
12.	Belbehra Dam	1967	Local Nalla	Korea	TE	14.16	1035	Irrigation	C
13.	Champi Dam	2003	-	Bilaspur	TE	15.42	2160	Irrigation	C
14.	Charpara Dam	1986	Local Nalla	Korea	TE	19.16	570	Irrigation	C
15.	Charcha Dam	1987	Local Nalla	Korea	TE	17.56	429	Irrigation	C
16.	Dandgaon Dam	1994	Local Nalla	Surguja	TE	17.12	1410	Irrigation	C

[44] Chalked out from the NRLD document
These dams have been chalked out on the basis of the district in which they lie. A more nuanced assessment needs to be conducted to determine as to exactly how many of them are in the Hasdeo Sub Basin.

17.	Deoripali Dam	1986	Local Nalla	Janjgir Champa	TE	11.7	570	Irrigation	C
18.	Dhanras Dam	1911	Local Nalla	Bilaspur	TE	11	450	Irrigation	C
19.	Dhawanpur Dam	1970	Local Nalla	Bilaspur	TE	10.1	1204	Irrigation	C
20.	Fulwari Dam	1991	Local Nalla	Bilaspur	TE	11	1525	Irrigation	C
21.	Ganeshpur Dam	1985	Local Nalla	Korea	TE	19	405	Irrigation	C
22.	Gej Dam	2002	Gej	Korea	TE	27.5	4065	Irrigation	C
23.	Ghatoi Dam	1992	Local Nalla	Janjgir Champa	TE	10.15	1950	Irrigation	C
24.	Ghogra Dam	1981	Local Nalla	Surguja	TE	20.97	347	Irrigation	C
25.	Ghongha Dam	1981	Ghongha	Bilaspur	TE	17.88	720	Hydroelectricity, Irrigation	C
26.	Gobari Dam	1976	Local Nalla	Korea	TE	16.15	430	Irrigation	C
27.	Gursia Dam	1992	Local Nalla	Korba	TE	17.15	130	Irrigation	C
28.	Jagatpur Dam	2004	Local Nalla	Korea	TE	18.86	180	Irrigation	C
29.	Jhumka Dam	1981	Gej	Korea	TE	29.8	2820	Hydroelectricity, Irrigation	C
30.	Junwani Dam	1988	Local Nalla	Korba	TE	10.5	675	Irrigation	C
31.	Kehra Dam	1991	Local Nalla	Korba	TE	11.8	1320	Irrigation	C
32.	Khadgawan Dam	1971	Local Nalla	Korea	TE	15	130	Irrigation	C
33.	Khanda Dam	1986	Local Nalla	Korea	TE	10.3	510	Irrigation	C
34.	Kharung Dam	1930	Kharung	Bilaspur	TE	21.31	495	Irrigation	C
35.	Kopra Dam	1993	Local Nalla	Bilaspur	TE	10.96	1680	Irrigation	C
36.	Kothari Dam	1980	Local Nalla	Korba	TE	13	660	Irrigation	C
37.	Koushalpur Dam	1986	Local Nalla	Surguja	TE	11	660	Irrigation	C

38.	Kunkuna Dam	1991	Local Nalla	Korba	TE	12.1	720	Irrigation	C
39.	Kusmaha Dam	1986	Local Nalla	Korea	TE	15.34	580	Irrigation	C
40.	Lai Dam	2004	Local Nalla	Korea	TE	16.5	518	Hydroelectricity, Irrigation	C
41.	Maharajpur Dam	-	Local Nalla	Korea	TE	16.5	518	Irrigation	C
42.	Malhania Dam	2002	-	Bilaspur	TE	21.8	2700	Irrigation	C
43.	Maniyari Dam	1930	Maniyari	Bilaspur	TE	28.96	2095	Hydroelectricity, Irrigation	C
44.	Morga Dam	1987	Local Nalla	Korea	TE	21	495	Irrigation	C
45.	Murma Dam	1986	Local Nalla	Korea	TE	14.2	1035	Irrigation	C
46.	Murwadand Dam	1992	Local Nalla	Korba	TE	15.9	210	Irrigation	C
47.	Nawkerra Dam	1981	Local Nalla	Surguja	TE	18.89	518	-	C
48.	Parasrampur Dam	2006	Garasili	Surguja	TE	20.7	1260	Irrigation	C
49.	Rajoli Dam	1986	Local Nalla	Korea	TE	18.76	585	Irrigation	C
50.	Rajpuri Dam	2005	Local Nalla	Korea	TE	15.6	1260	Irrigation	C
51.	Ramanujganj Dam	1990	Local Nalla	Surguja	TE	13.98	1390	Irrigation	C
52.	Rikhi Dam	1991	Local Nalla	Surguja	TE	14.4	810	Irrigation	C
53.	Sadamar Tank	1988	Local Nalla	Korba	TE	10.67	610	Irrigation	C
54.	Saila Dam	1991	Local Nalla	Korba	TE	11.96	1500	Irrigation	C
55.	Salihabhata Dam	1991	Local Nalla	Korba	TE	11.5	690	Irrigation	C
56.	Salihapara Dam	1991	Local Nalla	Korba	TE	10.1	960	Irrigation	C
57.	Saliyadih Dam	2004	Local Nalla	Surguja	TE	15.9	465	Irrigation	C
58.	Sawatpur Dam	1977	Local Nalla	Bilaspur	TE	16.89	1080	Irrigation	C

59.	Sawla Dam	1984	Local	Korea	TE	15.3	990	Irrigation	C
60.	Shivepur Dam	1981	Local Nalla	Surguja	TE	10	600	Irrigation	C
61.	Silphoda Dam	1986	Local Nalla	Korea	TE	15.9	645	Irrigation	C
62.	Sonhat Dam	1986	Local Nalla	Korea	TE	15.6	230	Irrigation	C
63.	Tamdand Dam	1980	Local Nalla	Korea	TE	17	425	Irrigation	C
64.	Tulutolia Dam	1975	Local Nalla	Bilaspur	TE	13.87	1187	Irrigation	C

6.1 IMPACT ON THE LIVES OF THE PEOPLE AFFECTED BY THE CONSTRUCTION OF THE DAM

6.1.1 Excerpts of an FGD conducted in the Village Khotkhorri (close to the backwaters of the Hasdeo Bango Dam)

1. This village has a population of nearly 300 and most of the people are "Manikpuri Bhagat" which means that they do not consume alcohol, mahua and non vegetarian food. These people are Kabirpanthi (followers of Kabir).
2. When the dam was constructed then they had to move up higher up in the hills as they did not get a compensation in spite of the fact that they did have a house in the area that was about to be submerged. Only those families that had agricultural land in the area were compensated.
3. But most of the families that did not have agricultural land used to cultivate vegetables when the water receded. So the main source of income for many of the families in the region got hampered. The people of the village are now solely dependent on the forest for their livelihoods.
4. Along with Khotkhorri, some other villages were also completely displaced. They include Bhurmahua, Banragarh, Durghattiyayi, Saraibhadra, Amlitikra and Gavarpahar.
5. The people of the village are of the opinion that even if now the dam gates are opened at the appropriate time then they can still cultivate on the flood plains. They could cultivate around 100-150 man of rice (1man = 40 kl). Land is mostly required for 4 to 5 months at a stretch. Effective dam regulation could help them regenerate their livelihood. Earlier when the dam was not there then clear drinking water was available at a distance of 0.5 kms from their homes. The movement of water was also slow and it easily spread across the flood plains. But since the construction of the dam, the land adjacent to the backwaters have been waterlogged and are of no use.

6. The backwaters contained different kinds of fish namely Mirkal, Mirga, Bangur, Jhori, Chinati, Bambi, Singi, Perna, Kekdou, Ghonghi, Singhar, Baliya, Mangur, Saour, Rohu, Catla,Jhinga, Pothi, Mehrali, Ketu, Thondo and Gina.
7. Since the village was just next to the forest there were incidences of snake bites very common in the area by Ghamna, Gehua, Karait and Tardomi(Viper). But before the construction of the dam the village was located near the confluence of the Chornai river, Bandhargarh Nalla and Dhardhoi Nalla. But this displaced village was highly isolated from the other areas.

CHAPTER 7: HUMAN INTERVENTIONS – COAL MINES

As per the Mineral Resources Department Website of the Government of Chhattisgarh, the state has 16% of the total coal deposits in the country and all of this is concentrated in 12 coalfields located in Surguja, Koriya, Korba and Raigarh. The former three districts form a part of the Hasdeo River Basin. Moreover the state ranks 2nd in coal production and thus contributes 18% to the production that takes place at the national level[45].

Table 7.1: Area Wise details of Underground, Open cast and Mixed Mines of SECL as on 31st March 2014[46]. (Figures indicate the number of mines)

Areas of SECL	Underground	Opencast	Mixed
Hasdeo Arand	4	-	-
Chirmiri	6	1	1
Baikunthpur	5	-	-
Bisrampur	5	3	-
Bhatgaon	5	3	-
Korba	10	2	-
Kusmunda	-	1	-
Gevra	-	1	-
Dipka	-	1	-
TOTAL	35	12	1

Table 7.2: Coal Mines and their associated forest area diversion and daily water requirement (Source – EIA Reports)

Coal Mine	District	Forest Area Diverted (Ha)	Daily Water Requirement	Source of Water	Notes
Chirmiri [47](OCM) EIA by Ecomen Laboratories Pvt. Ltd.	Koriya	332.986	0.50 MCM/day	Mine Water	Saudham Nallah flows through the northern part of Chirmiri Hill and joins Korea Nalla which in turn drains into Hasdeo River. EIA also speaks about one Balijhar Nalla.
Nawapara Underground Project (Underground Mine)	Sendurpara Geological Block of Bisrampur Coalfields, District-Surguja	71.98	-	-	-

[45] http://chhattisgarhmines.gov.in/coal.htm
[46] https://www.coalindia.in/DesktopModules/DocumentList/documents/SECL_08082014.pdf
[47] http://www.enviscecb.org/180/Executive%20Summary_English.pdf

Rehar Underground Coal Mining Project[48]. EIA conducted by M/s Ramky Enviro engineers Ltd.	Getra Village, District- Surguja	114.978	0.003 MCM/day	Mine Water	As per the report the excess mine water will be discharged into the nearby tanks which can then be used by the local villagers for agricultural purposes.
Mahan II OCP[49]	Bhatgaon Area, Bisrampur Coalfield. District- Surguja	52.769	1490 cum/day	270 cum/day (GW) + 1220 cum/day (mine water)	The Mahan River flows south of the block. An important seasonal nalla, the Gohanagar Nala, flows along the western boundary of the block and discharges its water into the Mahan River.
Amera Opencast Project[50]	Amera Village, Tehsil Lakhanpur, District - Surguja	51.989 Ha	234 cum/day [154 cum/day industrial demand + 80 cum/day domestic demand]	Mine Water + GW	The report mentions the fact that there will be changes in the drainage of the first order streamlets.
Madanpur South Coal Block[51], Hasdeo Arand Coal Field (OCM). EIA conducted by Geomin Consultants Pvt. Ltd.	Korba	490.902 Ha Protected Forest + 169.358 Ha Revenue Forest			Bisrar Nala which is the northern boundary of the area is the main drainage channel of the area and it flows westwards into the Hasdeo River at a distance 10 Kms west of the block.
Parsa Coal Block[52].	Hasdeo Arand Coal Field, District-	550.894 Ha	2100 cum/day	Mine Water + Bore Wells	The area is drained by the Hasdeo River. The drainage network is made up by the Atem River, Gej River and the Chornai River.

[48] http://www.enviscecb.org/117/ExeSummary_ReharUG_English.pdf

[49] http://environmentclearance.nic.in/writereaddata/EIA/07102014VG8VLG9YEIAmahanIIOC2mtpaunderClause7ii.pdf

[50] http://environmentclearance.nic.in/writereaddata/EIA/28042015DSW5U73WFULLEIAAMERA2MTYcompressed_opt.pdf

[51] http://www.enviscecb.org/MS%20Madanpur%20South%20Coal%20Company%20Ltd,katghora/Executive%20Summary%20English.pdf

[52] http://www.indiaenvironmentportal.org.in/files/file/summary-Proposed%20Parsa%20OpenCast%20Captive%20Coal%20Mine%20(5%20MTPA%20in%20Project%20Area%20of%201252.447%20Ha)%20of%20CSPGCL%20at%20Hasdo-Arand%20Coalfield.pdf

	Surguja and Surajpur				
Balgi Underground Project[53].	Tehsil Katghora, District Korba	Nil	-	-	The drainage network is made up by the Ahiran River and the Kholar Nalla that ultimately join the Hasdeo River.
Manikpur Coal Project [54](Proposed Expansion) EIA conducted by Ramky Enviro Engineers Ltd.	District-Korba	371.619	1.212 MLD	GW + Hasdeo River + Mine water + Canal Water	The main river that flows through the region is Hasdeo and its tributaries Gagechorai, Tan and Ahiran. Tha Rapakara Nallah flows into the core zone from the eastern side of the core zone and then ultimately joins the Hasdeo River.
Gevra Opencast Project[55]	Gevra Village, Ponri, Bareli, Tehsil-Katghora, District Korba.	1038.63	-	-	Hasdeo River is the master drainage of the area. The mine block is drained by Laxman Nallah which joins the Ahiran River, a tributary of Hasdeo River. Lilaghar River and Gangdel Nala also control the flow in the southern portion of the block.
Proposed Kusmunda Open Cast Expansion Project[56]	Eastern Sector of Jatraj, Resdi and Sonpuri, South Central Part of Korba Coalfields, District-Korba	582.883	16447 cum/day	Mine Water + Hasdeo Right Bank Canal +Ahiran River+ Tube Well	
Dipka OCP [57]	Dipka and Hardi Blocks, South Central Part of Korba Coalfields,	409.180	4360 cum/day		Drained mainly by the Lilaghar River which makes the South Western Boundary of the Block

[53] http://www.enviscecb.org/113/Balgi%20PH_Eng_.pdf
[54] http://environmentclearance.nic.in/writereaddata/EIA/1111291220121211129-2007.pdf
[55] http://www.environmentclearance.nic.in/writereaddata/EIA/18112014T1V5B4NKEIAgevra.pdf
[56] http://www.ercindia.org/files/eiadocuments/eiareports/2015/11022015_CG_KUSMUNDA%20(ENGLISH).pdf
[57] http://www.environmentclearance.nic.in/writereaddata/EIA/31102014PJRZBJV2eiaempdipkaocClause7[ii].pdf

	District Korba				

7.1 IMPACT OF COAL MINES ON THE LIFE OF PEOPLE IN THE BASIN

7.1.1 Excerpts of an FGD conducted with the people affected by the coal mines in Village Basan

1. The Pathaita Nalla used to pass through their village and contained water throughout the year but due to the mining activity, the nalla has disappeared. This Nalla earlier joined the Hasdeo but at present has no water contribution to the Hasdeo River. Drinking water is now obtained from the tube well. The drying up of the Nalla has wrecked havoc on the animals who are now left with no source of water.
2. The people who work in the mines complain of severe cough, body pain as a result of ingestion of the coal dust. So much so that even their spit is black in colour.
3. Due to the complete diversion of their village and forest land they have lost access to the common forest resources like mahua. Earlier they used to collect 2-3 quintal but now there is none. As a result of which their source of income has been destroyed. 36 Hectares of forest land was diverted for the mines. Birds like vultures and peacock have also disappeared. The drinking water source which was just 5 minutes away is now 15 mins to 0.5 hrs away.
4. They clearly accepted the precedence of the Dhori Water quality when compared to the tube well water.

7.1.2 Excerpts of an FGD conducted with the people affected by the coal mines in Village Ghar Barra

1. Ghatbarra, Fatehpur, Parogiya, Saidur and Sushkan made up one Gram Panchayat.
2. In the last one year due to the setting up of the Parsa Kete Basan Coal Mines[58], 5000 to 6000 trees have already been cut and another 20-25 acres of forest has been bleached. Shoddy Gram Sabha's were conducted without the mandatory 33% women representation.
3. The main sources of drinking water in the village are wells and tube wells. Every 5 to 6 houses have either one of them.
4. Mostly agriculture is done twice in a year, once in the rainy season and the other in the summer season. During the rainy season rice, maize and pulses like arhar and urad are grown. There is no irrigation facility in the village. So any supplemental water requirement is fulfilled by the wells. Rice was so abundantly grown in the region that it was given in return for a day's labour. But now there has been a drastic reduction in the cultivation of rice mainly due to the government's scheme

[58] Information obtained from Alok Putul (BBC Hindi Reporter)- Kete Besan Coal Fields which are a part of the Hasdeo Arand Forest. The Chhattisgarh government allotted the coal block to Rajasthan Government. Rajasthan Government in turn handed it over to the Adani's. It is now a joint venture between the Adani and the Rajasthan government in which the former owns a stake worth 74% while the latter owns the remaining that is 26%. Since it was a part of one of the most pristine forests in the country, the National Green Tribunal gave orders to stop mining in the area. Adani's then went to the Supreme Court. But even the SC judged against the Adani's. The villages present in the location have not been rehabilitated yet. PESA has been violated as permission from the Gram Sabha's have not been taken. 800 cases of bear human conflicts have been reported by the reporter but the EIA does not mention this fact.

of rice provision at Rs 1 for 35 kl to the tribal populace of the region and due to the non-availability of a clean source of water. Curently "Jethva Dhan or Jethi Dhan is being grown. The Jethi Rice was not grown in the rainy season as it gets damaged and contaminated with excess water pressure. Along with all this another version of rice called "Hariar Patti" is also being grown.

5. The people involved in the cultivation of rice usually make small huts near their fields and stay there temporarily till the crop has been harvested. The produce is just enough for the family's personal consumption and is not sold in the market for commercial gains. So the farmer's u/s of the Hasdeo Bango dam is clearly involved in subsistence agriculture.
6. The respondent has observed some changes in the area: Dense jungles have now become quite scattered, Earlier the rainfall was distributed well both temporally and spatially but now it rains every month and the amount needed during the rainy season is not sufficient. Use of chemicals like urea, potash and DAP has increased the land under irrigation but the quality of produce has decreased.
7. Due to the setting up of the Parsa Kete Basan Coal Mines, there is an inherent smell of coal in everywhere. Moreover early in the morning the air is filled with coal giving it a foggy appearance.
8. Just a month ago, 12-15 male cows (bael) died after consuming the water from the nalla. After they died, the village people threw their bodies in the forest. But the body was so highly contaminated that even the wild dogs of the forest did not eat it.
9. 3 to 4 years back one could find fishes in the nalla but after the opening up of the mine the natural ground water level went down plus the water released in the diversion channel was reduced which has now led to the very low discharge in the nalla.
10. Due to the mines present in the region, and trucks carrying coal plying on the adjacent roads day and night, there has been a heavy accumulation of coal dust on the roof tops of the nearby houses. During the rainy season the water washes the coal dust and black coloured water falls down the houses and gets collected around them. Even the leaves of the forest have turned black. 80% of the people in the village have stopped doing agriculture and are now solely dependent on the remaining forests. Agriculture in the village at least ensured an income of 25000 in a year. "Aavla" used to grow abundantly in the forests but has now totally disappeared. Its bark was earlier extracted for medicinal purposes.
11. "Barr Nalla" is one of the nalla that flows through the village and later on goes and joins the River Hasdeo. On one side of the nalla are the forests that have already been marked by the forest department for cutting and on the other side are the Parsa Kete Basan Mines. The flow of the water in the nalla has been blocked on all sided by a barricade of sand and a narrow diversion has been made for the passage of the nalla water. The water from the coal mines is discharged via pumps into the blocked nalla and further d/s it is slowly discharged into the diversion channel. So in half a kilometre stretch the colour of the water has changed from greenish blue to black and the flowing water has been rendered stagnant. This has had its consequences further downstream.

CHAPTER 8: INDUSTRIES IN THE HASDEO BASIN

Chhattisgarh has emerged as the power hub of the nation at the cost its natural resource exploitation. Nearly every raw material is available in Chhattisgarh for it to garner huge investments in the industrial sectors. The state government has made a very conducive environment for these industrial units to operate sometimes even bypassing the other ministries. Below is compilation of the different industrial establishments in the Hasdeo Basin.

Table 8.1 Sponge/Pig Iron Plants

S. No.	Name of Unit	Location
1.	M/s Airan Ispat & Power Ltd.	Silpahari Industrial Area, Bilaspur
2.	M/s Geetanjali Ispat & Power Pvt. Ltd.	Village Hardikona, Bilaspur
3.	M/s Indo Sponge Iron & Steel Pvt. Ltd.	Village- Jhagraha , Korba
4.	M/s Kalindi Ispat Pvt. Ltd.	Village- Belpan, Bilaspur
5.	M/s Mangal Sponge & Steel Pvt. Ltd.	Bilha, Bilaspur
6.	M/s Nova Iron & Steel Ltd.	Village- Dagori, Bilaspur
7.	M/s Phil Ispat Pvt. Ltd.	Village- Dhaorabhataha, Bilaspur
8.	M/s Prakash Industries Ltd.	Village- Hathnewra, Janjgir Champa
9.	M/s Radha Madhav Sponge Pvt. Ltd.	Village- Silpahari, Bilaspur
10.	M/s Satya Power & Ispat Pvt. Ltd.	Village- Gatori, Bilaspur
11.	M/s Shakun Sponge Pvt. Ltd.	Village- Silpahari, Bilaspur
12.	M/s Shree Radhey industries Ltd.	Village- Silpahari, Bilaspur

Table 8.2 Cement Plant

S. No.	Name of Company and Location	Year of Establishment	Annual Production Capacity (Lakh Tonne)
1.	Lafarge India Limited, Gopalnagar, Janjgir	1982	22.40

Thermal Power Plants

Chhattisgarh is presently one of the few states that have surplus power. It is also among the few profitable states in terms of utility based electricity. The GDP of the state is expected to reach US $46.8 billion in FY 17 from US $ 29.2 billion in FY14[59]

[59] file:///D:/WCF%20E-Flows/dam%20weblinks/About%20Chhattisgarh,%20Industries,%20Geography,%20Development,%20Information.html

Table 8.3: National Thermal Power Plants

S.No.	Name of Company	Location	Capacity (MW)
1.	National Thermal Power Corporation	Korba	2100
2.	Sipat II	Sipat, Bilaspur	1000

Table 8.4:Chhattisgarh State Electricity Board

S.No.	Name of Company	Location	Capacity (MW)
1.	Korba Eats Phase II	Korba	200
2.	Korba Eats Phase III	Korba	240
3.	Dr. Shyama Prasad Mukherjee TPS (Korba East Phase IV)	Korba	500
4.	Hasdeo Thermal Power Station (Korba West)	Korba	840

Table 8.5: Independent Power Producer

S.No.	Name of Company	Location	Capacity
1.	M/s Aryan Coal Beneficiation Private Ltd.	Korba	30

Table 8.6: Captive Power Plants

S. No.	Name of Company	Location	Capacity (MW)
1.	M/s BALCO	Korba	810
2.	M/s Prakash Industries Ltd.	Janjgir Champa	77.70
3.	M/s Lafarge India	Bilaspur	27.20
4.	M/s Arasmeta Captive Power Plant	Champa	43.36

Table 8.7 UPCOMING POWER PLANTS IN THE HASDEO RIVER BASIN

Industry	Location	Status	Forest Land Diverted	Water Requirement	Source	Notes
Karnataka Power Corp. Ltd. (1600 MW)	Janjgir Champa	I	-	-	-	-
ACB India	Korba	P	-	87 cum/hr	Kholar Nalla	-

Ltd[60]. (30 MW)						
Athena Chhattisgarh Power Pvt. Ltd[61]. (1200 MW)	Janjgir Champa	P	129.33 Ha	95890 cum/day	Mahanadi River	
Maruti Clean Coal & Power Ltd[62]. (2*135 MW rejects and coal based TPP) **EIA prepared by Min Mec Consultancy Pvt Ltd.**	Village Bandakhar, District Korba	I	-	353 cum/hr	The water will be taken from a dam proposed to be constructed on the Lilaghar river about 5Kms from the proposed plant site.	The major drains in the study area are Lilaghar River, Patni Nalla, Goknai Nalla, Ganjar Nala, Hathi Nala, Karra Nala, Tuma Nala and Sundhara Nala. All the nalla's discharge their load into the Hasdeo River and the Kurung River.
Chambal Infrastructures. (1320 MW)	Janjgir Champa	P	-	-	-	-
S. V. Power Pvt Ltd. (300MW)	Korba	P	-	-	-	-
Sona Power Ltd. (600 MW)	Janjgir Champa	I	-	-	-	-
Jain Energy Ltd. (1200 MW)	Korba	P	-	-	-	-
RKM Powergen Pvt Ltd[63]. (1400 MW) [64]	Janjgir Champa	I	-	122784 cum/day OR 5116 cum/hr	Mahanadi River	-

[60] http://acbindia.com/Uploads/30MW359.pdf
[61] http://www.greenclearancewatch.org/node/4797
[62] http://www.enviscecb.org/Maruti%20Clean%20&%20Coal%20Power%20Ltd/English.pdf
[63] http://www.greenclearancewatch.org/node/4874
[64] http://www.enviscecb.org/Ms%20RKM%20powerzone%20pvt%20ltd%20-%20janjgir%20-%20champa/Executive%20summary%20-English.pdf

Vandana Vidyut (540 MW)[65] **EIA Prepared by Anacon Laboratories Pvt. Ltd.**	Salora, Chhuti, Gangpur, Darrabhata and Jhora, District Korba	I	9763	2100 cum/hr	Hasdeo River	-
KSK Energy Ventures Ltd. (3600 MW)	Janjgir Champa	I	-	-	-	-
Adhunik Power & Natural Resources Ltd[66]. (1320 MW) **EIA prepared by Sun Consultancy and Services**	Villages Sakreli, Dumarpara, Deragarh, District Janjgir Champa	P	68.27	3650 cum/hr	River Mahanadi	-
State Power Generation Company Ltd. (500 MW)	Korba	P	-	-	-	-
Dheeru Powergen Pvt. Ltd[67]. (1050 MW)	Korba	P	130.84	80832 cum/day	Sarveshwar and Sarvamangala anicuts and Darri Barrage on the Hasdeo River	-
Power Finance Corporation Ltd. (4000 MW)	Surguja	P	-	-	-	-
Lanco	Pathadi,	P	-	254502	River Hasdeo	The figure in the

[65] http://www.enviscecb.org/MS%20vandana%20Vidyut%20Ltd/Executive%20Summary%20(English).pdf
[66] http://www.enviscecb.org/115/Executive%20Summary-English.pdf
[67] http://www.greenclearancewatch.org/node/4798

Amarkantak Pvt. Ltd[68]. (Proposed Expansion 1320 MW)	Pahanda, Khoddel, Saragbundia, Dandhani, Sandil, Katbitla and Baridih Villages, District Korba			cum/day		water requirement column denotes the total for generating 3240 MW power.
Jaiswal Neco Urja Ltd. (100 MW)[69]. (Proposed Integrated Steel Plant)	Village Dagori, Ameri Akhberi and Udgaon. District Bilaspur	I	-	19800 kl/day	Sheonath River	-
India Bulls Pvt. Ltd. (1320 MW)	Korba	P	-	-	-	-
Amarkantak Pvt. Ltd[70]. (600 MW). EIA Report Prepared by B S. Envi Tech Pvt. Ltd.	Pathadi, Pahanda, Khoddal and Saragbundia Villages. District Korba	I		65400 cum/day	Hasdeo River	-

Table 8.8 Aluminium Plant

Bauxite exploitation in the state is reserved for Public Sector undertakings. This bauxite is used for aluminium extraction and calcinations plants. Aluminium extraction plant of BALCO is operational at Korba. The ore is concentrated in Surguja and Korba district in the Hasdeo Basin.

[68] http://www.enviscecb.org/156/Executive%20Summary_English.pdf
[69] http://www.enviscecb.org/168/Executive%20Summary_English.pdf
[70] http://ifcextapps.ifc.org/ifcext/spiwebsite1.nsf/0/032BB72660FE8C2C852576BA000E2B0D/$File/Lanco%20Amarkantak%20CEIA%20-%20November%202005.pdf

S. No	Name of the Company	Location	Product and Production Capacity	Water Requirement and Source
1	Bharat Aluminium Co. Ltd.	Korba	Aluminium Wire (55750 Tonnes) Rolled Products (43600 Tonnes) Ingots and Others (18000 Tonnes)	

Table 8.9 Bauxite Blocks in the Hasdeo Sub Basin

District	Name of the Block	Area(Sq. Kms)	Reserve (million Tonnes)	Nearest source of water
Surguja	Chutai, Tehsil Samri	1	0.15	
	Chutai and Gopatu, Tehsil Samri	2.60 and 0.65	0.38 proved and 1.85 possible	
	Chutai, Tatijharia, Samri Block	10.18	4.91 estimated	
	Samripat block (Jamirapat area) Tehsil- Samri	3.50	3.37	
	Sarangdag, Tehsil Samri	4.20	9.17	
	Samri Block(Kutku Sector) Kudag Block (Dumarkholi Sector) Tehsil Samri	3	1.33 2.15	
	Tatijharia, Tehsil Samri	4.50	9.30	
	Jamirapat, Tehsil Samri	1.88	4.37	
	Nagardand, Tehsil Sitapur	5.46	10.161	
	Sapnadand, Tehsil Sitapur	2.88	11.468	

	Kudaridih, Tehsil-Sitapur	11.63	11.924	
	Kesara, Tehsil Sitapur	6.18	8.873	
	Barima. Tehsil Sitapur	3.00	2.39	
	Kandraja, Tehsil Sitapur	11.50	10.10	
	Barima, Tehsil-Sitapur	8	3.1775	
	East Barima, Tehsil Sitapur	1.27	0.1934	
	North Narvadpur	5.01	0.2553	
	South Narvadpur	3.55	0.9285	
	South Narvadpur	5.20	0.0255	
	South Barimauranga, Tehsil Sitapur	4	2.97	
	Parpatia, Tehsil Sitapur	0.70	0.994 probable	
	Uranga, Tehsil Sitapur	0.36	0.1866	
	Kesara & Lurena, Tehsil Sitapur	1.05	0.271	
	North Kameleshwarpur, Tehsil Sitapur	1.18	0.240	
	Bijlahawa, Tehsil Sitapur	0.805	0.25	
	Pathrai, Tehsil Sitapur	3.82	1.876	
	Pathrai North East, Tehsil sitapur	4.05	2.631	
	Sarbhanja, Tehsil Sitapur	1.92	0.20	
Korba	Paunakhara Pahar, Ranaikhet Pahar, Gaurduari Pahar	-	0.20	

As per Sudiep Srivastava, a Bilaspur based lawyer and activist, the Chhattisgarh Government has signed 102 MoU's with industrial houses. On the one hand where the government claims to have brought Rs 165000 crore investment to the state, they are also being questioned on the sanctity of the deals. These deals are doubted to be privately negotiated without any competitive bidding. Contentions also revolve around the fact that the Chhattisgarh government's MoU's assure assistance full support in the form of land, minerals, water and infrastructure, the cost of which is paid by the voiceless environment and the people dependent on them for their livelihoods.

The table below shows clearly the over allocation of the river's water. This information was obtained by Manish Rathod who is a Korba based Environmental activist.

Table 8.10: Water allocation – Information obtained under RTI filed by Manish Rathod (Korba based environmental activist)

S.No	Name	Water Allocation (MCM)
Current Water allocation		
1.	**CSEB (east)**	**37.50**
2.	**CSEB (west)**	**26.00**
3.	**NTPC (2100 MW)**	**110.00**
4.	**IBP Korba**	**0.156**
5.	**SECL Korba**	**0.963**
6.	**SECL Kusmunda**	**1.490**
7.	**BALCO Korba**	**10.200**
Total		**186.309**
Water allocation to other industries		
1.	**NTPC Seepat**	**120.00**
2.	**CSEB Korba (East and West) new thermal power project**	**50.00**
Total		**170.00**
Others industries		

1.	**BCCP Balco Korba**	**18.00**
2.	**BALCO Korba Expansion Project**	**27.00**
Total		**45.00**
Grand Total (186.309+170.00+45.00) =401.309 MCM > 400 MCM		

Incidences of Water Theft in the Region- As per the government rules, industries can source water only from the downstream areas of barrage or dams. At the time of securing permission for its plant, Vandana Vidhyut had pledged that it would set up two anicuts (small dams) downstream of Minimata Hasdeo Bango barrage and lay a 15 km-long-pipeline for carrying water to the plant. The works would have cost the company Rs 25 crore. Now the decision to allow the company to source water from Savamanglamandir upstream of Hasdeo barrage means it does not need to build anicuts. All it has to do is to lay two kilometres of pipeline (DTE, June 1, 2012).

CHAPTER 9: WATER QUALITY STATUS IN THE HASDEO SUB BASIN

The quality of the River Hasdeo is severely affected in its downward journey at 4 places namely Manendreagarh, Chirmiri, Korba and Champa[71]. All these 4 locations are industrial centres. At Manendragarh and Chirmiri are located the coal mines which compose of the first form of pollution that the river is subjected to. The Koria Nalla carries the waste water from the coal mining areas as well as urban wastewater into the Hasdeo River. In Korba lies the Thermal Power Plants that release their effluents via the Belgiri, Dhengur Nalla and the Ahiran River. Lastly in Champa, lies the paper mills that release the effluents via the Hasia Nalla into the river Hasdeo. High Pesticide load was observed in the very origin of the River at Amritdhara mainly because of the agricultural practices. The run-off in the catchment area has been accorded as the main reason for the high pesticide load in the river. As per the report River Hasdeo has a high carrying/purification capacity. After its quality getting highly deteriorated at Korba, the river regenerates itself by the time it reaches Champa. But then again due to the paper mills it gets polluted and again undergoes self purification after travelling for 30-40 Kms.

In an attempt to document the water quality status of the River Hasdeo, a physico chemical analysis of the river water was taken up by M.M. Vaishnav and Dineshwari Sahu[72]. Water samples were collected from 6 different stations namely Kohadia, Darri NTPC (National Thermal Power Corporation), CSEB (Chhattisgarh State Electricity Board) power plants, Ayodhyapuri, Purani Basti and Sitamani. All these points were located either near the discharge point of industrial effluents or near the domestic sewage discharge joint. The results showed that the pH of the water samples rendered it alkaline. Moreover the quantity of the total dissolved solids was also found in excess. Atleast 4 out of the 6 samples showed a TDS value of more than 2000 ppm. This led to a lower quantity of dissolved oxygen which had direct consequences on the aquatic life. The chloride, nitrate and fluoride content were also found to be in excess of the permissible limit.

M.M. Vaishnav alongwith Milan Hait[73] conducted a study to understand the effect of paper mill effluents on Ground and surface water bodies in some selected areas of Janjgir Champa in Chhattisgarh. This particular district is homes many manufacturing and production units like Madhya Bharat Paper Limited, Prakash industries Ltd. And a few others that are still under construction. Due to the fast paced industrialization huge quantities of untreated or partially treated waste in entering the

[71] CPCB Highlights 2003.
[72] M.M. Vaishnav & Dineshwari Sahu, Study of Some Physico-Chemical Characteristics of Hasdeo River Water at Korba (India), Journal of Environmental Research and Development, Vol. 1, No. 2, October- December 2006, Pg 140-142.
[73] M.M. Vaishnav & H. Milan, Effect Of Paper Mills effluents On Ground and Surface Water Bodies of Some Selected areas of Janjgir Champa, C.G., India, India Journal of Science Research, Vol. 4(2), 119-126, 2013.

water bodies and in turn deteriorating its quality. Out of the 8 samples collected, 4 are directly from the river. The minimum conductivity was found to be 852 μ mhos/cm while the range for required for the healthy survival of aquatic organisms is between 150- 500 μ mhos/cm. The maximum TSS value exceeded the permissible value. High suspended dissolved particles adversely affect those who are suffering from kidney and constipation problems. The WQI (Water quality Index) calculated indicated high loading of various kinds of pollutants. The values ranged from 93.2 to 98.53. This high pollutant loading has been attributed to leaching and percolation of surface water via domestic garbage and paper mill industrial effluent.

In yet another similar study taken up by the authors mentioned in the earlier paragraph, but this time specifically targeting the discharged effluent of the Madhya Bharat Paper Mill in Champa[74]. The paper and pulp industry has been considered as one of the largest polluting industries in the world. Their consumption of fresh water is also very high. The effluents released are dark brown in colour and are toxic in nature. The experiments concluded that the water was polluted as the values of EC, turbidity, TSS, DO, COD, phosphate, sodium, potassium, iron, copper, manganese and phenol were above the permissible limit for drinking water. Moreover the Water Quality Index (WQI) was also higher than 100 at all the sampling points which directly indicate the high pollution load in the river.

In the light of the blatant coal extraction taking place in the upper regions of the Hasdeo Basin, a study[75] was conducted to study the river water quality, but this time in the Koriya District. This time water samples were collected from 9 points in the Hasdeo River flowing in the Koriya District. These sampling points were Jhagrakhand, Kujra, Ramnagar, Rajnagar, Bijuri, Katkona, Pandavpara, Jhilmili and West Chirmiri. Unlike the previous study results, this study concluded that all the parameters ranging from pH, alkalinity, hardness, turbidity, chloride, iron, Dissolved Oxygen, TDS, sulphate, fluoride and nitrate were found to be within the permissible limits. These results can be accorded to the fact that before being impounded the relative contamination in water is reduced as compared to the one that is released from the industries. And moreover Koriya is an important portion of the catchment having a rich tree cover so natural treatment takes place simultaneously. To understand these results in its entirety, one needs to know the exact location of water sampling and how far is it really from the coal mine area.

While Koriya is having relatively clean river water, Janjgir Champa which marks the last district of the Hasdeo River Basin has community ponds which are highly polluted and unsafe for human

[74] M.M. Vaishnav, M. Hait & P.K.Rahangdale, Paper Mills Pollution Hazards on Ground and Surface Water Bodies of Adjoining Areas of Hasdeo River in Champa, C.G. (India), International Journal of Science and Research, Vol. 3, Issue 11, 2014, 1146-1151.

[75] P.R. Dwivedi, Dr. M.R. augur & Dr. A. Agarwal, Assessment of Water Quality of Hasdeo River, Koriya District, Chhattisgarh: with Special reference to Pollution due to Coal Mines, International Journal of Engineering Sciences & Research Technology, 2014, Vol. 3(6) Pg 854-857.

consumption[76]. Temple ponds were comparatively less polluted than small and large community ponds. But the river water on the other hand did not show appreciable signs of pollution which means that all the tested parameters were within their permissible limit. The reference taken was IS 10500-1989. But a deeper look into the methodology reveals the fact that out of the 12 samples taken, only one was from the Hasdeo River while the rest were from the ponds. Concluding the purity of a 333 Km long river with just I sample is not methodologically correct as it does not represent the river in its entirety.

Along the entire stretch of the Hasdeo River Basin, Industries have been lined. These industries release toxic and hazardous waste and thus directly cause harm to the life of living organisms[77]. It was observed in a study that fertilizer factories were discharging liquid effluents into the open area which gradually then mixed with the groundwater.

To study the role played by the city drainage effluents in polluting the rivers, a comparative study[78] was conducted by Reeta Bajpai. A comparison was made with water samples taken from the Hasdeo River Barrage near Seepat NTPC and Tovra Dam of Arpa Dam in Bilaspur. Bajpai clearly states the fact that urban areas of the developing countries treat rivers as their end points of effluent discharge. The effluents released from Seepat NTPC plant and drainage system of Bilaspur city has greatly distressed the geochemistry of the soil. As per the study the water of the river Hasdeo is cleaner as compared to that of River Arpa due to the barrage which keeps the water free from rural and urban drainage system. On the contrary the River Arpa is highly polluted and unsafe for domestic use.

Sediment quality is runs hand in hand with the water quality. River Ahiran which is the main source of water for the Katghora Block in Korba District has been greatly influenced by the effluents released by an array of industries that lie alongside. The waste products that are directly released into the river contain trace and toxic elements which either move downstream in the dissolved state or settle down on the river bed and the flood plains and being devoid of nutrients renders harm to aquatic organisms. The phosphate content[79] in the River Ahiran was recorded between 0.3mg/L to 2.7 mg/Lwhile its concentration should not actually exceed 0.1 mg/L. Phosphate increases the growth rate of blue green algae ans thereby reducing the dissolved oxygen level of the water. During the study the concentration of lead and cadmium was also found to be high in the sediments. The reason accorded

[76] U. Manish & B. Subhash, Study of Physico Chemical Properties of Surface Water (Hasdeo River & Ponds) in Champa and Janjgir Region, International Journal of Current Pharmaceutical and Clinical Research, Vol. 4, Issue 2, 2014, 126-128.
[77] M. R. Augur & R. Verma, Impact Assessment of Ground Water Quality by Waste Water Outfall from a Fertilizer Factory, Journal of Chemistry and Chemical Sciences, Vol. 2, Issue (2&3), 2012, 92-137.
[78] R. Bajpai, Comparative Analysis of Physicochemical Parameters of Hasdeo River Barrage & Arpa Water Samples of Bilaspur Region, International Journal of Scientific and Research Publications, Vol. 2, Issue 9, 2012, 1-5.
[79] S. Dhanesh, S.J. Prasad & J. K. Ashok, Characterization of Water and Sediment quality of River Ahiran in Korba Chhattisgarh, Research Journal of Recent Sciences, Vol. 3(5), 21-25, May 2014.

was the deposition of industrial and auto mobile waste. The authors have suggested a thorough monitoring of heavy metals pollution in the sediment of the River before taking up farming so as to prevent the entry of these toxic elements from entering the food chain.

A similar study was undertaken on the Belgarinalla[80], which also is a tributary of the River Hasdeo and passes through Korba. NTPC, BALCO, Vedanta, CSEB all of them releases their waste into this nalla. In its stretch of 20-22 Kms the river carries nothing but an enormous load of fly ash and from the power generating units, red mud from aluminium smelting unit, fertilizers, pesticides, domestic adn other wastes and thereby cause various kinds of skin diseases to the people who are forced to use it in the absence of an alternative source of water. All parameters including temperature, conductivity, turbidity, TS, TDS, TSS, BOD, COD, hardness, nitrite nitrogen, lead and cadmium were found to exceed its permissible limits. It's important to realize that we as humans lie at the top of the food chain and thereby receive these toxic elements which gradually accumulate as they are not susceptible to easy biodegradation.

CPCB had earlier declared Korba as one of the 24 critically polluted areas in 2009. The industrial activities within 15 Kms of Korba town is considered as critically polluted and with a CEPI index of 74.5[81] (83 in 2009 , 5th critically polluted area in India).

Table 9.1: Industrial areas located within the Critical areas:

S.No	Name of the Industry	Capacity
1.	M/s NTPC Ltd , Korba Super Thermal Power Station, Jamnipali, Korba	(3*200=600MW) + (3*500) =2100MW
2.	M/s Chhattisgarh State Electricity Board (CSEB), Hasdeo Thermal Power Station, Korba (West), Korba	4*210 =840 MW
3.	M/s Chhattisgarh State Electricity Board (CSEB), Korba Thermal Power Station, Korb a(East), Korba	(4*50=200MW) + (2*120 =240MW = 440MW
4.	M/s Chhattisgarh state Electricity Board (CSEB) Dr. Shyama Prasad Mukherjee Thermal Power Plant, Korba (East), Korba	2*250=550MW
5.	M/s Bharat Aluminium Co.Ltd, Balco Nagar, Korba	(Aluminium Smelter Plant (Alumina 330000TPA & hot Metal (Fabrication) – 370000 TPA

[80] S.Dhanesh & J.K. ashok, Study of Physico Chemical Parameters of Belgarinalla, Chhattisgarh, India, International Research Journal of Environmental Sciences, Vol 2(3), 41-45, March 2013.
[81] Final Technical Report of CEPI 2015 from IIT Kharagpur – Monitoring in Critically Polluted area (CPA), Korba of Chhattisgarh for Assessment of Comprehensive Environmnetal Pollution Index (CEPI).

6.	M/s Bharat Aluminium Co. Ltd, Balco Nagar, Korba (CPP-2)	4*135=540MW
7.	M/s Bharat Aluminium Co.Ltd. Balco Nagar Korba (CPP-1) Balco Captive Power Plant, Jamnipali, Korba	4*65.5=270MW
8.	M/s Gevra Open Cast Mines, SECL, Korba	35 MTPA
9.	M/s Dipka Open Cast Mines, SECL, Korba	25 MTPA
10.	M/s Kusmunda Open Cast Mines, SECL, Korba	10 MTPA
11.	M/s Lanco Amarkantak Power Private Limited, Village-Pathadi, Tehsil- Korba, Korba	2*300 = 600MW TPP

Table 9.2: Expansion units under construction, which have been granted environmental clearance before government of India notification dated 13/01/2010 (Situated within the Critical area)

S.No.	Name of the Industry	Capacity
1.	M/s NTPC Ltd. Korba Super Thermal Power Statiob, Jamnipali, Korba	500MW
2.	M/s Chhattisgarh State Electricity Board, Hasdeo Thermal Power Station, Korba (West), Korba	500MW
3.	M/s Bharat Aluminium Co. Ltd, Balco Nagar, Korba	4*300 = 1200 MW
4.	M/s Bharat Aluminium Co. Ltd, Balco Nagar, Korba	300 MW
5.	M/s Bharat Aluminium Co. Ltd, Balco Nagar, Korba	Aluminium smelter 5.5 LTPA
6.	M/s Lanco Amarkantak Power Private Limited, Village-Pathadi, Tehsil- Korba, Korba	660 MW + 660 MW TPP
7.	M/s Indo Sponge Power & Steel Private Limited, Rajgamar Road, Korba	Sponge Iron 100TPD
8.	M/s Himadri Chemicals industries, Jaghara, Korba	Liquid Coal tar Pitch 30000TPD
9.	SSI located in the industrial area Korba	All the SSI unit sare complying with the standards prescribed by the Board and regular monitoring is being carried out by Regional office, Korba.
	9.1 M/s Shiva industries	
	9.2 M/s Star Ferro Alloys	
	9.3 M/s R.R. Ferro Alloys	
	9.4 M/s Bhajanka Ferro Alloys	
	9.5 M/s Vinay Industries	
	9.6 M/s Jaiswal Oxides	

Currently the River Hasdeo is of Class B as per the IS 2296 i.e., water is fit for bathing purpose only.

Total waste water generated from the critically polluted area is approximately 2,00,000 KLPD. Fly ash from these industries find their way into the Dhengur Nalla, Jharia Nalla and the Belgari Nalla which travel about 7 Kms to finally join the River Hasdeo.

Excerpts From an Interview with Manish Rathod (Right To Information Activist based in Korba)-

1. The Dhengur Nalla and the Ahiran River carry nothing but fly ash and then mix with the Hasdeo River
2. Water Allocation to industries has increased which results in loss of water for the farmers. The farmers receive water via the canals.
3. The Hydroelectric power projects release water as part of their operations as a result of which the contaminants in the water get diluted otherwise they flow as a thick white fluid.
4. Industries prefer to lift water directly from the canal as the head is maintained and it is also cheaper to do so while lifting water from the dam is relatively expensive in terms of the pressure required and the setting up of pipelines.
5. The catchment area of the Hasdeo Bango Dam is 100 sq. Kms. The Darri reservoir was constructed only to ease the distribution of water. The Dhengur Nalla only carries the fly ash that is generated. When animals venture near these nalla's then the most often get trapped in them and thereby drown. The animals even consume the fly ash water which then enters the food chain and the harmful effects then get manifested in its milk. CSEB or Dr Shyama Prasad Mukherjee Plant is located just adjacent to the Darri Reservoir. Hot water is also released from the industries which take us water to use it as a coolant. This hot water that is released thus alters the aquatic ecosystem in the region.
6. The canals irrigate nearly 1.5 lakh acres of land but providing water to BALCO will mean that 10000 acres of land will remain deprived from water.
7. The entire Hasdeo River has been divided in terms of allocation by 2 projects. One is the Hasdeo Bango Project (U/S of the Darri Reservoir) and the other is the Hasdeo Nadi Project (D/S of the Darri Reservoir).
8. The Hasdeo Bango Project has a total carrying capacity of 3000 MCM of water in which 400 MCM has been allocated to industries and nearly 1000-1600 MCM has been reserved for agriculture. The allocation to industries cannot exceed more than 400 MCM. CSEB west extracts 26 MCM of water directly from the reservoir itself owing to its closeness to it.
9. The Hydel Power Projet runs for 7 to 8 hours every day as a result of which water is released in the river which washes away the fly ash that is collected. But after the month of October and November the Hydel Power Projects are not run so water is not released hence higher

concentration of fly ash in the river thereby greater risks to human and animal life all along the river and the various nalla's that carry the fly ash.

10. 2 new industries have come up but have not as yet begun operations. They are Dheeru Power Gen and Vandana Vidyut. Both these industries have been allocated water from the Hasdeo Nadi Project which means that they are supposed to set up the relevant infrastructure to extract water from D/s of the Darri reservoir. Vandana Vidyut prior to beginning of operations were supposed to construct an anicuts 10 Kms D/s of the Darri Reservoir and set up a pipeline 30 Kms long to pump the water up to its premises. This alone would have cost Rs. 150 – 200 crore alone. This venture was not only expensive but also did not assure the stipulated quantity of water. So to tide over this problem it began construction of a 5 km pipeline extracting water from U/s of the Darri Reservoir. The case is in the court as of now and all operations are at a standstill. If Vandana Vidyut is allowed to extract water from its new 5 Kms. pipeline then it will be a problem for NTPC Seepat which is located D/s. VV was asked to extract water from the D/s because of two reasons. One that the U/s portion had already reached its extraction limit and secondly it was supposed to take water from the D/s that further received it from the many small nalla's that joined the Hasdeo River D/s.
11. **The new plant of BALCO which is located U/s of the reservoir with a total water requirement of 28 MCM has been allotted 8 MCM from the Hasdeo Bango Project, 4 MCM from the Tan River and 16 MCM from the Hasdeo Nadi Project. But this 16 MCM is also being extracted from the Hasdeo Bango Project. So already the 400 MCM allocation has been exceeded by 16 MCM. Moreover once Vandana Vidyut begins extracting 26 MCM from U/s will lead to a shortage of 42 MCM D/s. This will have its implications D/s where 10000- 15000 acres will receive less water across 3-4 villages.**
12. The irrigated area starts 20Kms after the canal.
13. In Korba the area covered by the industries is much more than that covered by the city.
14. NTPC brings coal via a conveyor belt from a distance of 14-15 Kms.
15. People who are involved in River bed cultivation suffer from gastric, cancer, asthama and TB.
16. There are hills and reservoirs constructed for containing the fly ash that is generated. It covers an area of 8000-10000 acres in the city. Soil is put over the fly ash and then trees are planted. Settlement time has to be given for the fly ash to get separated from water but there is not sufficient land to allow it to settle and hence is directly discharged in the river. When this fly ssssash mixes with the sand then it deteriorates the quality of the sand and soil also.
17. Flood plain agriculture is usually done with polluted water. They use it to grow cucumber, watermelon and other allied vegetables.
18. Swastik Industries (appears blue on Google Maps) has not begun operations but is located just 20 m away from the Hasdeo River.

19. Only 5% of the fly ash is actually recycled by using it up in bricks and cement. When 1 Lakh tonnes of coal is burnt then 50000 tonnes of fly ash is generated.

RESEARCH METHODOLOGY

EMPIRICAL FIELD OF RESEARCH:

In order to study the impact of human interventions on the Hasdeo river and its associated catchment and command, the entire study are was divide into 4 zones. The zonation was done to encapsulate the different dependencies on the river ecosystem and track the manner in which this relationship has transitioned in the light of the developmental activities undertaken in the state after its formation.

Zone A: Mountainous-forested catchment in the forests of Surguja

Zone B: Urban and Industrial areas (Coal Mines + Thermal Power Plants)

Zone C: Just Upstream of the Minimata Bango Dam

Zone D: Downstream of the Minimata Bango Dam near the confluence of the Hasdeo and Ahiran River

DATA COLLECTION:

Type of Data- For this field work, a mix of primary and secondary data was used.

Source of Secondary Data: Research Papers, Newspaper articles, EIA documents, Web Portals.

METHODS OF DATA COLLECTION

In Depth Interviews- As part of information collection, in depth interviews were conducted. These interviews lasted for 30-40 minutes. Since the interview guide was semi structured, the respondents were encouraged to speak from their personal experience and expertise in their fields.

Focussed Group Discussions- FGD's were conducted with the prospective groups to gain deeper understanding of the impacts that dams and coal mines had on their lives and sources of livelihoods. From time to time the discussion did digress from the E Flows issue to very basic human struggles of survival in the region. The minimum number of participants available per FGD was 4.

EXPERIENCE IN THE FIELD:

This was indeed a unique opportunity to conduct research independently and because of the background reading done prior to the field work, it helped in gaining a nuanced understanding of the issues that concern the environment and the people. In the peak of summer, this region close to the tropic of cancer had almost all the natural barriers for the completion of the field work. The first base was Ambikapur form where we covered the first 3 zones. The travelling was done mainly with the help of public busses. But inside the jungle and near the backwaters of the Hasdeo Bango Dam , our

local guide and activist made arrangements to move. Nearly all the FGD's were arranged with the help of Jaynandan Ji. Amidst all its exoticness, there was a gloomy silence which indicated that things were not aligned. And indeed it was so. The construction of the dam, and the rampant exploitation of coal buried underneath the forests had wrecked havoc on the lives and livelihood of the people. These three zones clearly indicated the manner in which the catchment of the Hasdeo Sub Basin was being destroyed. The consequences of which were clearly visible in the form of pollution and disappearance of local nallas.

To cover the 4th Zone, we moved to Korba. Korba acclaimed as the power hub clearly showed the ways in which it was ravaging the Hasdeo River and its tributary Ahiran. The fly ash generated in the TPP's was being released into the river and had thereby accumulated in on the river beds and the flod plains.

The local people are fully aware of the adverse situation in which their rivers are and be it rural or urban, the people condemn the costs that development is causing. But at the same time, their decisions are also being juggled by the local leaders and administrators who themselves are caught up in the trap of the industrialists. The chain of interdependency was clearly visible and so were the little efforts on the part of the locals to save their rivers.

This field work could not cover the further d/s regions of Janjgir Champa which may impart a degree of skewness to the analysis. Due to time and resource constraints and the natural constraints of the human mind, a lot has also been missed out. But further research in the domain will answer the currently unanswered questions.

A lot of work still needs to be done in the direction of identifying all the tiny sources that add into the Hasdeo River for which a very comprehensive field survey of the basin need to be conducted. Moreover the difficulties in tracking the changes in the ecosystem are due to the lack of a base inventory of all the resources. The little work that has been done in this direction is all by independent researchers. A thorough follow up regime needs to be put in place to be constantly updated. Moreover close monitoring of water allocations and pollution levels is a key requirement to assess the E Flows requirement of the river. All this cannot be done without the local people who live and breathe the disguised development. Thus an amalgamation of the social and scientific is the most urgent requirement.

APPENDIX I: QUESTIONNAIRE

SOCIO ECONOMIC VARIABLES FOR THE E FLOWS ASSESSMENT

Zonation of the Hasdeo sub basin based on gradient change and diversity of dependence on the river.

Zone A- mountainous- forested catchment preferably where there is a tribal settlement and the forests are intact (near the Origin of the Hasdeo River)

Zone B – where there is urban and or industrial dependence (coal mines, Thermal Power Plants) on the river

Zone C – Upstream of Hasdeo Bango but where fishing / farming / irrigation dependence is high

Zone D – Below the Hasdeo Bango and at the confluence of Hasdeo with Ahiran.

FGD survey schedule

1. Village level (General Information to be gathered from the river stretch selected)

1. Name of the village and other demographic details and its location on the map. (close to which city and river)
2. Household size and average household income.
3. Main occupations of the inhabitants (rank based on maximum prevalence) – farming / fishing / cattle rearing / agricultural labour / industry or mines worker/other occupation.
4. How many of them depend directly on the river? Which River? For what all purposes?
5. Drinking water / Irrigation / flood plain farming / fishing / boating / bathing cattle / washing clothes/ bathing and swimming / recreation like angling / navigation on motor boats / any other (please specify)

2. Socio – Economic Dependence Assessment

2.1. Agriculture

1. Crops grown – Type of crops / season (time of the year)
2. Area (ha.) under each crop if possible
3. Number of farmers whose main livelihood is farming
4. Farmers – small/medium/large/commercial land holdings/ fruit cultivation/flowers/polyhouse/subsistence agriculture (SOURCE OF WATER + DEPENDENCE ON THE RIVER + WATERLOGGING + WHICH CROPS)
5. Dependability on chemical fertilizers or natural manures.

6. Dependence on river for irrigation – direct manual irrigation / Lift Irrigation / diesel pumps
7. Water used for irrigation from river (this may not be available directly – will have to be estimated from the amount of water that is lifted from the river using various devices)
8. Has there been increase in number of crops in a year since irrigation facilities – if so which all crops benefitted and extent of area increase over last 25 years?
9. Are the present flows / depth adequate for meeting the farming requirements during summer (February – May)/ monsoon (June – October) / winter (November – January) ?
10. Has there been a lowering of depth or decrease in flows over the years? If so how much and why in their opinion?
11. Do they perceive increasing water scarcity / shortage for irrigation over the years? If so since when and why?
12. What are the optimum flows / depth required during summer / monsoon / winter in the river to meet irrigation requirements in their opinion ?

2.2 Water for Domestic Consumption

1. What is the average household consumption?
2. What is the source of domestic / drinking water – river direct / river through pipe supply / wells / ponds / check dams across the river / nallah diverting water from river / any other ?
3. Is water fit enough for drinking or do they need to purify it.
4. Any alternative sources of getting water for drinking.
5. Degree of reliance on the main source and alternative source of water (x days/365 days OR x months/12 months)
6. Perceived water scarcity over the years – if so since when and why?
7. Perceived change in water quality over the years – if so since when and why?

2.3 Livestock

1. No and type of livestock owned – cows / buffaloes/ goat / poultry / any other
2. Dependence on river and flood plains for different activities related to livestock rearing – frequency and season
3. Any other dependence – preparing fuel dung?
4. Is the present depth / flows adequate for livestock bathing.

2.4 Flood Plain farming

1. Is flood plain farming prevalent? If so the season / area / location (name of the place)
2. The type of crops grown and average yield from each crop
3. Number of farmers / families involved in flood plain farming

4. Number of days flood plains remain submerged during monsoon (approx)
5. Perceived changes in flood plain area / submergence over years (increased or decreased) if so why and to what extent?
6. Perceived changes in fertility of flood plains over the years (this is to get information on nutrient and sediment transport by the river which it deposits along flood plains)

2. 5. Fisheries

1. Types of fishes – food and ornamental seen or known to the fishing communities
2. Number of families / persons engaged in fisheries
3. Caste and class dominance in the occupation of fishing.
4. Age group involved in fishing and gender roles.
5. From how long have they been fishing?
6. Types of fishing usually practiced –
7. Staple food – is it the fish caught or do they buy from outside?
8. River and stretch on which they do fishing.
9. Perception about high flows and low flows and fish availability corresponding to the same.
10. Average fish catch and market to which sold usually (how has the number transitioned?
11. Alternative source of income in the non-fishing season (agriculture/ handicrafts)
12. Any changes perceived in fish catch / fish species over the years? If so since when and why? (quantity and quality)
13. Bumper fishing in an earlier time?
14. Has lowering of water depth / flow reduction been perceived affecting the fish catch / fish species? If so how much and why and which all species affected ?
15. Migration due to non-availability of fish?
16. Water quality affecting fish catch / during which season / fish kills reports if any ?
17. Incidences of dead fish.
18. Which fish fetches good price in the market? (Current status of availability and its nutritional information)
19. Incidences of being stopped by fishing (any penalty or legal action or resistance)
20. What did they do about it in response?
21. Collect information about the fishing gear. How has it transitioned?
22. Do they have boats or not?
23. Initial investment on fishing gear / any recurrent expenses?
24. Indigenous method of fish catching, is it still practiced or they have changed?
25. Government interventions for their welfare.
26. Their perceptions about damming the river?
27. Do they derive any benefits from the project?

28. Try collecting information about the gauge, discharge, nallahs, their location, wetted perimeter, wildlife and plant species found in them.
29. Provision of basic amenities
30. Their interests in the river, being a stakeholder
31. Time dependency on the river- how many generations have depended on the river?

2.6. River Sand Mining

1. Is river sand mining prevalent at the site? If so since how many years
2. Number of families / persons engaged in river sand mining
3. The method by which sand is mined from river bed / flood plain and the ghats from where sand is loaded and transported
4. Average income from sand mining and the mode of sale
5. Has sand mining increased / decreased over years? If so extent and reason ?
6. Perceived changes in the river flows / depth affecting deposition of sand / sand mining

2.5. Small Scale Industries (SSI)

1. Number and Type of SSI units operating at the site – (give the list / since when started and type of raw materials used)
2. Their dependence on the river / nallahs / ponds / check dams/ river side wells for water and quantity of water used
3. The extent of pollution to the river caused by the SSI units if any and the polluting materials
4. Does the SSI unit perceive water scarcity / water quality reduction over the years if so how much?

2.6. Large Industries – Coal Mining, Thermal Power Plants

1. Number and details of large scale industries operating near the site and depending for water on the river? – Name / since when operational / type / area allotted / raw materials / product / production figures (per annum / per month)
2. Any forest diversion involved? If so how much and
3. Number of employees – from locality / from distant places and average income to the family from the industry
4. Water dependence by each industry – quantity per day / how water is drawn from river / distance from river to the industry / how water is transported from river / what it is used for in the production process

5. Pollution of river and nearby water bodies by the industry – Is any pollutant or effluent dumped or discharged into the river? If so type of pollutant / quantity of pollution per day / effluent treatment facilities / treatment ponds if any
6. Any CSR activity by the Industry towards river upkeep / social activities?
7. Number of new industries planned and their details – list / product / raw materials / capacity / employment/ water requirement / effluent treatment

2.7. Boating / Ferrying / Inland navigation

1. Is there ferry service / boating / inland navigation operation at the site selected ? Of so how many people are engaged / the number of people on average who depend upon the services per day or week / for what all purposes / income on daily or weekly basis
2. What is the optimum depth required for smooth operation of the ferry during summer / winter
3. Are they experiencing change in flows / depth of the river affecting the ferry / inland navigation services? If so how much and since when?
4. Has there been reduction in the ferrying / inland navigation over years. If so why and since when?
5. How much is the optimum flow/ depth in their opinion required for smooth ferrying / boating?
6. Any perceived reduction in income from ferrying / inland navigation? If so how much and why ?

2.8 Cultural / Religious dependence

1. Are there culturally / religiously important sites in the river site selected? if so, name / location/ which religion/ how old is the site / annual festival time or season
2. The type of dependence of the site on the river stretch
3. The depth / flows required for the religious / cultural purpose
4. Reduction in quantity and quality of flows / depth perceived
5. Optimum flows / depth required for the cultural / religious purpose

2.9 Medicinal Plants

1. Names and pictures of the different medicinal plants and the name and picture of the product made from them
2. The purpose of that medicinal plant.
3. Source (Water body/ forest)

4. Area in which it is found (Like if it is found in the forest then, where, at the fringe areas which implies easy collection, or deep inside which implies difficulty in collection)
5. Height at which it is found.
6. Availability has increased or decreased.

2.10 Natural Resources

1. Names of the raw materials people take from the forests and pictures
2. Method of processing
3. Final product – name and picture
4. Price it fetches in the market
5. Changes in availability across years.
6. Have they resorted to any alternate product .
7. The dam or any developmental activity like coal mining or TPP, has disrupted their use of natural resources in any way and if yes then from when.

What was there earlier in the land that was submerged? Which villages and approximately how many people lived there? Where have they been shifted? What was the occupation did they practice?

TRIBUTARIES – What is the condition now? Still perennial or not? Disappearance of certain fish due to low water level or overfishing by commercial fisheries

Details of commercial fisheries if they exist in the region – Try to meet them

Cross check names of all anicuts

Stake Holders – Farming Community, Forest dependent, fisher community, hunters, mining, quarrying, manufacturing small products, TPP, Water supply, Bee-keeping, Sand mining, construction, trade, transport and communication, public administration.

APPENDIX II: RESPONDENTS AND KEY CONTACTS

S. No.	Name and Designation	E- Mail	Contact Number
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4.	Sandeep, Activist	sampatel04@gmail.com	08109046007
5.	Jaynandan, Activist	-	09713677886
6.	Lakshmi Chauhan, Environmental activist	-	09893189955
7.	Manish Rathod, Environmental Activist	-	-
8.	Sameer Lakra	-	09693561768 08969188142
9.	Salman Ravi, BBC	-	09873603590
10.	Satya Prakash	-	-
11.	Santosh Patel	-	08103506415
12.	Raj Kumar Srinivas	-	09617541640