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STRATEGIES TO REDUCE ADVERSE IMPACTS OF AGRICULTURAL ACTIVITIES ON RIVER NARMADA: A CASE STUDY OF HOSHANGABAD CACHMENT

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By

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Declaration

I **Ronit Kumar Gautam,** Scholar No. **2014BPLN037** hereby declare that the thesis titled **Strategies To Reduce Adverse Impacts Of Agricultural Activities On River Narmada: A Case Study Of Hoshangabad Catchment** submitted by me in partial fulfilment for the award of the degree of **Bachelor of Planning**, at School of Planning and Architecture, Bhopal, India, is a record of bonafide work carried out by me. The matter/result embodied in this thesis has not been submitted to any other University or Institute for the award of any degree or diploma.

Signature of the Student

Date: _____

Certificate

This is to certify that the declaration of **Ronit Kumar Gautam** is true to the best of my knowledge and that the student has worked under my guidance in preparing this thesis.

RECOMMENDED

_____

Signature of the Guide

Prof. Bade Shomit Dilip

ACCEPTED

_____

Dr. Nikhil Ranjan Mandal

Head, Department of Planning

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Ronit Kumar Gautam

Thesis Abstract

Water one of the five fundamental components through which everything has been made is essential for presence and survival of people and different type of life on earth. Waterways are one of the suppliers of surface water. Spots, where streams existed man-made lakes and lakes are developed and numerous urban areas were set up. The stream assumes an extraordinary part in giving different administrations and things including different normal assets, transportation, vitality, dispersion of waste, entertainment and so on.

Worry over farming diffuse contamination sources in incorporated water quality administration has been developing as of late. Various uncommon highlights of the Indian scene should be considered. These include: (I) to a great degree changing precipitation and stream-stream designs; (ii) still generally customary agrarian practices with normal utilization of manures and pesticides and critical regions under dry cultivating or just peripheral water system; (iii) a huge dairy cattle populace, with horticulture quite often connected with creature farming; (iv) a culture of living near the waterway (if not in the waterway) with ruling instream employments of showering, washing, steers swimming, squander transfer, and so on and huge scale floodplain cultivating; and (v) sparse regard for principles, controls and laws close by a to a great degree frail law-authorization apparatus.

The study demonstrates that in the non-storm (non-surge) periods, which may represent everything except 2 months of a year, farming diffuse contamination sources appear to have no effect on stream water quality. Amid these periods streams are low to negligible and contamination is commanded by the in-stream utilizes, sullage waters of provincial groups and point releases from urban/mechanical sources, assuming any. Contamination because of agrarian return waters, either as wash-off or as drainage, has all the earmarks of being uncommon amid the 8– 10 reasonable climate months.

Utilization of compound composts and pesticides (or some other rural synthetic substances) in India is still low contrasted with created nations, and keeping in mind that eutrophication because of large amounts of washed-off supplements is seen in provincial lakes and other dormant waterways getting farming seepage, and over the top pesticide residuals are frequently announced for vegetables, grub,

drain, and so on., observing of streams and streams does not demonstrate any huge contamination because of supplements or pesticides from horticultural diffuse contamination amid reasonable climate months. High nitrate fixations have been accounted for in groundwater and in numerous regions, for example, Punjab and Haryana, these can regularly be connected specifically to diffuse farming sources. The real issue of horticultural diffuse contamination gives off an impression of being the substantial sediment loads, alongside expansive amounts of broke up salts, supplements, organics and even overwhelming metals and bacterial contaminants washed off amid surges. The sediment tends to stop up the stream channel to additionally empower regular floodplain horticulture. This outcomes in an endless loop, which debases the channel, builds surge harm and is unfortunate from environmental and maintainability perspectives. For the investigation the information has been gathered in regards to the horticulture and editing design through farming emergency course of action and evaluation and different examinations in light of the agrarian exercises and impacts of it over River Narmada in Hoshangabad Catchment. Essential overview with respect to the agriculturists and the products and sort of trimming and manure and pesticides they utilize by and large in the field has been done through a gathering dialog. For looking at the level of contamination in Narmada reports of CPCB has been considered, contrasting 3 years of informational index demonstrates an obvious change in the level of contamination.

Cultivating activities can add to supplement contamination when not legitimately oversaw. Composts and creature fertilizer, which are both rich in nitrogen and phosphorus, are the essential wellsprings of supplement contamination from horticultural sources. Overabundance supplements can affect water quality when it downpours or when water and soil containing nitrogen and phosphorus wash into close-by waters or drain into ground waters. With time, few stages have been taken up to re-establish waterway banks or to counter these effects however disgraceful comprehension about stream and its environment comes about are not sufficiently productive, there are legitimate arrangements in regards to water, water body and its different parts yet all-encompassing methodology towards rebuilding and preservation of stream Ghats.

सारांश

पांच मौलिक घटकों में से एक पानी जिसके माध्यम से सबकुछ बनाया गया है, वह लोगों के अस्तित्व और अस्तित्व और पृथ्वी पर विभिन्न प्रकार के जीवन के लिए आवश्यक है। जलमार्ग सतही जल के आपूर्तिकर्ताओं में से एक हैं। स्पॉट, जहां मानव निर्मित झीलों और झीलों के प्रवाह मौजूद थे और कई शहरी क्षेत्रों की स्थापना की गई थी। धारा विभिन्न प्रशासन और विभिन्न सामान्य संपत्तियों, परिवहन, जीवन शक्ति, अपशिष्ट फैलाव, मनोरंजन आदि सहित विभिन्न प्रशासन और चीजों को देने में असाधारण भूमिका निभाती है। खेती में चिंता से संबंधित जल गुणवत्ता प्रशासन में प्रदूषित प्रदूषण स्रोत देर से विकास कर रहे हैं। भारतीय दृश्य की विभिन्न असामान्य हाइलाइटों पर विचार किया जाना चाहिए। इनमें शामिल हैं: (i) एक महान डिग्री बदलती वर्षा और स्ट्रीम-स्ट्रीम डिज़ाइन; (ii) अभी भी आम तौर पर खाद खेती या केवल परिधीय जल प्रणाली के तहत खाद और कीटनाशकों के सामान्य उपयोग और महत्वपूर्ण क्षेत्रों के साथ पारंपरिक कृषि प्रथाओं; (iii) एक विशाल डेयरी मवेशी जनसंख्या, बागवानी के साथ अक्सर प्राणी खेती से जुड़ा हुआ है; (iv) पानी के नजदीक रहने की संस्कृति (अगर पानी में नहीं है) शावर के प्रवाह के साथ शावर, धोने, तैरने की तैराकी, हस्तांतरण में कमी, और इतने बड़े पैमाने पर बाढ़ के मैदान के खेती के साथ; और (v) एक महान डिग्री कमजोर कानून-प्राधिकरण उपकरण के लिए सिद्धांतों, नियंत्रणों और कानूनों के करीब स्पैस सम्मान।

अध्ययन से पता चलता है कि गैर-तूफान (गैर-उछाल) अवधि में, जो वर्ष के 2 महीने को छोड़कर सबकुछ का प्रतिनिधित्व कर सकता है, कृषि फैलाने वाले प्रदूषण स्रोतों का प्रवाह जल गुणवत्ता पर कोई प्रभाव नहीं पड़ता है। इन अवधि के दौरान धाराएं नगण्य तक कम होती हैं और प्रदूषण का उपयोग इन-स्ट्रीम द्वारा किया जाता है, प्रांतीय समूहों के सुस्त जल और शहरी / यांत्रिक स्रोतों से बिंदु रिलीज, किसी भी मानते हैं। कृषि वापसी के पानी के कारण प्रदूषण, या तो धोने या जल निकासी के रूप में, 8 -10 उचित जलवायु महीनों के बीच असामान्य होने के सभी नियम हैं।

भारत में यौगिक खाद और कीटनाशक (या कुछ अन्य ग्रामीण सिंथेटिक पदार्थ) का उपयोग अभी भी बनाए गए राष्ट्रों से कम है, और यह ध्यान में रखते हुए कि प्रसंस्करण झीलों और अन्य निष्क्रिय जलमार्गों में खेती करने के लिए बड़ी मात्रा में धोए गए खुराक की खुराक की वजह से यूट्रोफिकेशन देखा जाता है। सीपेज, और शीर्ष कीटनाशक अवशेषों पर अक्सर सब्जियों, ग्रब, नाली, आदि के लिए घोषित किया जाता है।, धाराओं और धाराओं का निरीक्षण उचित जलवायु महीनों के बीच बागवानी फैलाने वाले प्रदूषण से पूरक या कीटनाशकों की वजह से किसी भी बड़े प्रदूषण का प्रदर्शन

नहीं करता है। भूजल और कई क्षेत्रों में उच्च नाइट्रेट फिक्सेशंस के लिए जिम्मेदार ठहराया गया है, उदाहरण के लिए, पंजाब और हरियाणा, इन्हें नियमित रूप से फैलाने वाले कृषि स्रोतों से अलग किया जा सकता है। बागवानी फैलाने वाले प्रदूषण का वास्तविक मुद्दा पर्याप्त तलछट भार होने का एक प्रभाव देता है, जिसमें टूटने वाले नमक, पूरक, ऑर्गेनिक्स और यहां तक कि जबरदस्त धातुओं और जीवाणु दूषित पदार्थों की विस्तृत मात्रा के साथ सर्ज के बीच धोया जाता है। तलछट नियमित रूप से नियमित रूप से बाढ़ के बागवानी को सशक्त बनाने के लिए स्ट्रीम चैनल को रोकता है। अंतहीन पाश में यह परिणाम, जो चैनल को खराब करता है, वृद्धि हानि बनाता है और पर्यावरण और रखरखाव दृष्टिकोण से दुर्भाग्यपूर्ण है। जांच के लिए होशंगाबाद कैचमेंट में नर्मदा नदी पर कृषि अभ्यास और इसके प्रभावों के प्रकाश में कार्रवाई और मूल्यांकन के कृषि आपातकालीन पाठ्यक्रम और विभिन्न परीक्षाओं के माध्यम से बागवानी और संपादन डिजाइन के संबंध में सूचना एकत्र की गई है। कृषिविदों और उत्पादों के संबंध में आवश्यक अवलोकन और क्षेत्र में बड़े पैमाने पर उपयोग करने वाले ट्रिमिंग और खाद और कीटनाशकों की तरह एक सभा संवाद के माध्यम से किया गया है। सीपीसीबी की नर्मदा रिपोर्टों में प्रदूषण के स्तर को देखने के लिए, 3 साल की सूचनात्मक सूचकांक के विपरीत प्रदूषण के स्तर में एक स्पष्ट परिवर्तन दर्शाता है।

जब संचित रूप से निरीक्षण नहीं किया जाता है तो खेती की गतिविधियां पूरक संदूषण में जोड़ सकती हैं। खाद और जीव उर्वरक, जो दोनों नाइट्रोजन और फास्फोरस में समृद्ध हैं, बागवानी स्रोतों से पूरक प्रदूषण के आवश्यक कुएं हैं। ओवरबंडेंस सप्लीमेंट्स पानी की गुणवत्ता को प्रभावित कर सकती हैं जब यह कम हो जाती है या जब नाइट्रोजन और फॉस्फरस युक्त पानी और मिट्टी पानी के नजदीक पानी में या पानी में निकलती है। समय के साथ, जलमार्ग बैंकों को फिर से स्थापित करने या इन प्रभावों का सामना करने के लिए कुछ चरणों को उठाया गया है, हालांकि धारा और उसके पर्यावरण के बारे में अपमानजनक समझ पर्याप्त रूप से उत्पादक नहीं है, पानी, जल निकाय और इसके विभिन्न हिस्सों के संबंध में वैध व्यवस्थाएं हैं फिर भी घाटों के पुनर्निर्माण और संरक्षण की दिशा में सभी समावेशी पद्धतियां।

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Structure

The structure of the entire report has been debriefed here. This gives an idea of what the reader will find inside the report and in which chapter one should look into for the same.

CHAPTER 1: INTRODUCTION

In this chapter, the topic of the study is introduced by touching upon different dimensions of the aforesaid research topic. On the basis of the relevance, the background of the study has been mentioned. It also includes the research methodology required to fulfil the aim and objectives of the study. Also, it tells about the scope of the study as well the limitations.

CHAPTER 2: LITERATURE REVIEW

This chapter mentions about the relevant literature through which the base for the study is established. It defines various concepts, definitions, techniques and contexts for understanding the research. A case study of the Scott River, California, United States have also been mentioned to give an insight of what the nature of the study is.

Apart from this, the site and the criteria for selecting the study area have been mentioned.

CHAPTER 3: SITE SELECTION DETAILS

In this chapter the details of the site and location has been discussed in detail with the help of maps and literature review. The affected sites and the parameters on basis of site has been taken and the particular location to work upon has been discussed.

CHAPTER 4: DATA ANALYSIS AND FINDINGS

Here, the data collection methodology and techniques to analyse the survey results have been talked about. This chapter also defines the parameters which have been used to carry forward the survey. Furthermore, the findings of the study have been highlighted for easier understanding.

CHAPTER 5: RECOMMENDATION AND BENEFITS

The chapter deals with recommendations for improving the River water quality in Hoshangabad Catchment by considering strategies specifically for agriculture pollution and to reduce its adverse effects as well as defining benefits for those recommendation which have been implemented.

CHAPTER 1. INTRODUCTION

Water contamination happens when undesirable materials enter in to water, changes the nature of water and unsafe to condition and human wellbeing. Water is a vital characteristic asset utilized for drinking and other formative purposes in our lives. Safe drinking water is fundamental for human wellbeing everywhere throughout the world. Being a general dissolvable, water is a noteworthy wellspring of contamination. As indicated by world wellbeing association (WHO) 80% sicknesses are water borne. Severing water different nations does not meet WHO gauges. 3.1% passing happen due to the unhygienic and low quality of water.

Water pollution is a serious problem in India as almost 70 per cent of its surface water resources and a growing percentage of its groundwater reserves are contaminated by biological, toxic, organic, and inorganic pollutants (IDFC, 2011). For the monitoring and evaluation of 18 Indian rivers, some of the stretches have been identified by CPCB. These stretches are observed in and around the large urban areas where the water quality is severe due to industrial effluents, domestic pollutants and agricultural residues where all such are discharged untreatably. In Class I and II towns, the amount of untreated sewerage has been doubled from the year 1991 to 2008 i.e., 12,000 MLD to 24,000 MLD.

Agricultural residues affect the surface water as they contain the ingredients from fertilizers and pesticides which have the indirect impact on the surface water bodies. In the agricultural sector, fertilizer use increased from 7.7 MT in 1984 to 13.4 MT in 1996 and pesticide use increased from 24 MT in 1971 to 85 MT in 1995 (G. S. BHALLA).

The poor quality of water bodies not only affect the environment but also human health. This is leading to increasing burden of vector borne diseases, cholera, dysentery, jaundice and diarrhoea etc. Water pollution is found to be a major cause for poor nutritional standards and development in children also (Dey, 2015). The health problem associated with unclean water enormous of the 3.4 million people killed each year by water-related diseases, 2.1 million mostly children are die from diarrhoea disease stemming from lack of access to safe water, inadequate sanitation and poor hygiene (WHO Health Creating Healthy Cities in the 21st

century, 1999). According to the World Health Organization (WHO), long-term regular exposure to pesticides causes approximately 772,000 new cases of diseases every year. (Kuruganti, 2005)

Release of residential and modern emanating squanders, spillage from water tanks, marine dumping, and radioactive waste and environmental testimony are significant reasons for water contamination. Substantial metals that discarded and mechanical waste can collect in lakes and waterway, demonstrating hurtful to people and creatures. Poisons in mechanical waste are the significant reason for insusceptible concealment, conceptive disappointment and intense harming. Irresistible ailments, similar to cholera, typhoid fever and different maladies gastroenteritis, looseness of the bowels, heaving, and skin and kidney issue are spreading through dirtied water. Human wellbeing is influenced by the immediate harm of plants and creature nourishment. Water toxins are murdering ocean weeds, molluscs, marine winged animals, fishes, shellfish and other ocean creatures that fill in as nourishment for human. Bug sprays like DDT focus is expanding along the natural pecking order. These bug sprays are hurtful for people.

1.1 Background

Water is the most indispensable component among the common assets, and is basic for the survival of every single living being including human, supports liveability for organisms, and financial advancement. Today there are numerous urban communities overall confronting an intense lack of water and almost 40 percent of the world's sustenance supply is developed under water system and a wide assortment of mechanical procedures relies upon water. Nature, financial development, and improvements are on the whole exceedingly impacted by water-its local and regular accessibility, and the nature of surface and groundwater. The nature of water is influenced by human exercises and is declining because of the ascent of urbanization, populace development, mechanical creation, environmental change and different elements. The subsequent water contamination is a genuine risk to the prosperity of both the Earth and its populace.

The issue of water quality crumbling is primarily because of human exercises, for example, transfer of dead bodies, release of mechanical and sewage squanders and farming spill over, which are significant reason for biological harm and stance genuine wellbeing perils. The level of contamination is for the most part surveyed by concentrate physical and concoction attributes of the water bodies.

India is among the top ten nations having water rich resources with 4% of world's freshwater. It has various rivers and streams which are perennial and non-perennial such as Ganga, Brahmaputra, Tapti, Mahanadi, Narmada, Yamuna, Krishna, Godavari etc. The Ganges-Brahmaputra and the Indus systems are the largest as they drain almost half of the country carrying more than 40% of the utilisable surface water from the Himalayan watershed to the ocean and over 70% of India's rivers drain into the Bay of Bengal, mostly as part of the Ganges-Brahmaputra system (DAS, 2009). The State of Madhya Pradesh is rich in water resources having rivers as Narmada, Mahi, Tapi with the tributaries of Ganga Basin as it is centrally located within the nation.

Table 1: Major River Basins in Madhya Pradesh

S.No	**River Basin**	**Key Rivers (Length within the state in Km)**	**Catchment in the State (sq. Km)**	**Key Tributaries**
1.	Ganga	Sone (500 Km)	478.49	Mahanadi, Katni, Kawal,Johila, gopad, Bana, Kanhar, Rehar
2.		Tamas (Tons) (238 KM)	11974	Simarbarh, Satna, Bihar, Belan, Sonekar
3.	Yamuna	Chambal (965 Km)	59940	Kalisindh, parvati, Kshipra, Khan, Kuno, Seop
4.		Sindh (450 Km)	26699	Kunwari, Mahaur, Pahuj

5.		Betwa (216 Km)	19635	Kaliasot, Halali, Baah, Bina, Dhasan, Jamni
6.		Ken (360 Km)	24785	Sonar, Bewar, Bearma, Barve, Patne, Urrmil, Semeri
7.		Baghain	-	-
8.		Paisuni	-	Jamsar, Rajnak
9.	Narmada	Narmada (1077 Km)	85930	Tawa, Barna, Dudhi, Shakkar, Hathani, Tenduni, Hiran
10.	Tapti	Tapti (332 Km)	9800	Ambharo, Mona, Puna, Kanair, Kanha, Sukta
11.	Godavari	Wainganga (272 Km)	-	Pench, kanhan, Bagh
		Wardha (58 Km)	-	-
12.	Mahi	Mahi (183 Km)	-	Anas, Khairya, Bageri, Jammar

Source: State of India's Rivers for India River Week, 2016

CPCB monitored 41rivers at 96 locations in 2015. Among the 91 locations, 55 locations did not met the water quality standards. These are specified as below:

Table 2: Details of Polluted River stretches in the State

S.No.	**Basin**	**River**	**Stretch**	**Towns**	**Length (in Km)**
1.	Narmada	Banjar	Malanjkhad-Tingipur	Malanjkhad,Tingipur	15

		Denwa	Dhupgarh-Sarni	Dhupgarh,Sarni, Banipura	50
		Gour	Jabalpur-Saliwada	Jabalpur	15
		Narmada	Mandala-Bhedaghat, Sethani ghat-Nemawar	Mandala, Jabalpur, Hoshangabad, Nemawar	160
2.	Yamuna	Betwa	Mandidweep-Vidisha	Mandidweep,Vidisha , Bhopal, Raisen	70
		Chambal	Nagda-Rampura	Nagda, Rampura	150
3.	Ganga	Tons	Chakghat-Chappar	Gargata, Chakghat, Chapar	5
4.	Chambal	Chillar	Shajapur-Muradpura	Shajapur, Dansipura, Muradpura	10
		Parvati	Batawada-Pilukhedi	Batawada,Pilukhedi, Narsinghgarh	160
		Shivna	Mandsaur-Malaykedi	Mandsaur	8
		Kshipra	Siddhawaght-Trivenisangam	Ujjain	8
5.	Tons	Bichia	Silpari-Gadhawa	Rewa	5
6.	Sindh	Gohad	Gohad dam-Gormi	Gohad, Gormi	25

7.	Mahi	Jammer	Dholowad-Raoti	Raoti	5
8.	Betwa	Kaliasot	Mandidweep-Samardha Village	Bhopal, Mandidweep	12
9.	Kshipra	Khan	Kabit Khedi - Khajrana	Indore	8
10.	Godavari	Waingang a	Chindwara-Balaghat	Chindwara, Balaghat, Seoni	150
12.	Tapi	Tapi	Nepanagar-Burhanpur	Nepanagar, Burhanpur	25
13.		Kolar	Surajnagar-Shirdipuram	Indore	8
14.		Malei	Jaora-Barauda	Jaora	10
15.		Kunda	Khargone-Khedikhurd	Khargone	15

Source: River Stretches for Restoration of Water Quality, CPCB, 2015

River Narmada is one of the 13 prominent rivers of India, which covers 98,797 sq km of total water-shed area (Sharma Shraddha, 2011). The river is said to be lifeline of the state which origins from Amarkantak. Narmada bowl comprehensively covers 25 regions of Madhya Pradesh, 6 areas of Gujrat, 3 regions of Chhattisgarh and 2 locale of Maharashtra. It is the biggest west streaming waterway in India. It is one of the main three noteworthy waterways that streams east to west in India (other two being Tapti and Mahi). It is considered as the limit between northern India and Southern India. It is the main stream in India which moves through a break valley between Vindhya Range in north and Satpura go in south (Tapti and Damodar additionally move through fracture valleys in their course however for a short separation). According to a fanciful legend, waterway Ganga comes once a

year to Narmada to wash down itself, subsequent to being contaminated by individuals.

Narmada is one of the seven Holy Rivers of India. It is trusted that a plunge in any of these seven stream washes one's transgressions away. Consistently enthusiasts Parikarama, a 2600km Yatra or journey from the wellspring of the Narmada to its mouth at the sea and back once more.

The Narmada River is a noteworthy wellspring of drinking water, water system and hydroelectricity for Madhya Pradesh and Gujrat. In areas like Hoshangabad, Raisen, Sagar, Dhar, Sehore and so on. Wheat development is more famous. In Hoshangabad, late alluvium with differed thickness can be seen. This dirt is to a great degree fruitful and bolster Cotton, Jawar and Wheat. There are 21 noteworthy and 23 medium water system extends in the bowl and Tawa water system venture is one of the significant water system ventures exhibit in Hoshangabad.

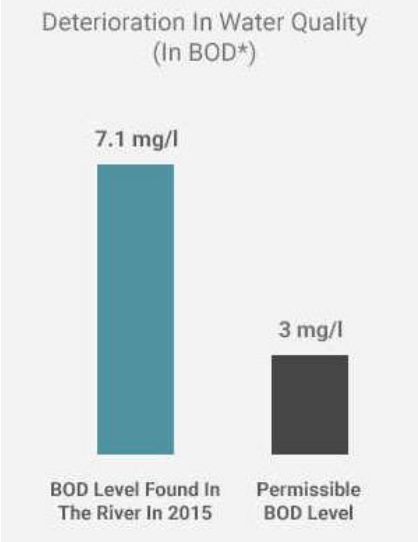

Figure 1: BOD Level in Narmada as by CPCB

With the increase in rapid urbanization and industrialization, the water quality of Narmada has been depleted and it is not abstained like other rivers of India. As by the Bureau of Indian Standards, the water quality of river is falling in the Category ‘C’. It has been observed that the city of Hoshangabad is majorly accountable of its poor quality being the largest city situated on the side of Narmada. The city has several Ghats and Paper mills. The untreated domestic sewage is disposed of in the river along with industrial effluents, religious materials and agricultural run-off.

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1.2 River Pollution and its impact on the human health

There is no indication of stream contamination being halted. It is expanding step by step. There are a few wellsprings of water contamination, which cooperate to diminish general waterway water quality. Ventures release their fluid waste items into streams. Our farming practice that utilizations concoction composts and

pesticides additionally add to stream contamination as water depletes these chemicals into the waterways. Residential squanders that we toss into streams adds to contamination levels. As populace develops, the measure of towns and urban areas additionally develops. With that the measure of local squanders that we toss into stream increments. In the greater part of the towns and urban communities, the civil channels convey our losses to waterways. (Mukesh Katakwar, 2016)

1.3 Aim

To reduce adverse impact of agricultural activities on River Narmada in Hoshangabad catchment.

1.4 Objective

- To identify the various agricultural activities practices in Hoshangabad district.
- Assessing the impacts of identified activities and practices on water quality in study area.
- Suggesting strategies to reduce the effects of identified activities and practices

1.5 Scope

Objective 1: To identify the various Agricultural practices.

- Determining specific area and activities which are polluting most Delineation of the most affected areas within Hoshangabad city.

Objective 2: Assessing the impacts of identified activities and practices on water quality in study area.

- Data available from Central Pollution Control Board (CPCB) Narmada valley development authority MPPCB and primary survey (Interview with the local and visual survey) Analysis and assessing the identified agricultural activities which area most polluting on the basis of secondary data.

Objective 3: Suggesting strategies to reduce the effects of identified activities and practices.

- Suggesting proposals for reducing the effects of identified activities in the Hoshangabad Catchment.

1.6 Limitations

- The study is limited to only parameters of agriculture activities occurring in the Hoshangabad catchment.

1.7 Expected outcome

The outcome of this study is to suggest strategies for spatial and religious activity

1.8 Methodology

The methodology developed for conducting this thesis is shown in figure.1. Design of methodology is done on the basis of objectives to be achieved. Different steps are interlinked with each other for proper understanding of flow in the research. Firstly area identification according to needs and components, indictor is selected to start field work. Data collected are primary and secondary. Assessment is done in two phase first is rapid assessment and second is detailed assessment in rapid, detailed land cover map is created.

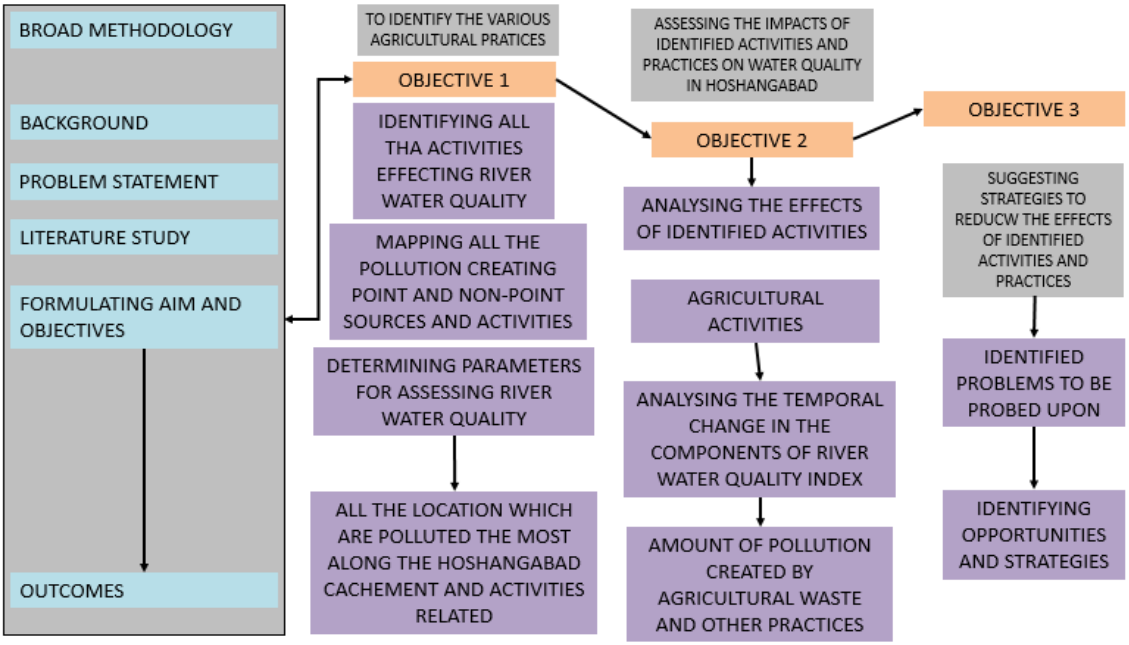

Figure 2. Methodology

CHAPTER 2. Site Selection

The Site selection comprises of opting the district with respect to the river and its micro watershed.

2.1.1 Narmada River

Narmada River flows from Amarkantak to Arabian Sea, covering a distance of about 1397kms. On the way it passes through hilly tracks, dense forests, plains and finally disappears when it reaches Arabian Sea. The Narmada, also called the Rewa, it is in central India and the fifth longest river.

River Narmada is one of the 13 prominent rivers of India. Narmada is considered to be the lifeline and west flowing river of the state of Madhya Pradesh. Narmada basin extends over states of Madhya Pradesh, Gujarat, Maharashtra and Chhattisgarh having an area of 98,797 Sq.km which is nearly 3% of the total geographical area of the country with maximum length and width of 923 & 161 km.

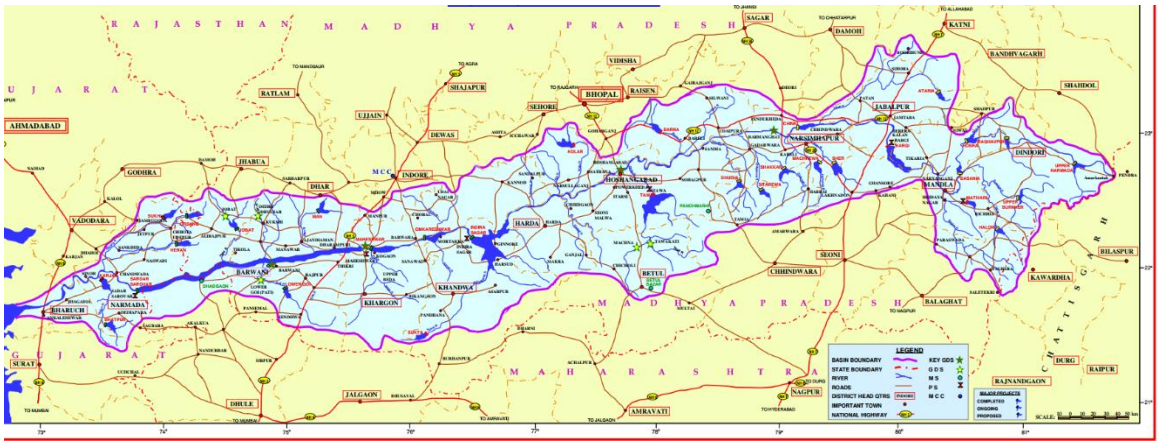

Figure 3: Basin map of Narmada

Narmada River has a religious importance as it is one of the five holiest rivers in India and the other four are the Ganges, Godavari, Yamuna, and Kaveri. It is assumed that a dip in any of these rivers will help you get rid of your wrongdoings. In mythology, it is stated that the Narmada is older than the Ganga. The Mahabharat, the Ramayana, and the Puranas mention about the Narmada quite often. Considering the holy importance of river and to grasp the energy level along with spiritual level, many people use to do Narmada Parikrama/Parikarma.

The River has been chosen as it has the highest catchment of 85930 sq. km as compared to other rivers within the state as by State of India's Rivers for India River Week, 2016 (already stated in 'Table : Major River Basins in Madhya Pradesh' of Background)

2.1.2 Hoshangabad District

Hoshangabad district has predominantly an agricultural based economy (Ministry of Water Resources, 2013) with 3150 sq. km under cultivable land. It is arranged in the eastern piece of Madhya Pradesh. Before 1998-99 District Harda was a piece of Hoshangabad District. After the division of the region, the present territory of 6704 Sq. Km. It is encompassed by Sehore and Raisen areas in the North, Narsinghpur district in the east, Chhindwara region in the south west, Betul region in the south and Harda region in the west. Hoshangabad area lies between north scopes 22º 15' and 23º 00' and east longitudes 77º 15' and 78º 42' in part of study of India toposheet Nos, 55F and 55J. Hoshangabad is the area headquarter and Itarsi, Sohagpur, Piparia, Pachmarhi and Bankheri are a portion of the real towns.

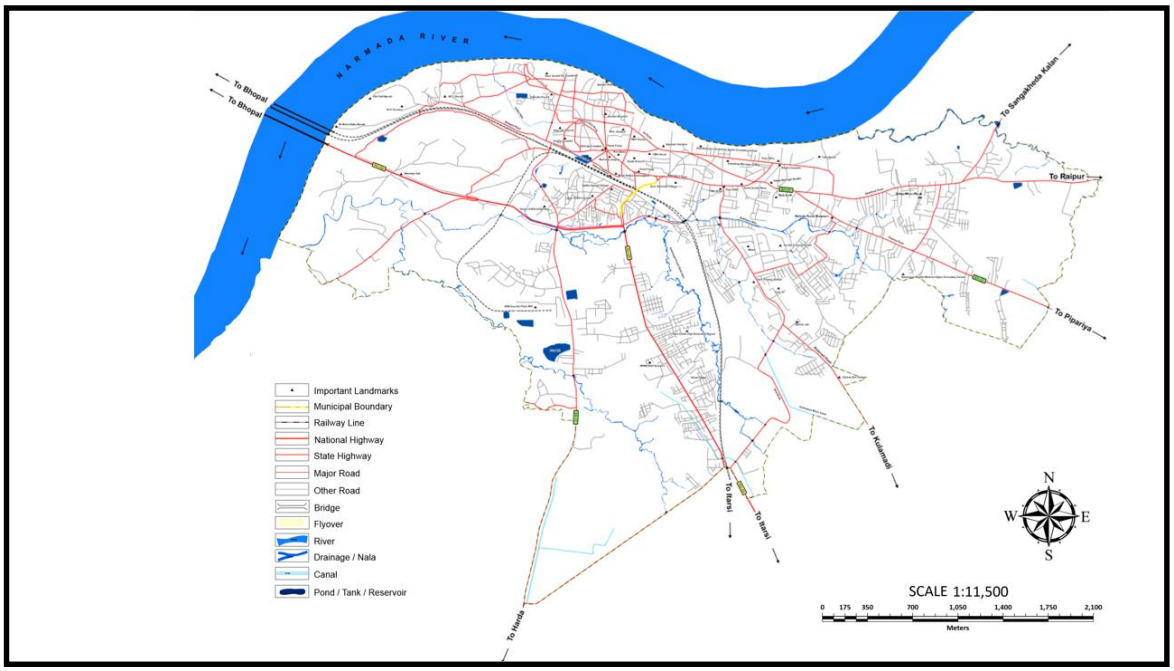

Figure 4: Base Map, Nagar Palika Parishad, Hoshangabad District - Hoshangabad (M.P.)

Itarsi is an essential railroad Junction lying on Delhi-Chennai, Delhi-Bangalore and Patna Mumbai rail route courses. National Highway No. 69 and State Highway No.

21 and 22 go through the region. The towns in the area are receptive by reasonable climate motorable tract.

The district is divided into eight Tehsils namely Babai, Bankhedi, Hoshangabad, Itarsi, Piparia, Seonimalwa, Sohagpur and Dolaria and seven development Blocks, namely Bankhedi Block, Pipariya Block, Sohagpur Block, Babai Block, Hoshangabad Block, Kesla Block (Itarsi Tehsil) and Seoni Malwa Block. (Fig-1). The total population of the district is 1,240,975 as per Census 2011.

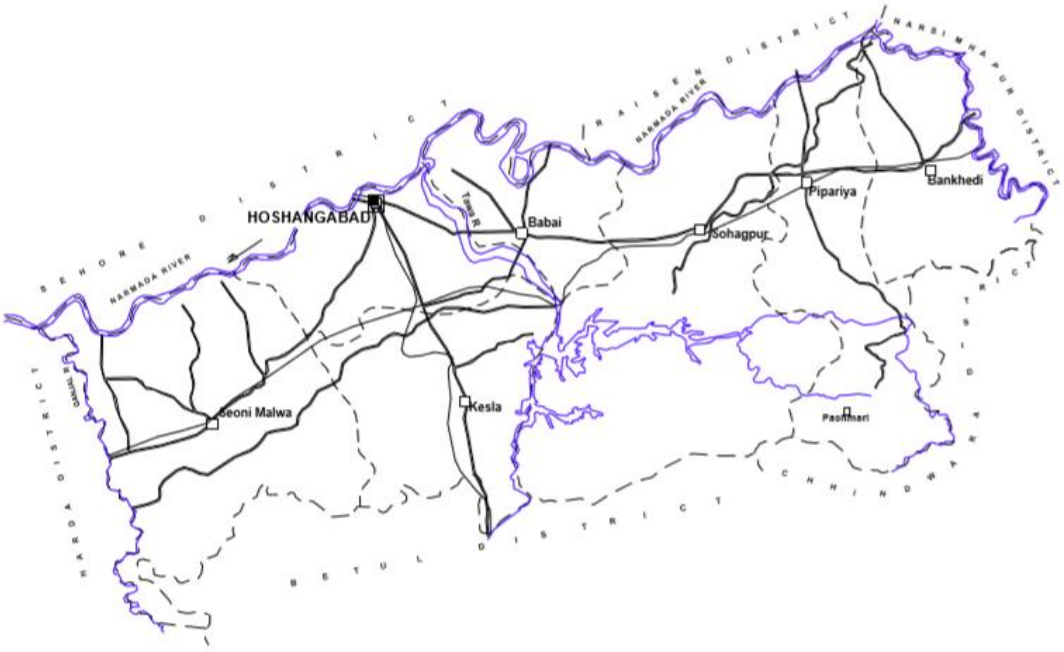

Figure 5: Narmada River map in Hoshangabad

2.1.2.1 Drainage Pattern

The entire district is drained by Narmada River and its tributaries. Thus the area falls in the Narmada Basin. The river Narmada flows along the northern boundary of the district. The river Narmada originates from the Amarkantak plateau and after flowing through Hoshangabad, Mandla, and Jabalpur from the north-eastern part. The Tawa River is the major tributary of the Narmada River and flows from south to North West before merging into the Narmada River. Denwa River originates from south-eastern part of the Hoshangabad district and flows district and flows from east to west direction before joining the Tawa River (south of Rainpur) where Tawa dam has been constructed.

The essential nalas are Keolari, Hather and Indra Nadi. The waterways depleting the zone in the western part are Morand, Banjal and Ajnal. The Morand River joins the Ganjal River close Chhidgaon and streams towards Narmada River.

2.1.2.2 Irrigation

Tawa dam is a major source of water for irrigation system in the district. About 60% of the total area of Hoshangabad district is irrigated by Tawa canal system (Ministry of Water Resources, 2013). The Tawa dam has been constructed about 823 m down stream of Tawa and Denwa rivers.

Table 3: Irrigation by different sources

S.No.	Source	Hoshangabad District Total	
		Number	Area (in sq. km)
1.	Canal	6	1474
2.	Tube wells	4853	523
3.	Dug wells	23495	535
4.	Tanks	9	11
5.	Other sources	-	163
6.	Net area irrigated	-	2703

Source: District Ground Water Information Booklet, Hoshangabad District

The Tawa dam is built around 823 m. downstream of the conversion of Tawa and Denwa waterways at east longitude 77º 58'30" and north scope 22º 33' 40". It has a Catchment territory of 5982.90 Sq. Km. with 20055 ha zone under submergence. The left Bank Canal begins from Ranipur and runs parralel to Narmada waterway course along the breaking points of the foot slope pediments of Satpura. This trench takes off straightforwardly from the store with a head release of 103.06 cumecs. The initial 6.44 km length is fixed with thick concrete. The Handia branch channel with a head release of 29.9 cumecs takes off from the fundamental trench at 92 km point. The correct bank trench is taken through a passage from Kamthi and runs parallel pretty much to the course of Narmada stream. The distributary framework has been arranged along the waste partition. Because of topographic distinction between the privilege and left bank trench has been taken through 6 km long passage. Bagra branch channel and Piparia fan out waterways go up against

either side of the pickup weir. The Bagra channel is 60 km long. The aggregate length of distributaries and minors on the correct bank is 450 km.

Numerous minor water system Schemes are likewise working in the region, among which Dokrikhera Tank Project in Bankheri square is unmistakable. Dokrikhera Tank Project has a gross order territory 9104 ha and culturable summon region 7625 ha.

2.1.2.3 Cropping

District is very rich in the field of agriculture due to good sources of irrigation and fertile alluvial soil. Wheat and gram are the main crops grown during Rabi season. Soyabean, Mustard, Til and Groundnut are the main oilseeds produced here. The farmers have started the production of Sunflowers.

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2.1.2.4 Rainfall & Climate

The atmosphere of Hoshangabad region is portrayed by a sweltering summer and general dryness with the exception of amid the south west rainstorm season. The year might be isolated into four seasons. The chilly season, December to February is trailed by the hot season from March to about the centre of June. The period from the centre of June to September is the southwest storm season. October and November shape the post rainstorm or progress period.

The typical precipitation of Hoshangabad region is 1225.9 mm. It gets greatest precipitation amid southwest rainstorm period. Around 92.8% of the yearly precipitation got amid storm seasons and just 7.2 % of the yearly rainfalls occur amid October to May period. Rainfall shapes the sole wellspring of common energize to ground water administration and the rain water is accessible basically amid the southwest rainstorm time frame as it were. The greatest precipitation got in region at Pachmarhi i.e. 2122 mm and least at Hoshangabad i.e. 1302.3 mm.

The typical greatest temperature got amid the period of May is 42.1°C and least amid the long stretch of January is 11.7°C. The ordinary yearly means most extreme and least temperature of Hoshangabad region is 32.8°C and 19.8°C separately. Amid the southwest storm season the relative moistness by and large surpasses 91% (August month). In rest of the year is drier. The driest piece of the year is the late spring season, when relative stickiness is under 33%. April is the driest month of the year. The breeze speed is higher amid the pre-storm period when contrasted with post rainstorm period. The most extreme breeze speed 7.7 km/hr saw amid the long stretch of June and is least 2.9 km/hr amid the period of December. The normal ordinary yearly breeze speed of Hoshangabad area is 5.0 km/hr.

2.1.3 Selection of watershed

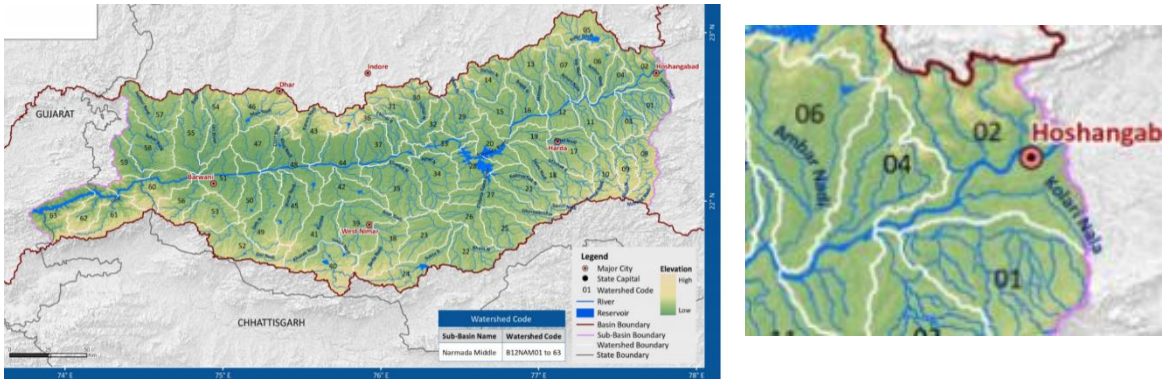


Figure 6: Middle Narmada Sub-Basin

Water quality of Narmada is decreasing and Hoshangabad is the most polluted stretch with the BOD as high as 11.4 mg/l in Hoshangabad downstream, 3.1 mg/l in Sethani Ghat, Hoshangabad and 3.2 mg/l in Hoshangabad which should be very low or approx. to zero but presence of such high BOD reflects that waste and organic matter present in water is very high (central pollution control board) because of various anthropogenic activities like direct discharge of sewage dumping of waste in stream is leading river towards vary high pollution level. So, there is a grave need of tackling this aspect and increasing self-cleansing mechanism of river. As already stated in the background, the stretch also been identified by CPCB as the Polluted River stretch in the State.

Table 4: Polluted River Stretch of Narmada

S.No.	Basin	River	Stretch	Towns	Length (in Km)
1.	Narmada	Banjar	Malanjkhad-Tingipur	Malanjkhad,Tingipur	15
		Denwa	Dhupgarh-Sarni	Dhupgarh,Sarni, Banipura	50
		Gour	Jabalpur-Saliwada	Jabalpur	15
		Narmada	Mandala-Bhedaghat, Sethani ghat-Nemawar	Mandala, Jabalpur, Hoshangabad, Nemawar	160

Source: River Stretches for Restoration of Water Quality, CPCB, 2015

In last 10 years land cover of selected area is changed a lot built up is increased from 2.59% to 4.95% of total area of watershed, land with only rabi crop has seen decrease from 44.56% to 16.57% and land with kharif crop has also seen a decrease from 18.67% to 1.17% but land with double or triple crop is increased from 15.67% to 1.17% but land with double or triple crop is increased from 15.67% to 47.66% this indicated the increase of intensive agriculture and built up in selected region.

In 2015 and in 2017 cases of floating Azola is seen in stretch of Hoshangabad. This is a weed which is very common in lower moist part of mountains. This is very common plant in lower part of Panchmadi and after drying of them they may be coming to river. In 2015 sewage was the reason of this problem and taskforce of experts is formed for investigation of case of increasing floating Azola. So, these types' cases are increasing in the stretch of Narmada.

Masheer (tor-tor) pride of Narmada, state fish of Madhya Pradesh is also known as tiger of water. Stretch of Hoshangabad is honoured by the presence of it. This fish has its importance from history. This can be seen in many Ghats and temples along the river Narmada and its tributaries in forest tigers has their own importance in managing it same as that Masheer has its importance for river, its catch is decreased from 50% to 4% in a decade. Like Masheer many species are on the verge of extinction and this zone needs attention regarding its conservation.

Watershed B12NAM02 is one of the watershed which depicts the typical setting along river Narmada, geomorphological in this area Narmada flows in gorge, one of the oldest observation point for sedimentation discharge gauge and quality. It has two towns one district head quarter with master plan one industrial town with two textile industries, rest of the rural areas of Hathnor villages in Sehore district is the place where remains and fossils of early man named Narmada man is found who is named in the honour of valley in which it is find.

Narmada places dependent on it for water, other mineral like sand and fishes; all the things in one watershed in other places like Mandla, Jabalpur etc. they share watersheds. This feature of water shade makes it a good sample to analyse it and assessment of this type of area can reflect the results of all the similar parts, problems are common and in this way solution can be applied with little bit of change and modification..

2.1.4 Selected area under micro- watershed

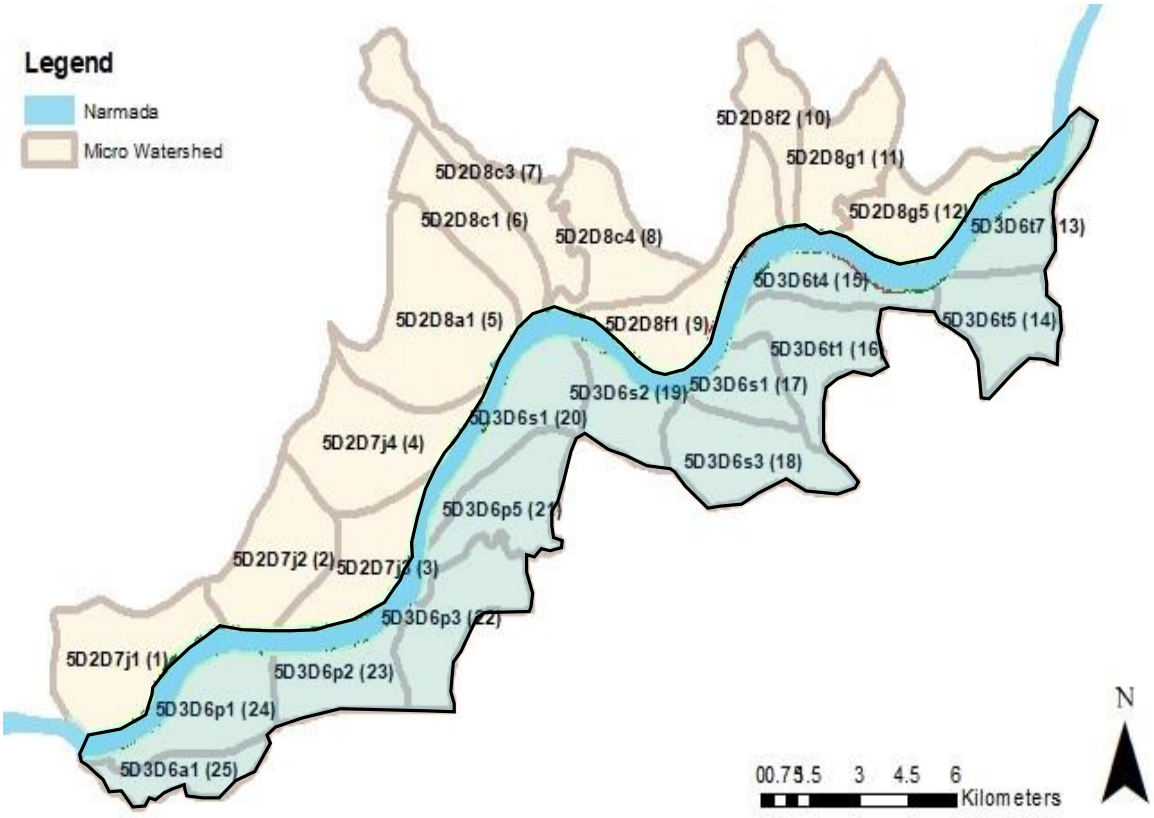


Fig.7. Map of the micro-watershed of Narmada River (Hoshangabad Catchment)

CHAPTER 3. LITERATURE REVIEW

Several research papers have been consulted for researching the types of agricultural pollution and parameters on which it effects the river water quality and how those adverse effects can be reduced have been studied in different case studies throughout the world.

3.1 Water quality

The nature of common water in waterways, lakes and stores and underneath the ground surface relies upon various interrelated elements. In its development on and through the surface of the heart, water can respond with the minerals that happen in the dirt and shakes and to break up an extensive variety of materials, so its characteristic state is never unadulterated. It generally contains an assortment of dissolvable inorganic, solvent natural and natural mixes. Notwithstanding these, water can convey a lot of insoluble materials that are held in suspension. Both the sums and sort of pollutions found in characteristic water fluctuate from place to put and by season and relies upon various variables. These elements incorporate geography, atmosphere, geology, organic procedures and land utilize. The pollutions decide the attributes of a water body.

Oxygen is the most entrenched pointer of water quality. Broken up oxygen is in reality fundamental for the survival of every single amphibian life form. Besides, oxygen influences countless water pointers, biochemical as well as stylish ones like smell, lucidity and taste. Monetary investigations appear to demonstrate that larger amounts of salary have a tendency to enhance oxygen levels. Oxygen levels of a portion of the significant streams have these days came back to their past abnormal states following quite a while of low levels. This has enhanced the likelihood of life. Waterways in the wealthier nations have progressed toward becoming relentlessly cleaner over the previous decade. However, when estimated for nitrates, less than one out of ten European waterways is any more extended regular: most have nitrate levels four times the standards found in nature. As urban communities extend to help bigger populaces, rooftops, parkways and parking garages progressively supplant penetrable soils and vegetation. Rain water in urban zones is diverted into sewers and deplete frameworks as opposed to sifting into the ground to raise the water table. In creating nations the photo is altogether

different. Waterways in the poorest nations have demonstrated a generous drop in the level of broke up oxygen. Nine-tenths of all sewage in forming nations runs specifically into streams, lakes and oceans without treatment. Oxygen is the most settled marker of water quality. Broken up oxygen is in actuality basic for the survival of every single oceanic life form. In addition, oxygen influences an immense number of other water pointers, biochemical as well as stylish ones like smell, lucidity and taste. Financial investigations appear to show that more elevated amounts of salary have a tendency to enhance oxygen levels. Oxygen levels of a portion of the real streams have these days came back to their past abnormal states following quite a while of low levels. This has enhanced the likelihood of life. In creating nations the photo is altogether different. Waterways in the poorest nations have demonstrated a considerable drop in the level of broke down oxygen. Nine-tenths of all sewage in forming nations runs specifically into streams, lakes and oceans without treatment. Suspended solids in a moving waterway will settle out at a different focuses or be conveyed longer separations, contingent upon their size and the rate of the stream. The higher the measure of suspended solids is, the cloudier or more turbid is the water. Suspended issue can influence the measure of light entering water and thusly confine the measure of photosynthesis that can happen and along these lines the development of plants. Little particles settling out in extensive sum on the base of a water body can keep a few living beings from living there and in addition keeping green plants from photosynthesizing.

How quick the water body moves influences the level of blending of water and how much dioxygen it will convey. In this way, quick streaming profoundly upset streams won't just be immersed with oxygen yet in addition convey all around blended supplements, which will be eventually conveyed to a waterway. The temperature of a water body is vital to the measure of broke down dioxygen it can contain. The hotter the water, the less dioxygen it contains.

3.2 AGRICULTURAL POLLUTANTS: SOURCES AND EFFECTS

Major rural supporters of water contamination (and the primary focuses for waterpollution control) are supplements, pesticides, salts, dregs, natural carbon, pathogens, metals and medication deposits. Table 1 demonstrates the relative

commitments of these to waterquality debasement. The significance of various types of farming contamination changes with singular circumstances, and negative effects, for example, eutrophication (which may incorporate residue, supplements and natural issue) emerge from mixes of stressors.

Nutrients

water contamination from supplements happens when manures are connected at a more noteworthy rate than they are settled by soil particles or sent out from the dirt profile (e.g. by plant take-up or when they are washed off the dirt surface before plants can take them up). Abundance nitrogen and phosphates can filter into groundwater or move through surface overflow into conduits. Phosphate isn't as solvent as nitrate and smelling salts and has a tendency to get adsorbed onto soil particles and enter water bodies' careful soil disintegration.

In domesticated animal's creation, feedlots are regularly situated on the banks of conduits so that (supplement rich) creature squander (e.g. pee) can be discharged specifically into those waterways. Excrement is normally gathered for use as natural manure, which, if connected in abundance, will prompt diffuse water contamination. By and large, as well, compost isn't put away in contained zones and, amid critical precipitation occasions, it can be washed into waterways by means of surface spill over.

In encouraged aquaculture, supplement loads conveyed to water bodies are essentially a component of sustain creation and nourish change (fecal squanders). Uneaten nourish in serious sustained aquaculture can be a critical supporter of supplement stacks in water.

Together with different stressors, high supplement burdens can cause the eutrophication of lakes, repositories, lakes and beach front waters, prompting green growth sprouts that smother other oceanic plants and creatures. In spite of information holes, 415 beach front regions have been recognized worldwide as encountering some type of eutrophication, of which 169 are hypoxic (WRI, 2008). The over the top amassing of supplements may likewise increment unfavorable wellbeing impacts, for example, blue-child disorder, because of abnormal amounts of nitrate in drinking-water.

Pesticides

Bug sprays, herbicides and fungicides are connected seriously in horticulture in numerous nations (Schreinemachers and Tipraqsa, 2012). At the point when disgracefully chose and oversaw, they can dirty water assets with cancer-causing agents and other lethal substances that can influence people. Pesticides may likewise influence biodiversity by executing weeds and creepy crawlies, with negative effects up the evolved way of life. In created nations, albeit extensive utilization of more seasoned wide range pesticides endures, the pattern is towards the utilization of more up to date pesticides that are more particular and less lethal to people and the earth and which require bring down amounts per unit region to be successful.

By the by, a large number of huge amounts of dynamic pesticide fixings are utilized as a part of farming (FAO, 2016a). Intense pesticide harming causes huge human grimness and mortality around the world – particularly in creating nations, where poor agriculturists frequently utilize exceedingly perilous pesticide definitions.

Salts

The generation of bitter seepage and draining water in farming has developed relatively with the expansion in water system in late decades.

Water system can assemble salts aggregated in soils (filtering divisions), which are then transported by waste water to getting water bodies and cause salinization. Intemperate water system can likewise raise water tables from saline aquifers and increment the drainage of saline groundwater into waterways. The interruption of saline seawater into aquifers – every now and again the consequence of unreasonable groundwater extractions for farming – is another imperative reason for salinization in waterfront zones (Mateo-Sagasta and Burke, 2010).

Real water-saltiness issues have been accounted for in Argentina, Australia, China, India, the Sudan, the United States of America, and numerous nations in Central Asia (FAO, 2011). In 2009, around 1.1 billion individuals lived in districts that had saline groundwater at shallow or middle of the road profundities (IGRAC, 2009).

Profoundly saline waters change the geochemical cycles of real components –, for example, carbon, press, nitrogen, phosphorus, silicon and sulfur (Herbert et al., 2015) – with general effects on biological systems. Salinization can influence freshwater biota by causing changes inside species and in group arrangement and can at last prompt biodiversity misfortune and movement. As a rule, when saltiness builds, the biodiversity of microorganisms, green growth, plants and creatures decays.

Sedimentation

Unsustainable land utilize and despicable culturing and soil administration in horticulture are expanding disintegration and silt spillover into waterways, lakes and repositories, with gigantic amounts of soil lost and transported to water bodies each year. The worldwide rate of disintegration in croplands is assessed at 10.5 megagrams (Mg) per ha every year, which compares to 193 kilograms of soil natural carbon per ha every year. Appraisals for pastureland are lower, at 1.7 Mg for every ha every year, which is identical to 40.4 kilograms of soil natural carbon per ha every year. It is evaluated that 43 percent of the agrarian residue motion is in Asia (Doetterl, Van Oost and Six, 2012).

High rates of disintegration happen in zones where precipitation is high, inclines are steep and vegetation cover is poor. Disintegration is bothered by overgrazing in pasturelands, by unseemly furrowing on soak slants and, all the more extensively, by deforestation, landclearing and the corruption of riverine vegetation.

Residue in waterway frameworks is a mind boggling blend of minerals and natural issue, conceivably including physical and synthetic poisons. Residue can cover and crush angle generating beds, stop up angle gills, and diminish helpful capacity volume in repositories. Sedimentation can harm conduits, gag streams and make filtration fundamental for civil and water system water supplies. It can likewise influence delta development and progression and cutoff the traversability of water bodies.

Particles of earth and residue in silt can adsorb numerous kinds of chemicals on their surfaces, including supplements, overwhelming metals and industrious

natural contaminations. Dregs, subsequently, is a key means by which such contaminations are transported to water bodies.

Organic matter

Natural issue from creature excreta, uneaten creature bolster, creature handling enterprises and blundered trim deposits are on the whole critical water poisons. Animals related squanders have among the most elevated organic oxygen request (BOD). For instance, the BOD of pig slurry is in the scope of 30 000– 80 000 milligrams for each liter, contrasted and the run of the mill BOD of local sewage of 200– 500 milligrams for every liter (FAO, 2006). Locally, aquaculture can be a noteworthy supporter of natural loads in water. In Scotland, for instance, the release of untreated natural waste from salmon generation is equal to 75 percent of the contamination released by the human populace. Shrimp aquaculture in Bangladesh produces 600 tons of waste for every day (SACEP, 2014).

Natural issue expends broke up oxygen in water as it debases, contributing unequivocally to hypoxia in water bodies. The release of natural issue likewise builds the danger of eutrophication and algal sprouts in lakes, supplies and waterfront regions.

Pathogens

Domesticated animals excreta contain numerous zoonotic microorganisms and multicellular parasites that can be unsafe to human wellbeing. Pathogenic microorganisms can be waterborne o r sustenance borne (the last particularly if the nourishment has been inundated with sullied water). A few pathogens can get by for a considerable length of time or weeks in the excrement released onto arrive and may later sully water assets by means of spillover (FAO, 2006; WHO, 2012). Pathogens from domesticated animals that are negative to general wellbeing incorporate microscopic organisms, for example, Campylobacter spp., Escherichia coli O157:H7, Salmonella spp. furthermore, Clostridium botulinum and parasitic protozoa, for example, Giardia lamblia, Cryptosporidium parvum and Microsporidia spp., all of which cause a huge number of contaminations consistently (Christou, 2011).

Emerging pollutants

New horticultural contaminations, for example, anti-microbials, immunizations, development promoters and hormones have risen over the most recent two decades. These can achieve water by means of filtering and overflow from domesticated animals and aquaculture ranches, and also through the use of compost and slurries to rural land (OECD, 2012b). Deposits of overwhelming metals in rural sources of info, for example, pesticides and creature bolster are likewise developing dangers. Today, in excess of 700 developing poisons and their metabolites and change items are recorded as present in European sea-going conditions (NORMAN, 2016). Farming isn't just a wellspring of developing poisons, it likewise adds to the spread and reintroduction of such toxins into sea-going conditions through wastewater (re)use for water system and the use of city biosolids to arrive as manures. An expected 35.9 Mha of agrarian grounds are liable to the circuitous utilization of wastewater (Thebo et al., 2017). The potential dangers to human wellbeing postured by introduction to rising toxins by means of defiled horticultural items needs consideration.

3.3 Non-point sources of pollution

Nonpoint source (NPS) contamination, dissimilar to contamination from point sources, for example, mechanical and sewage treatment plants, originates from numerous diffuse sources. Dirtied spill over is caused by precipitation or snowmelt moving over and through the ground. As the overflow moves, it gets and diverts characteristic and human-made poisons, finally keeping them into watersheds through lakes, streams, wetlands, beach front waters, and even our underground wellsprings of drinking water.

Non-point source pollutants, irrespective of source, are transported overland and through the soil by rainwater and melting snow. These pollutants ultimately find their way into groundwater, wetlands, rivers and lakes and, finally, to oceans in the form of sediment and chemical loads carried by rivers. As discussed below, the ecological impact of these pollutants range from simple nuisance substances to severe ecological impacts involving fish, birds and mammals, and on human health. The range and relative complexity of agricultural non-point source pollution are illustrated in Figure 1.

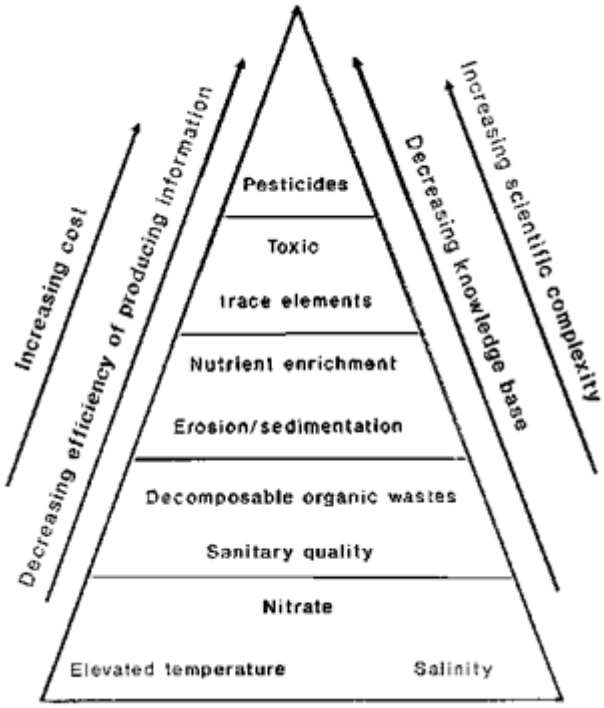


Figure 8: Hierarchical Complexity of Agriculturally-Related Water Quality Problems (Rickert, 1993)

3.4 Point source pollution

We tend to consider ecologically or wellbeing harming contamination as wastewater that originates from processing plants, civil and modern wastewater treatment plants, urban tempest sewers, and whatever other sources where dirtied water is released through a pipe or channel. This kind of contamination is known as 'point source' (PS) contamination. Since it is released through funnels or channels, it can be effectively observed for amount and water quality (physical and compound properties). Likewise, in light of the fact that it moves through funnels or channels, PS contamination can be controlled by gathering and treatment of the dirtied water before it is released into streams, lakes or stores.

In numerous nations, for example, in China and the United States, most types of PS contamination are controlled by enactment that requires treatment of PS contamination to particular water quality models, however the level of treatment

and level of implementation of enactment differ extraordinarily from nation to-nation.

3.5 Categories of major water pollutants

Pollutant category	Definitions/Examples
Dioxins	Highly toxic, carcinogenic, petroleum-derived chemicals that are persistent in the environment and may be found in fish tissue, water column, or sediments.
Metals	Substances identified only as ‘metals’; also, selenium, lead, copper, arsenic, manganese, others (Note: may, in some cases, include mercury).
Mercury	a toxic metal with neurological and developmental impacts on wildlife and humans; found in fish tissue, water column, or sediments. In agriculture, mercury can be associated with mercury-treated seed.
Nutrients	Primarily nitrogen and phosphorus; in excess amounts, these nutrients over-stimulate the growth of weeds and algae and can lead to serious algae blooms and oxygen depletion in rivers and lakes that can cause fish-kills. agricultural use of fertilizer is a major source of nutrients in rivers, lakes and reservoirs
Organic enrichment/ oxygen depletion	low levels of dissolved oxygen; high levels of COD or biochemical oxygen demanding substances (e.g. organic materials such as plant matter, food processing waste, sewage) that use up dissolved oxygen in water when they degrade. Runoff from fields contributes to the build up of organic matter in rivers, lakes and reservoirs.
Pathogens	bacteria and pathogen indicators E.coli, total coliforms, faecal coliforms, Enterococci; used as indicators of possible contamination by sewage, livestock runoff and septic tanks
Polychlorinated biphenyls (PCbs)	A toxic mixture of chlorinated chemicals that are no longer used in the US but some are still used in China; these are persistent in the environment; used in industry and electrical equipment; primarily found in fish tissue or sediments.

Pesticides	Substances identified as ‘pesticides’; also, chlordane, atrazine, carbofuran, and others; many older pesticides such as DDT are banned in China, but are used illegally and are persistent in the environment.
Sediment	Excess sediments, siltation; affects aquatic life by altering and suffocating habitat and clogging fish gills. Agriculture is a major cause of sediment runoff into rivers, lakes and reservoirs.
Toxic organics	Chemicals identified only as ‘toxic organics’; also, priority2 organic compounds, non-priority2 organic compounds, polycyclic aromatic hydrocarbons (PaH), and others; often persistent in the environment.
Salts	High salt concentrations prevent the uptake of water by plants. The plant symptoms are similar in appearance to those of drought. Agricultural drainage has higher salt concentration than irrigation water and increases salinity in water bodies.

Table.5. major water pollutants

3.6 AGRICULTURAL AND RURAL NON-POINT SOURCE POLLUTION

Agricultural and rural non-point source pollution refers to four different types of activities:

- **Plant production**: includes exercises, for example, furrowing, and planting, treating, water system and irritation administration. The essential weights on water bodies are gotten from compost spill over after precipitation or in water system water that streams back to waterways ('water system return streams'), supplements (particularly nitrogen) that permeate through the dirt and pollute the groundwater, and dregs that is disintegrated from fields and washed into conduits amid and after precipitation.
- In territories where precipitation conveys natural waste (straw, mulch, excrement) from the fields into conduits, the expansion of COD turns into an issue. Different kinds of plant generation weights on water quality incorporate flushing of salt from farmland that has been salinized by water

system rehearses, and uncalled for transfer of pesticide compartments that can sully surface and groundwater.

- **Rural living**: alludes to a large number of little agrarian towns crosswise over China that are fundamentally possessed by ranchers. Water contamination from provincial living is to a great extent from transfer of human waste (strong and fluid) and fluid and strong compost from local creatures that live in or around singular farmhouses (however not from feedlots – see beneath). The impact of provincial life on water quality fluctuates incredibly crosswise over China; on the North China Plain, towns are typically not situated on conduits and have generally little effect on surface water quality. Conversely, towns in southern China are typically situated on the banks of waterways and may enormously influence water quality when squander streams specifically into the conduit.
- **Aquaculture**: alludes to cultivating of sea-going creatures, for example, fish, crabs or shrimp, in inland and seaside regions, including mediation in the raising procedure to improve generation of the stock being developed. The water quality effects incorporate sustained aquaculture and, especially, abundance bolster that isn't devoured by cultivated species, for example, fecal issue delivered by confined species and anti-toxins that sully the encompassing water region.
- **Livestock raising**: centers around family-worked raising of domesticated animals, and on town and group feedlots that are not typically controlled by Chinese laws for feedlot activity and contamination control. Feedlots are frequently situated on the banks of conduits with the goal that fluid creature squander (pee) can be cleaned straightforwardly into the waterway. Strong waste (excrement) is generally gathered for compost. Much of the time, in any case, this isn't put away in contained territories and keeps running off into conduits when there is noteworthy precipitation. The effect of raising domesticated animals on water quality is particularly genuine in numerous zones of China. The principle toxins are: supplements (particularly N as smelling salts), overwhelming metals (contained in pee and fertilizer), and pathogens (that are discharged in pee and excrement), and encourage added substances (anti-microbials, and so on.). In China, lifted levels of

COD and smelling salts are frequently connected to upstream creature feedlots. Note that raising creatures on a mechanical scale (extensive business feedlots), in spite of the fact that when still a worry, is presently to a lesser degree a water quality issue than in the past on the grounds that creature squander is seen to be a financial item that can be changed over to manure or biogas and sold.

Table.6. Classes of non-point source pollution (highlighted categories refer to agricultural activities) (Source: International Joint Commission, 1974, and other sources)

Agriculture		
Animal feedlots Irrigation Cultivation Pastures Dairy farming Orchards Aquaculture	Runoff from all categories of agriculture leading to surface and groundwater pollution. In northern climates, runoff from frozen ground is a major problem, especially where manure is spread during the winter. Vegetable handling, especially washing in polluted surface waters in many developing countries, leads to contamination of food supplies. Growth of aquaculture is becoming a major polluting activity in many countries. Irrigation return flows carry salts, nutrients and pesticides. Tile drainage rapidly carries leachates such as nitrogen to surface waters.	Phosphorus, nitrogen, metals, pathogens, sediment, pesticides, salt, BOD[1], trace elements (e.g. selenium).
Forestry	Increased runoff from disturbed land. Most damaging is forest clearing for urbanization.	Sediment, pesticides.
Liquid waste disposal	Disposal of liquid wastes from municipal wastewater effluents, sewage sludge, industrial effluents and sludges, wastewater from home septic systems; especially disposal on agricultural land, and legal or illegal dumping in watercourses.	Pathogens, metals, organic compounds.
Urban areas		
Residential Commercial Industrial	Urban runoff from roofs, streets, parking lots, etc. leading to overloading of sewage plants from combined sewers, or polluted runoff routed directly to receiving waters; local industries and businesses may discharge wastes to street gutters and storm drains; street cleaning; road salting contributes to surface and groundwater pollution.	Fertilizers, greases and oils, faecal matter and pathogens, organic contaminants (e.g. PAHs[2] and PCBs[3]), heavy metals, pesticides, nutrients, sediment, salts, BOD, COD[4], etc.
Rural sewage systems	Overloading and malfunction of septic systems leading to surface runoff and/or direct infiltration to groundwater.	Phosphorus, nitrogen, pathogens (faecal matter).
Transportation	Roads, railways, pipelines, hydro-electric corridors, etc.	Nutrients, sediment, metals, organic contaminants, pesticides (especially herbicides).
Mineral extraction	Runoff from mines and mine wastes, quarries, well sites.	Sediment, acids, metals, oils, organic contaminants, salts (brine).
Recreational land use	Large variety of recreational land uses, including ski resorts, boating and marinas, campgrounds, parks; waste and "grey" water from recreational boats is a major pollutant, especially in small lakes and rivers. Hunting (lead pollution in waterfowl).	Nutrients, pesticides, sediment, pathogens, heavy metals.
Solid waste disposal	Contamination of surface and groundwater by leachates and gases. Hazardous wastes may be disposed of through underground disposal.	Nutrients, metals, pathogens, organic contaminants.
Dredging	Dispersion of contaminated sediments, leakage from containment areas.	Metals, organic contaminants.
Deep well disposal	Contamination of groundwater by deep well injection of liquid wastes, especially oilfield brines and liquid industrial wastes.	Salts, heavy metals, organic contaminants.
Atmospheric deposition	Long-range transport of atmospheric pollutants (LRTAP) and deposition of land and water surfaces. Regarded as a significant source of pesticides (from agriculture, etc.), nutrients, metals, etc., especially in pristine environments.	Nutrients, metals, organic contaminants.

Table 7: Agricultural impacts on water quality

Agricultural activity	Impacts	
	Surface water	Groundwater
Tillage/ploughing	**Sediment/turbidity**: sediments carry phosphorus and pesticides adsorbed to sediment particles; **siltation** of river beds and loss of habitat, spawning ground, etc.	
Fertilizing	Runoff of nutrients, especially phosphorus, leading to eutrophication causing taste and odour in public water supply, excess algae growth leading to deoxygenation of water and fish kills.	Leaching of nitrate to groundwater; excessive levels are a threat to public health.
Manure spreading	Carried out as a fertilizer activity; spreading on frozen ground results in high levels of contamination of receiving waters by pathogens, metals, phosphorus and nitrogen leading to eutrophication and potential contamination.	Contamination of ground-water, especially by nitrogen
Pesticides	Runoff of pesticides leads to contamination of surface water and biota; dysfunction of ecological system in surface waters by loss of top predators due to growth inhibition and reproductive failure; public health impacts from eating contaminated fish. Pesticides are carried as dust by wind over very long distances and contaminate aquatic systems 1000s of miles away (e.g. tropical/subtropical pesticides found in Arctic mammals).	Some pesticides may leach into groundwater causing human health problems from contaminated wells.
Feedlots/animal corrals	Contamination of surface water with many pathogens (bacteria, viruses, etc.) leading to chronic public health problems. Also contamination by metals contained in urine and faeces.	Potential leaching of nitrogen, metals, etc. to groundwater.
Irrigation	Runoff of salts leading to salinization of surface waters; runoff of fertilizers and pesticides to surface waters with ecological damage, bioaccumulation in edible fish species, etc. High levels of trace elements such as selenium can occur with serious ecological damage and potential human health impacts.	Enrichment of groundwater with salts, nutrients (especially nitrate).
Clear cutting	Erosion of land, leading to high levels of turbidity in rivers, siltation of bottom habitat, etc. Disruption and change of hydrologic regime, often with loss of perennial streams; causes public health problems due to loss of potable water.	Disruption of hydrologic regime, often with increased surface runoff and decreased groundwater recharge; affects surface water by decreasing flow in dry periods and concentrating nutrients and contaminants in surface water.
Silviculture	Broad range of effects: pesticide runoff and contamination of surface water and fish; erosion and sedimentation problems.	
Aquaculture	Release of pesticides (e.g. TBT[1]) and high levels of nutrients to surface water and groundwater through feed and faeces, leading to serious eutrophication.	

3.7 Water pollution and its impact

Creating methods for cultivating and farming is the reason people live on the planet they do today. It is a vital methods for survival, without which there would be starvations everywhere throughout the world. For a large number of years, farming

was a characteristic procedure that did not hurt the land it was done on. Indeed, agriculturists could go down their property for some ages and it would even now be fruitful as ever. Notwithstanding, present day rural practices have begun the procedure of farming contamination. This procedure causes the corruption of the eco-framework, land and condition because of the present day side-effects of horticulture.

No single reason can be ascribed to the across the board farming contamination we confront today. Agribusiness is an intricate movement in which the development of harvests and animals must be adjusted superbly. The procedure of agrarian contamination originates from the numerous stages their development experiences.

1. Wellbeing Related Issues: Agricultural contamination is the principle wellspring of contamination in water and lakes. Chemicals from manures and pesticides advance into the groundwater that end up in drinking water. Wellbeing related issues may happen as it add to blue infant disorder which causes demise in babies. Oil, degreasing operators, metals and poisons from cultivate gear because medical issues when they get into drinking water.

2. Impact on Aquatic Animals: Fertilizers, compost, waste and alkali transforms into nitrate that decreases the measure of oxygen exhibit in water which brings about the demise of numerous amphibian creatures. Once more, microbes and parasites from creature waste can get into drinking water which can posture genuine wellbeing dangers for different oceanic life and creatures.

Holding agrarian contamination within proper limits is considerably harder than it appears. For the homesteads to wind up clean by and by, levels of water, soil and mechanical contamination must be held under control. In the course of the most recent decade or something like that, legislatures have turned out to be stricter about upholding directions. Ranchers are additionally ending up more mindful of the harm and are searching for arrangements.

Numerous homesteads are moving back to conventional fertilizer, coordinate water system from neighborhood water bodies and natural methods for holding vermin populaces under control. Enormous Ag ranchers are likewise looking for

approaches to scale safeguard measures without far reaching business interruption. Be that as it may, for the procedure of rural contamination to be completely reigned in, there must be a total move in the way farming is rehearsed.

Case studies:-

1. **Narmada River water: Pollution and its impact on the human health, Mukesh Katakwar**
   International Journal of Chemical Studies 2016

This examination was led to discover the contamination circumstance of Narmada River and the medical issue of the encompassing inhabitants. The outcomes unmistakably verify that the water nature of Narmada stream may not be in a situation to maintain the amphibian life and not reasonable for utilizing lo

From the examination of information it was watched that there is a particular variety in water quality amid dry and wet season. As the stream of water is less amid dry season and dilute level goes the nature of water end up poor. Thus water stays more dirtied amid dry season. Again amid wet season because of precipitation the stream is more, level of water increments and the water quality turns out to be generally better.

There is no indication of stream contamination being ceased. It is expanding step by step. There are a few wellsprings of water contamination, which cooperate to decrease general stream water quality. Enterprises release their fluid waste items into streams. Our horticulture rehearse that utilizations compound manures and pesticides additionally add to stream contamination as water depletes these chemicals into the waterways. Local squanders that we toss into streams adds to contamination levels. As populace develops, the span of towns and urban areas additionally develops. With that the measure of residential squanders that we toss into stream increments. In the vast majority of the towns and urban communities, the metropolitan channels convey our losses to streams. There are cases of waterways bursting into flames in view of high contamination levels. This shows how genuinely dirtied our streams are. In our regular day to day existence we can without much of a stretch see manifestations of waterway contamination. The skimming dead fishes in our

stream, any hued water in the waterway, or an awful stench from the waterway point towards waterway contamination. The study provides evidence that local communities are suffering from a variety of health problems that could be a direct or indirect such as skin problems, stomach problems, gastric ulcers, diarrhoea, dysentery, yellow fever, cholera, dengue, malaria and other epidemic disease also available in this area. The people lives in the aria are also suffering by the odor pollution and by the respiratory problems. If you see or feel any of these things in a river be sure that the river is a victim of pollution. River pollution can be due to the causes below:

a) Acid rain
b) Industrial pollution
c) Agricultural pollution
d) Oil Pollution
e) Solid waste

2. Restoration plan of Narmada River with Designated best use classification of surface water quality based on river expedition, monitoring and quality assessment

- To examine the existing situation and preparation of a restoration plan for the river comparing the satellite images of LANDSAT 1978 and LISS III 2008 shows reduction in the forest cover and wetlands in the entire Narmada Basin due to rapid land use change. This procedure can be helpful in breaking down the river in the most influenced zones. Steadily, the stream which is even dry at many spots begins developing. The study is related to the land use and its changing characteristics year by year and its effects on the river, good or bad. By comparing the two images it can be concluded that the forest cover and the wetlands has been decreasing by year. More built up towards the river is harming river both directly and indirectly. Exposure of river close to the buildings expose it to the open site for solid waste dumping site.

3. Karnophuli River Front Development, Chittagong, Bangladesh, Md.Kamrul Islam, Sudipta Chowdhury

American Journal of Engineering Research (AJER)

- This Paper aims to develop activities like commercial and pedestrian site beautification. This paper is helpful in deciding the type of proposals which will be given on the basis of the analysis as it was already mentioned in the paper about the Failure of the Bangladesh government and the responsible institutions, specifically to enforce the regulations and guidelines which resulted in unsuccessful riverfront developments in this country.

3.8 Policy and legal provisions related to water pollution

1. Water Prevention and Control of Pollution Act, 1974

The prime object of this Act is to provide for the prevention of water pollution and cater to the maintenance of the water bodies and carry out activities to promote restoration of water. With the objective of giving practical implementation to this Act, the Central Pollution Control Board and the State Pollution Control Board have been established by the central and state authorities. The Central Pollution Control Board is to promote the cleanliness of streams and wells in different areas of the state. The Central Pollution Control Board has the power to advise the central government on various matters, which are concerned with the prevention and control of pollution of water. Under the Act mentioned above, the board has the power to encourage and conduct research and investigation with a view of promoting, the prevention of contamination of water in a significant manner.

1. The Water Prevention and Control of Pollution Cess Act, 2003

Industrial waste is one of the causes of the of water pollution. Often the waste from the industries is being disposed of into the rivers which pollute the river to a significant extent. According to **Section 2** of this Act, industries include any operation or process or sewage or disposal treatment or any industrial effluent. **Section 3** of this Act provides an exemption to industries from levying cess on those industries, which consume water below the specified limit. Water gets polluted through the toxic or non-biodegradable substances when the

processing of these materials is being done in any industry, and such industries are required to pay cess under this law.

2. The Water (Prevention & Control Of Pollution) Act

The Act provides for constitution of central and State Boards for preventing water pollution, power to take water samples and their analysis

• It allows for appeals, revision, minimum and maximum penalties, publication of names of offenders, offences by companies and Government departments, cognizance of offences, water laboratories, analysis etc.

• Prevention and control of water pollution is achieved through a permit or 'consent administration' procedure.

• Discharge of effluents is permitted by obtaining the consent of the State Water Board, subject to any conditions specified by them.

• Any person who fails to comply with a directive of the State cannot, however, entertain in suit under this Act unless the suit is brought by, or with the sanction of the State Board.

3. Forest Conservation Act

• The Indian Forest Act of 1927 consolidated all the previous laws regarding forests that were passed before the 1920s.

• The Act gave the Government and Forest Department the power to create Reserved Forests, and the right to use Reserved Forests for Government use alone.

• It also created Protected Forests, in which the use of resources by local people was controlled.

• Some forests were to be controlled by the village community, and these were called village Forests

3.9 Case studies:

3.9.1 Effects of agricultural practices on the water quality of the Scott River: with focus on primary production.

The Scott Coastal Plain lies at the base of the Blackwood catchment, extending 70km along the south shore of Western Australia and 20km inland. In 2001 the Department of Agriculture built up a procedure for a manageable future for this locale, regarding escalating and shifting farming area utilize. This examination intends to anticipate the impacts that future land uses will have on the natural water nature of the Scott River. Supplement and essential generation information from locales along the Scott River were dissected, with the information from each site speaking to the reaction of the stream from arrive utilization of a sub catchment. Varieties were contemplated amid various phases of the year. The points of the examination were to connect watched add up to nitrogen to add up to phosphorous proportions (TN: TP) in the Scott River with arrive use from the catchment, discover a connection amongst TN: TP and generation and decide whether the creation rates were unfavorably influencing the water quality. Specific consideration was put on the event of cyanobacteria, which represent a risk to both biological system and human wellbeing.

The expansive extent of land utilize committed to creature farming was reflected in the low TN: TP saw in the Scott River. These conditions advanced creation just on a few events. Promote examination uncovered that the water temperatures and the nitrogen and phosphorous fixations were constraining development. High TN: TP proportions were connected with low profitability. Cyanobacteria were never present among high TN: TP and appeared at low TN: TP yet ruled infrequently. Promote examination demonstrated that

cyanobacteria at upstream destinations amid spring and winter showed up amid supplement constraining conditions. There were expanded convergences of cyanobacteria saw amid summer. The prevailing phytoplankton bunches changed with the seasons. Amid summer, cyanobacteria, diatom and dinoflagellate tallies ruled, as did diatoms and chrysophytes in fall. Amid winter, generation was commanded by green growth and dinoflagellates and in spring, phytoplankton bunches were similarly prevailing.

In spite of the fact that the best centralizations of supplements were sent out into the stream amid winter, during this time, the water temperature was excessively icy, making it impossible to advance unnecessary development of phytoplankton and along these lines did not greatly affect the water nature of the Scott River. Supplement fixations were bring down in the mid-year time frame yet this did not keep comparative centralizations of phytoplankton from showing up in the Scott River. The hotter conditions promoted a bigger convergence of cyanobacteria, which is a worry for the soundness of the waterway as a few types of cyanobacteria can be lethal even at low focuses.

3.9.2 Findings of study

- Rural practices in the Scott Coastal Plain are just affecting the water nature of the Scott River at specific circumstances of the year. The larger part of supplement transport happens amid winter however frosty water temperatures are averting over the top development of phytoplankton. The hotter temperatures in the mid-year are empowering higher centralizations of cyanobacteria to happen
- Albeit supplement focuses in the stream are high in winter and spring, cell checks were never at blossom levels, showing no indications of eutrophication. Explanations behind the low cell tallies incorporate chilly water temperatures, and also the likelihood of light restrictions and zooplankton touching. Low stoichiometry concurred with the event of cyanobacteria. At TN: TP >50 there were no cyanobacteria recorded and at TN: TP < 20 cyanobacteria were seen on a few events however fixations were low. This is as yet huge as specific species are dangerous at fixations as low as 5 cells/mL.

- Supplement focuses were likewise genuinely high amid low precipitation periods, demonstrating groundwater as a supplement source. Amid summer these supplement fixations and hotter water temperatures were perfect conditions for expanded phytoplankton cell focuses as saw at site SRF01. Amid this time cyanobacteria focuses were higher because of hotter conditions and maybe bring down stream rates however did not happen at low TN: TP. There might be a move to benthic ruled algal generation at upstream locales in the mid-year because of the lower water level, in any case if the waterway is dry this would not be the situation.

3.9.3 Effect of Agricultural Activity on River Water Quality: A Case Study for the Lower Colorado River Basin

Biofuel request can possibly affect trimming exercises crosswise over United States. Ceaseless trimming of a solitary yield, evacuation of the larger part of plant material, and expanding the utilization of water system and substance inputs are only a couple of cases of changes that might be expected underway agribusiness because of biofuel arrangements. Generation exercises that are concentrated on the ceaseless development and expulsion of biomass can affect soil richness, prompting an increment in evacuation of plant supplements in overflow, influencing profitability and adding to surface what's more, ground water defilement (Office of Technology Assessment 1984). Besides, agrarian practices that uncover fundamentally delicate soil to cruel conditions and land employments leave next to zero time for soil rebuilding and increment synthetic misfortunes in overflow and permeation (Lal and Stewart 1994). Basta, Huhnke, and Stiegler (1997) assessed the effect of agrarian compound overflow on water quality and found that utilization of synthetic contributions to dissolved soils is a noteworthy supporter of surface and ground water tainting. Hamilton and Helsel (1995) additionally noticed that the main considerations influencing the measure of chemicals achieving water bodies from horticultural cropland are affected via arrive utilize rehearses, hydrology, dregs structure, precipitation, and yield compose.

As of late, somewhat because of biofuel activities, there has been an expansion in corn sections of land in the Lower Colorado River area of Texas (National

Agricultural Statistics Service 2010). Waterway release in this district has been expanding and related water quality has been consistently declining. These wonders propose there might be unintended results identified with the reaction of creation agribusiness to government vitality arrangement. This farming generation locale offers a chance to assess the ramifications of editing design changes on stream release and related water quality. It is likewise expected that corn grounds increments will counterbalance real esatate gave to other significant products in the district, for example, soybeans and grain sorghum, counting sections of land enlisted in a preservation program (Tokgoz et al. 2007). Made strides comprehension of the impacts of a trimming design change on release in this area is normal to be helpful in anticipating results in different districts.

3.9.4 Findings of the study

Measurable investigation of yearly release and precipitation in the Texas Lower Colorado Stream bowl for 1968 to 2008 proposes that expanding watered corn real estate expanded the release to the stream. This outcome is predictable with crafted by Schilling et al. (2010) who recommended editing exercises were more critical than environmental change in influencing release to a stream. Measuring the size of product land impact, flooded corn grounds for this situation, on expanding stream is an essential benchmark for surveying the noteworthiness of trimming designs change on provincial water designs. This case depends on the Lower Colorado River bowl. A motivation behind this activity was to underline that vitality (or other) arrangement can have unintended results, recommending a requirement for more extensive examination before execution. All areas are one of a kind with particular attributes, influencing a summed up conclusion to invalid.

3.9.5 Agricultural Practices and Water Pollution Issue: A Case Study of Bertam River, Malaysia

Bertam River, one of the fundamental waterways in Cameron Highlands1. A forceful land use lately for farming exercises, tourism and urban advancement are relied upon prompt more contamination stacking in water. A capacity to anticipate horticulture rehearses affect is winding up more critical since this stream assumes noteworthy part as water assets for drinking, water system and hydroelectric power particularly for individuals living around there.

Testing Activity Eight inspecting locales were picked along Bertam River, Cameron Highlands. Surface water tests were taken month to month from August 2012 - June 2013 inside dry and wet occasions. Triplicate water tests gathered by submerged 1 Liter HDPE bottle. Physical factors and GPS were recorded by utilizing YSI 550 multi sensor test and Explorist 300, individually. In research facility, parameters evaluated were nitrogen, phosphorus, metal substance following standard technique.

System: Quantitative investigation was proficient by utilizing HACH DR 3900 (supplement) and ICP-OES Optima DV 4300 (metal) instruments. For metal investigation, adjustment was finished with 6 arrangement standard arrangements and relationship coefficient was accomplished 0.999 for each metal. Tests were investigated in triplicates and mean estimation were at long last decided.

Factual Analysis: Analysis of Variance (ANOVA, $p< 0.05$) and Pearson relationship was translate to recognize the relationship between sets of factors.

CHAPTER 4. DATA ANALYSIS

Based on the results of the primary and secondary survey, stepwise analysis was carried out. This includes identifying the polluting agents involved in agricultural activities and the agricultural lands which are effecting the most on the basis of this possible solutions has been given which have been undertaken in different countries to counter the adverse impacts.

4.1 landuse landcover analysis

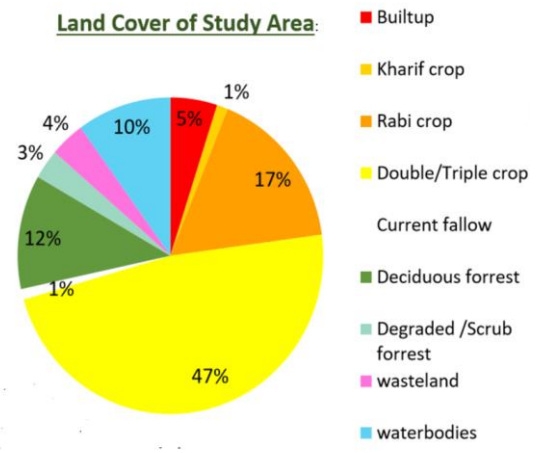
Study area:

- Stream of River Narmada (22047’49.16’’N, 77046’49.58’’E, 296m;)
- Watershed number B12NAM02
- Area of riparian buffer: 803 ha;

Villages:

- North bank: 16 Riparian and 6 Non riparian villages (22 village) (Sehore)
- South bank: 14 Riparian and 5 Non riparian village (19 viilages) (Hoshangabad)

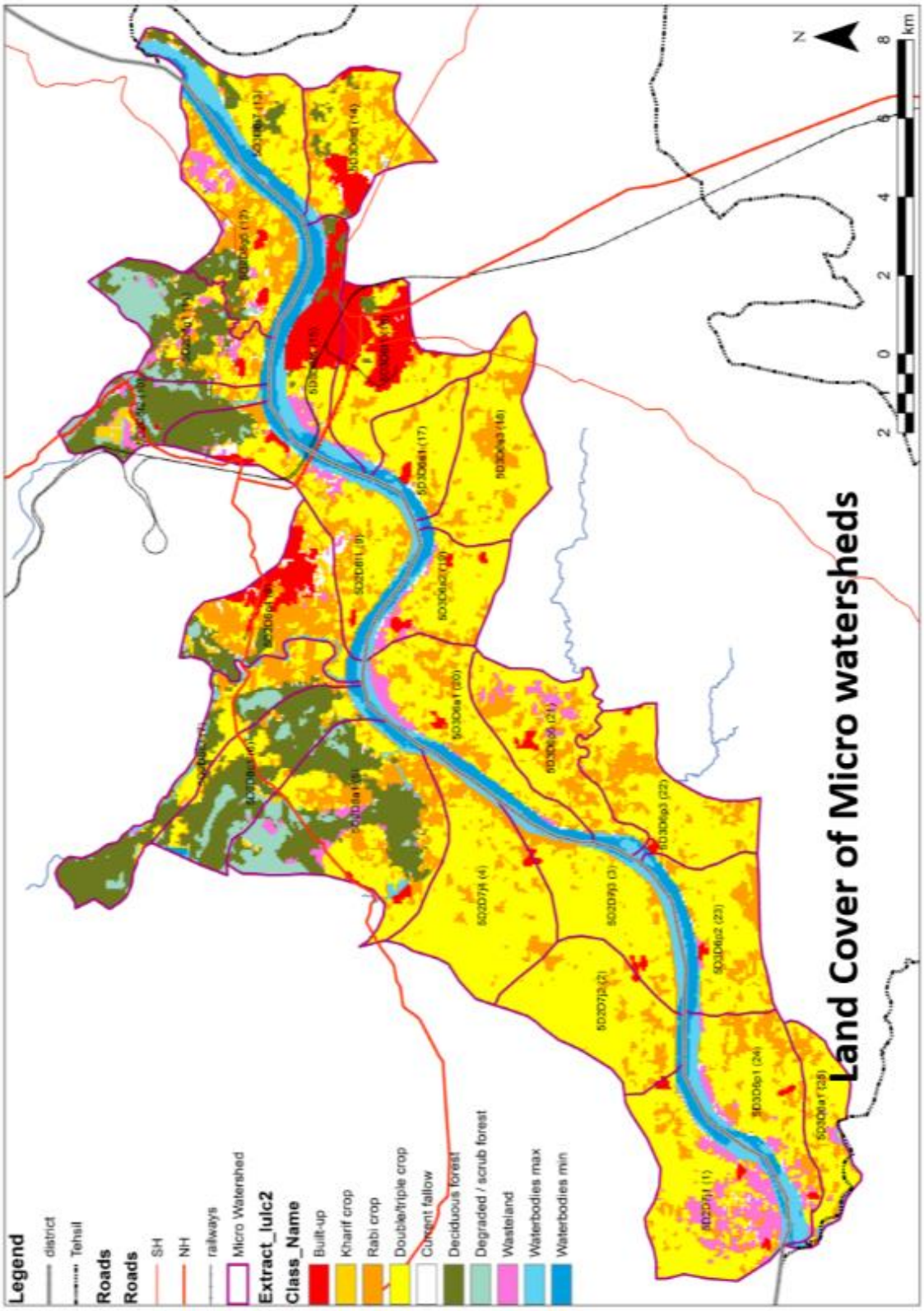
Figure 8. percentage distribution of landcover of the whole microwatershed



Landcover:

The study area is consist of 12 % forest but 65% area is under agriculture 47% area under triple crops shows intensive agricultre.

Figure.9. LU LC Map of the Hoshangabad district



4.2 Landcover(Hoshangabad)

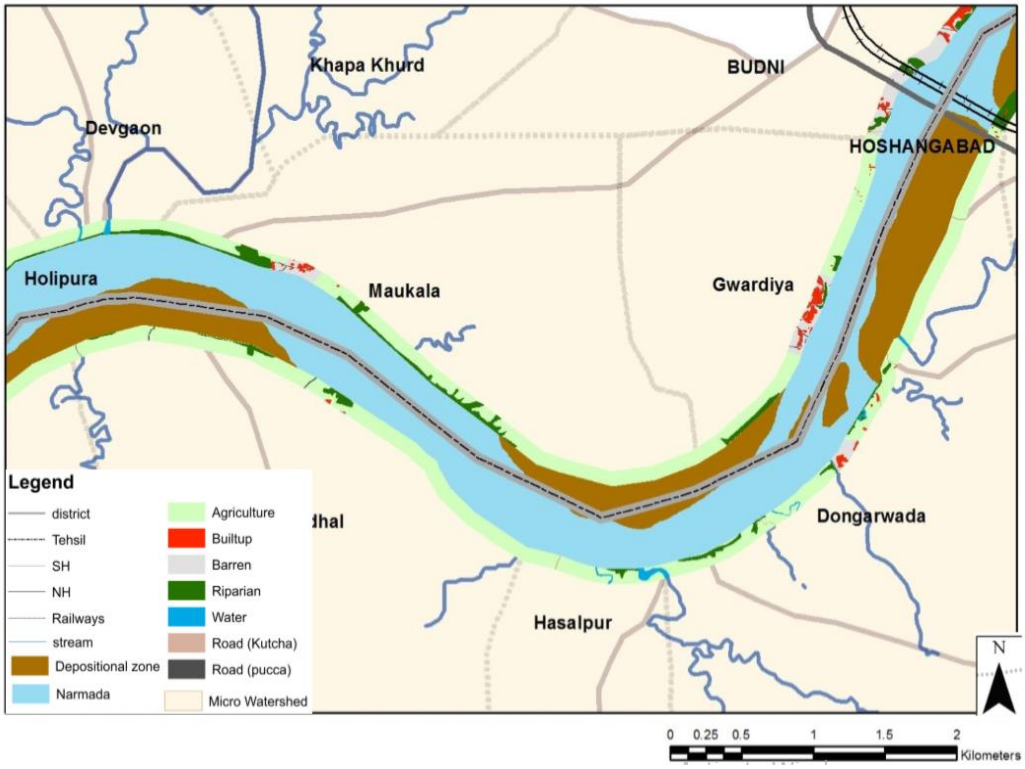


Figure.10. landcover of the selected area

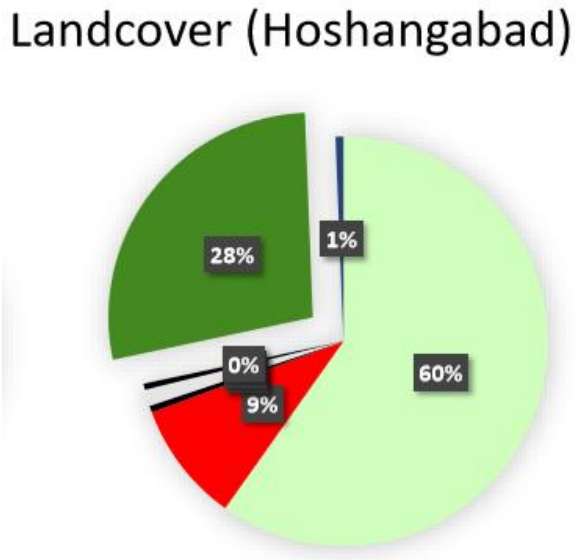


Figure.11. percentage distribution of lancover

Land cover analysis of Narmada River 500m buffer has shown that it has predominantly agriculture land more than any other category. Built-up mainly focused in centre of the district

4.3 Activity mapping

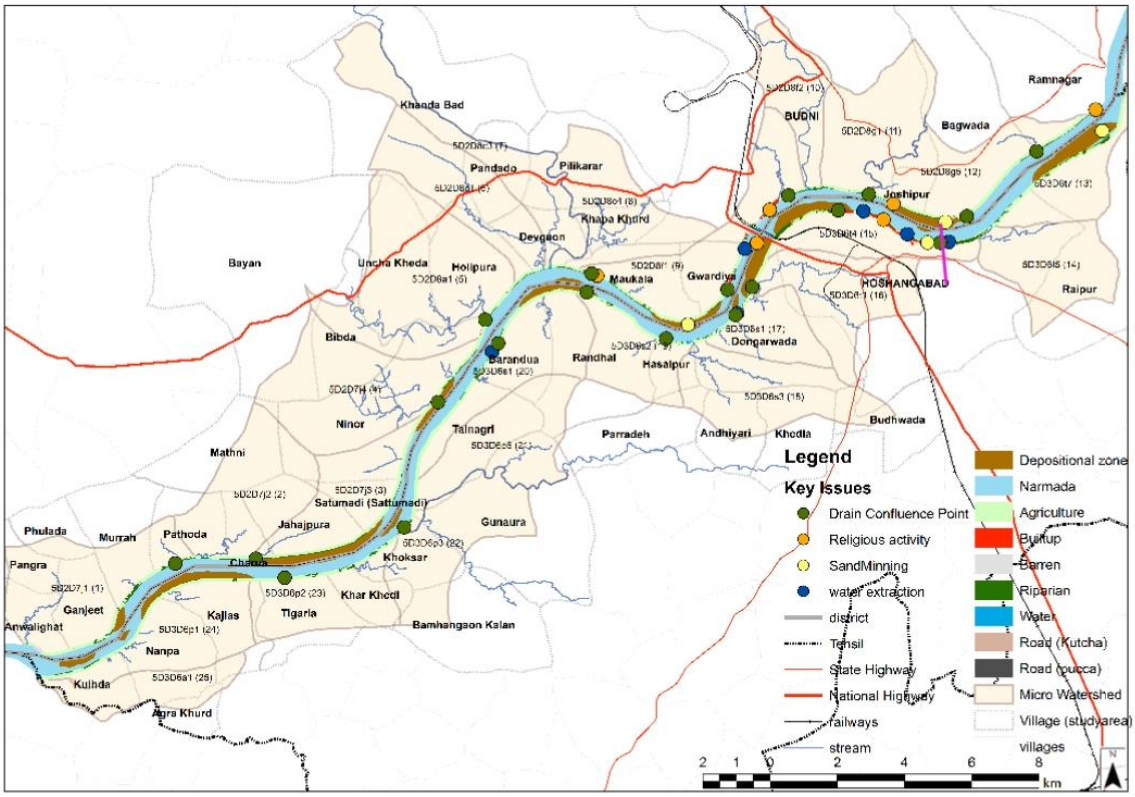


Figure.12. Activity mapping on River Narmada in Hoshangabad

Sand mining: The north Ghat of Narmada is highly exploited for mining the sand. Sand mining quires are less in southern Ghat.

Grazing: Animals are set free on banks for grazing and this leads to the destruction of riparian vegetation. This reduces the cohesion of soil and leads to increased erosion.

Long stretch of historical Ghat: Waste water of buildings along Ghat directly disposes it to Ghat and mixes with river create unhygienic conditions. Irregular cleaning results in accumulation of waste.

Intensive agriculture: Major problem in management is the increased runoff with high level of pollutants. The over use of fertilizers is causing this. Major reason are connectivity to major market and Narmada is a water surplus basin so availability of water is not an issue.

4.4 Hydrological analysis:

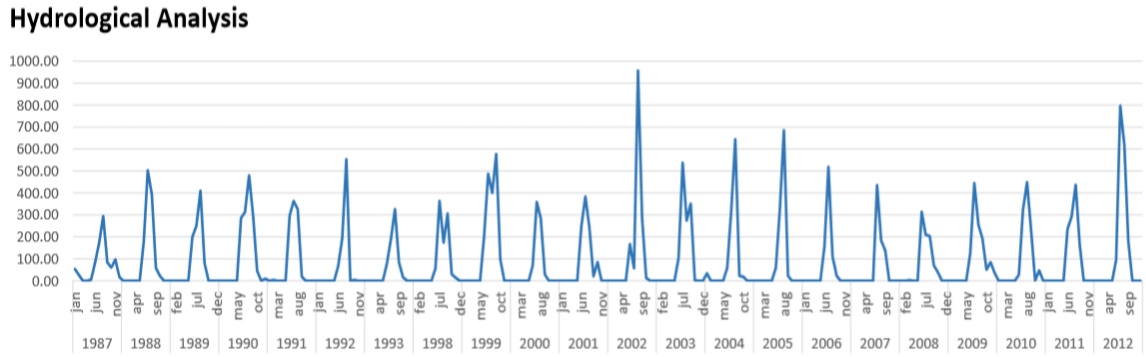


Fig.13.Monthly varioation of rainfall in h oshangabad rain gauge station from 1987 to 2012 (data missing 1994-1997)

There has been a clear increase seen during the time April to September, 2002 in comparison to other years following by the same in year 2012 itself.

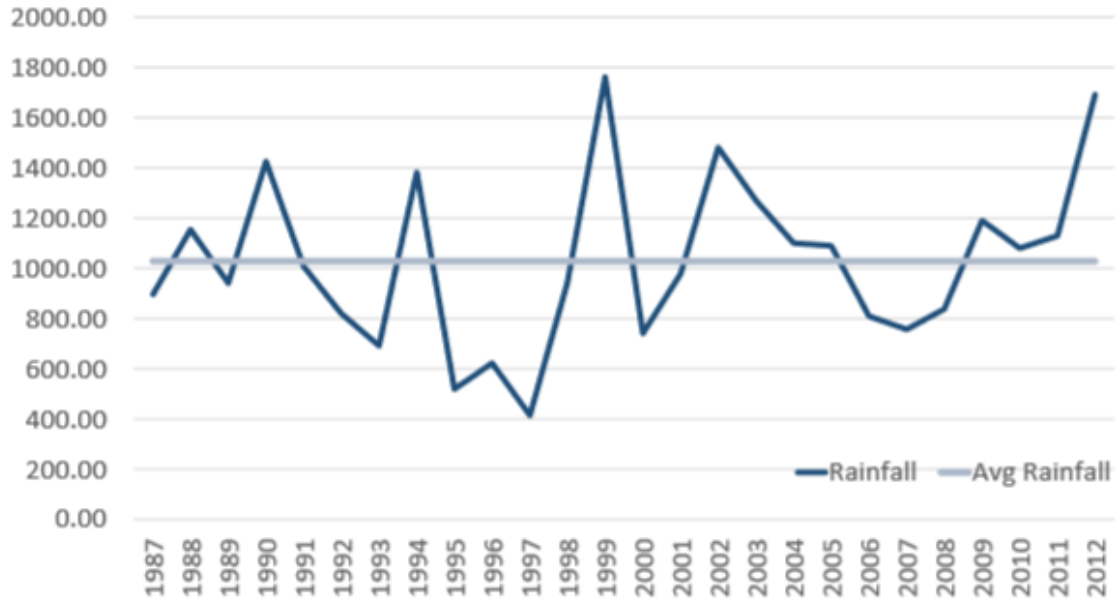


Fig.14.Annual variation of rainfall in Hoshangabad rain gauge station from 1987 to 2012

The figure above shows the clear depreviation in the amount of rainfall in the year 1995 to 1997, but has seen an increase in year 2012.

4.5 Water quality index:

S.No.	water quality parameter	Characteristics of water body				
		Drinking water source without conventional treatment but after disinfection	Outdoor bathing (organised)	Drinking water source with conventional treatment followed by disinfection.	Propagation of wild life, fisheries.	Irrigation, industrial cooling, controlled waste disposal.
1	pH	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	6.0-8.5
2	CL(mg/L)	250	-	600	-	600
3	DO(mg/L)	6	5	4	4	3
4	BOD(mg/L)	2	3	3	-	-

Table.8. Surface water quality standards (CPCB)

4.5.1 Findings of CPCB pollution tables year 2016 and 2017

- The pH of river water ranged from 7.5 to 8.9, which shows that it always remains alkaline. Temperature values found from 22.2°C to 35.1°C, the minimum being in winter and maximum in summer. The values of chloride ranged between 15.5-70.9 mg/l.
- The range of total hardness (TH) was 55.0-154.1 mg/l.
- The values of DO ranged between 7.12-11.30 mg/l.
- The values of BOD ranged between 1.5-3.9 mg/l, which is mostly higher than the permissible limit at downstream sampling point and in turn affects the Dissolved Oxygen.

- The COD values were found to be 7.2-27.3mg/L indicating about organic pollution in river water.
- Higher values of pH, Cl, total hardness, BOD, COD and lesser value of DO were noticed in summer season, which creates a problem for the Survival of aquatic life. DO content of water was very low in summer because of its enhanced utilization by microbes in the decomposition of organic matter (Sangu and Sharma).
- The high value of BOD and COD may be because of high pollution load and reduced water flow, while the low values in September may be due to dilution of water.

4.6 Physiography:

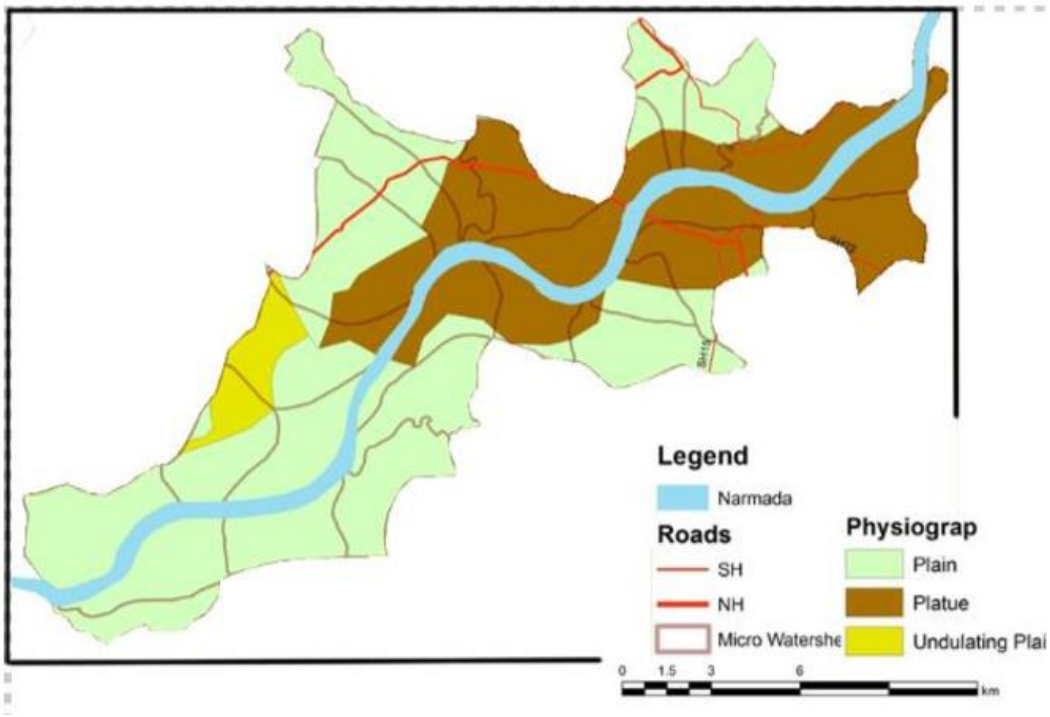


Figure. 15. Slope map

Deals with the type of geomorphological formation and type of landform exist in a specific area. In study area major initial part is plateau and river Narmada flows in a gorge rest of the area are plains. This gives the high slopes along the bank.

4.7 Soil depth

Soil depth is the measure explains the trend of soil to be found below the surface. It becomes one of the major factor of deciding which plant can be grown in that area. Initial section of area has comparatively deep soil 125 cm to 150 rest are

shallow.

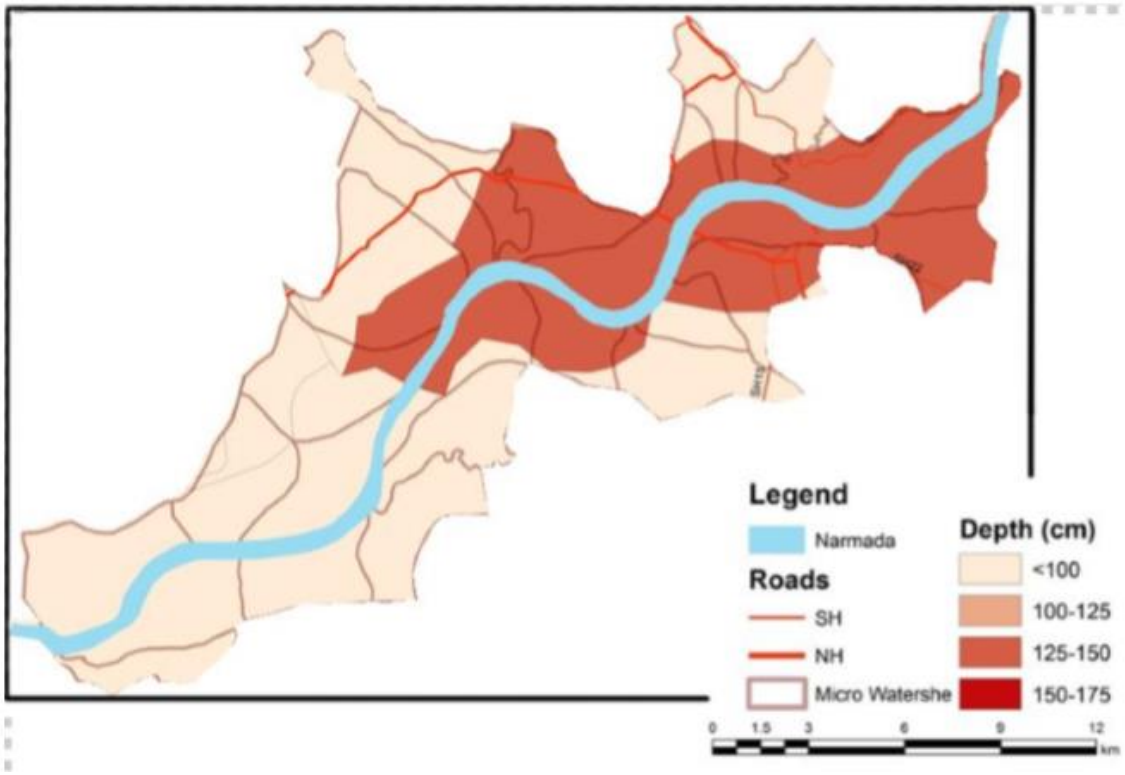


Figure.16. soil depth

4.8 District agricultural profile

Celebrated around the world for its fruitfulness, the overarching soil of the Narmada valley is dark alluvial topsoil, normally known as "dark cotton" is very argillaceous and wonderful for its awesome porosity and ensuing retentiveness of dampness. The aggregate geological region of the locale is 670,300 hectares, out of which, woods zone was 257,593 hectares i.e 38.41 % of aggregate zone. The non-agrarian land was 19,124 hectares, uncultivable and fruitless land was 25,256 hectares, cultivable land was 24,954 hectares and waste land was 6,354 hectares. In the uneven tracts the dirt is sandy and by and large unsuited for the development of spring crops.

Navigated by the holy Narmada waterway and its tributaries, Hoshangabad locale speaks to rich agrarian land and has been a transcendently rabi delivering territory. Locally rabi crops are known as "Unhari". Rabi crops rule the provincial economy

to such a degree, to the point that the Kharif crops known as "Sihari" were scorned previously. Rabi development is relatively synonymous with agribusiness.

Among rabi crops wheat is the primary yield took after by gram, masoor, pea and linseed. In the year 2009-2010 aggregate sown region was 527,642 hectares, out of which, Rabi crops sown in 274,623 hectares. Among the Kharif crops, paddy, jowar, maize, kodo kutki, tur and soyabean are the real harvests sown in 253,019 hectares. Twofold editing region was 223,200 hectares as revealed in Census 2011.

Alike a larger part of the regions, Hoshangabad locale is excessively commanded by horticulture. The aggregate geological region of the region is 670,300 hectares, out of which 286,096 hectares zone were watered i.e. 42.68 %. Principle wellspring of water system was trenches. Water system by channels was 141,018 hectares; by tanks 1,064 hectares; by tubewells 77,982 hectares; by wells 50,054.

Sowing window for 5 major field crops (start and end of normal sowing period)	Soybean	Rice	Maize	Pigeonpea	Blackgram	Greengram
Kharif- Rainfed	3rd week of June – 1st week of July	1st week of July – 2nd week of July	3rd week of June – 2nd week of July	3rd week of June – 2nd week of July	1st week of July - 2nd week of August	1st week of July- 2nd week of July
Kharif-Irrigated		2nd week of July – 4th week of July				
	Chickpea	Pea		Lentil	Wheat	Sugarcane
Rabi- Rainfed	1st week of October			2nd week of October		
Rabi-Irrigated	2nd week of October	2nd week of September- 2nd week of October		2nd week of October – 2nd week of	2nd week of October –4th week of December	October-March

Table.5. Major Crops sown in the Hoshangabad region (Agriculture Contingency Plan 2012)

Table.5. Major Crops sown in the Hoshangabad region and polluting agents

s.no.	Sitre number	Name of water body	District	Activity	Time period	Type of crop	Polluting agent
1	Agriculture	Narmada	Hoshangabad	Wheat	Oct/Nov-March/April	Rabi	DAP ,Urea,Potash ,MOP
2		Narmada	Hoshangabad	Gram	Oct/Nov-March/April	Rabi	DAP ,Urea,Potash ,MOP
3		Narmada	Hoshangabad	Sarso	Oct/Nov-March/Apri	Rabi	DAP ,Urea,Potash ,MOP
4		Narmada	Hoshangabad	Rice	may/june-Sep/Oct	Kharif	DAP ,Urea,Potash
5		Narmada	Hoshangabad	Soyabean	may/june-Sep/Oct	Kharif	DAP ,Urea,Potash
6		Narmada	Hoshangabad	Toor	Oct/Nov-March/April	Rabi	DAP ,Urea,Potash ,MOP
7		Narmada	Hoshangabad	Jau	Oct/Nov-	Rabi	DAP ,Urea,Potash ,MOP

					March/April		
8		Narmada	Hoshangabad	Urad	may/june-Sep/Oct	Kharif	DAP ,Urea,Potash

4.8.1 Outcomes

After analysing the slope through slope analysis it concludes that the slope in the micro watershed is high towards the river, hence when in the rainy season, the river intakes all the runoff from the agricultural land lying in the study area.

From the analysis of data it was observed that there is a distinct variation in water quality during dry and wet season. As the flow of water is less during dry season and water level goes down the quality of water become poor.

As a result water remains more polluted during dry season. Again during wet season due to rainfall the flow is more, level of water increases and the water quality becomes relatively better.

CHAPTER 5. RECOMMENDATIONS AND BENEFITS

Waterways are fundamental to human prosperity. In any case, numerous streams the world over are seriously debased or in danger, which undermines their capacity to give basic biological system benefits and related advantages. With a specific end goal to better draw in chiefs in preservation endeavors, WWF accepts there is a pressing need to combine and fortify the confirmation base in regards to the connection between enhanced waterway wellbeing and the advantages human social orders get from streams – social, monetary or vital.

5.1 Introduction

Riparian and buffer zone management.

Function of riparian buffer zones

5.1.1 Water quality improvement

Riparian vegetation has well-known beneficial effects on the water quality. Riparian forests of mature trees (30yrs-75yrs) are known to effectively reduce nonpoint pollution from agricultural fields. Vegetation in the riparian buffer is also a key component of the nutrient cycle. As ground water and surfaces water from the uplands run through the riparian areas, the dissolved nutrients they contain are removed through both the uptake by vegetation and adsorption to soil particles. The removal of sediment from upland erosion is another important function related to water quality that is provided by the buffer. But the most effective method in water quality improvement by riparian buffer is restriction of pollutant locations in buffer areas.

Riparian zones:

1. No harvest zone:
   Where timber harvest is completely prohibited (pioneer trees with less commercial value)
2. Special management zone:
   Where limited form and amount is permitted

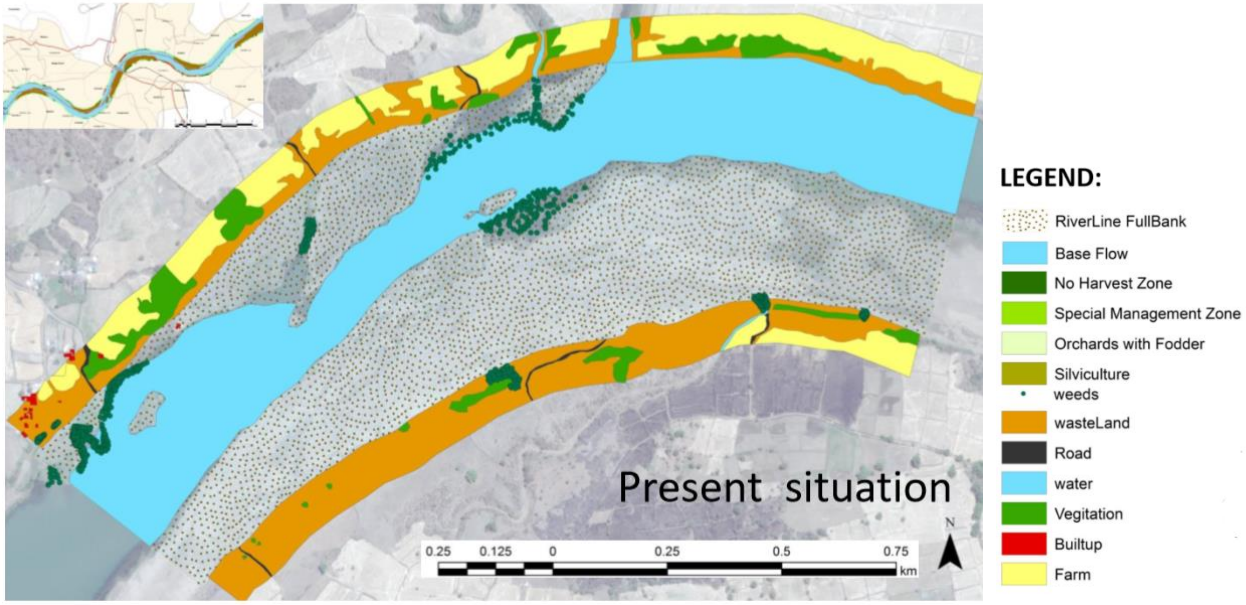


Figure.17. landcover of the study area

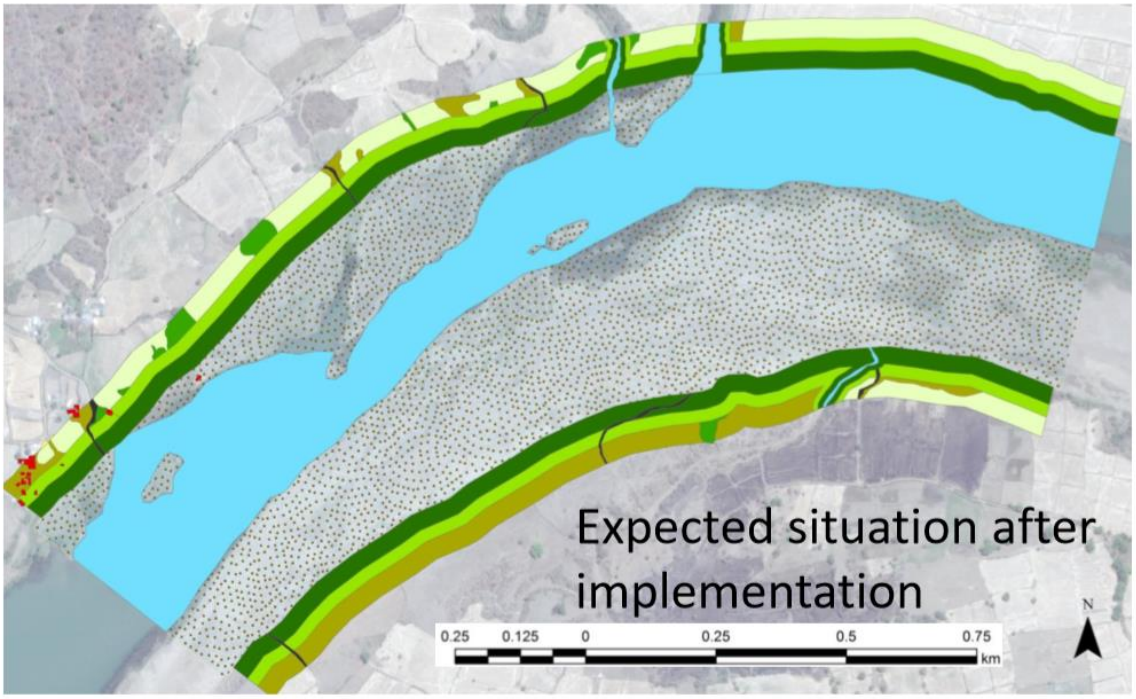


Figure.18. landcover of the study area

5.1.2 Design of Public Awareness Plan

The design of public awareness plan will be helpful in keeping the river clean and that too with the help of public support. Awareness plan will not only target people around the villages but will work also in the city. Awaring farmers about the type of pesticides and fertilizers they use and in the season they use them particularly will help up in reducing the runoff pollution and improve the soil quality. This public awareness programme will also help up in informing people about the different levels of pollution in river and there causes and effects.

The overall project development objective is to increase significantly the use of environmentally-friendly agricultural practices in the study area and thereby reduce nutrient discharge from agricultural sources in Hoshangabad to the Narmada River.

The public awareness activities will be delivered through cost effective, innovative vehicles as well as through the provision of training in the use and benefits of environment-friendly agricultural practices.

Key Issue	Desired Outcomes
1. Pollution Pollution of water caused by leakage of pollutants into the water system: from nonpoint sources, from livestock waste, and from human waste	• Increased understading of the problems caused by pollution and waste disposal • Agreed action to reduce levels of pollution • Reduction in nutrient discharge in ground waters • New sources of funds for pollution control and reduction • Replicability of pollution reduction activities • Access to waste disposal technologies
2. Water and life quality Land pollution generates unhealthy drinking water and associated diseases	• Better understanding of the relationship between waste disposal and water quality, water quality and health quality • Agreed action to reduce water contaminating practices at both household and agricultural levels • Improved health hence improved life conditions
3. Environment-friendly agricultural practices Current agricultural practices are exclusively crop-production oriented and are generating soil erosion and deforestation.	• Adoption of the environment-friendly agricultural practices chosen for the project • Replication of environment-friendly agricultural practices at national level
4. Manure management practices Current management, storage and application of fertilizers, manure and domestic waste is highly pollutant.	• Adoption of manure management practices • Replication of manure management practices at national level
5. Unfulfilled potential for tourism Lack of fish and wildlife food and cover, lack of recreational opportunities for citizens and tourists	• Enhanced media coverage and promotion of local potential for tourism • Increased awareness among locals on sustainable tourism • Higher levels of collaboration with NGOs to encourage local eco-tourism activities
6. Community environmental education and awareness Poor coverage of environmental issues in schools, low level of interest for environment in communities	Increased environmental awareness through enhanced school and NGO's participation

Source : Agricultural pollution control, Romania

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ANNEXURE 1

SOURCE:MPPCB, SHADOL (2017-18) near sethani ghat (downstream)						
	Ph	Cl	TH	DO	BOD	COD
APRIL	8.12	27.59	118	7.6	1.4	9.88
MAY	7.94	26.99	122	7.8	1.5	20
JUNE	7.84	27.96	230	7.7	1.6	19.36
JULY	7.74	23.99	124	7.8	1.5	9.68
AUG	7.68	22.66	124	7.8	1.4	9.6
SEPT	7.68	24.66	130	7.7	1.3	10
OCT	7.83	19.99	128	7.9	1.3	10
NOV	8.43	54.2	140	8.8	1.3	19.2
DEC	8.33	34	184	6.7	3	20
JAN	8.36	20.24	160	7.8	2.3	19.6
FEB						
MARCH						

Table.11. Water quality index throughout the year near Sethani Ghat (Downstream)

location near korighat (upstream)						
	Ph	Cl	TH	DO	BOD	COD
APRIL	8.04	26.6	126	7.9	1.6	19.76
MAY	7.92	27.99	132	7.7	1.4	10
JUNE	7.84	28.92	138	7.8	1.5	9.68
JULY	7.73	23.99	126	8	1.3	9.68
AUG	7.76	2365	130	7.8	1.4	9.28
SEPT	7.69	24.63	134	7.7	1.3	10
OCT	7.98	23.99	112	7.8	1.3	20
NOV	8.43	31.53	148	8.9	1.1	9.6
DEC	8.3	38	178	7	3	20
JAN	8.28	23.21	160	8.6	2.3	19.6
FEB						
MARCH						

Table.12. Water quality index throughout the year near Korighat Ghat (Upstream) (2017-18)

SOURCE:MPPCB, SHADOL (2016-17) near sethani ghat (downstream)						
	Ph	Cl	TH	DO	BOD	COD
APRIL	8.12	25.99	122	8	1.3	20
MAY	8.5	35.99	122	7.6	1.4	20
JUNE	8.31	27.59	130	7.8	1.2	19.76
JULY	8.28	26.6	138	7.7	1.1	19.76
AUG	8.5	31.53	122	7.6	1.7	10
SEPT	7.98	32.52	120	8.3	1.5	10
OCT	8.32	32.52	124	7.9	1.3	20
NOV	8.14	28.92	122	7.9	1.5	18.72
DEC	8.43	31.53	126	8.1	1.4	20
JAN	8.26	29.99	128	8	1.3	19.88
FEB	7.92	28.57	138	7.4	1.5	19.88
MARCH	7.78	30.85	134	7.4	1.4	10

Table.13. Water quality index throughout the year near Sethani Ghat (Downstream) (2016-17)

location near korighat (upstream)						
	Ph	Cl	TH	DO	BOD	COD
APRIL	7.92	25.99	122	8	1.3	20
MAY	8.5	29.99	152	7.6	1.5	20
JUNE	8.26	26.6	128	7.7	1.1	9.88
JULY	8.32	27.59	132	7.6	1	9.88
AUG	8.39	28.57	116	7.5	1.8	10
SEPT	8.32	29.36	118	8	1.2	20
OCT	8.28	31.53	122	8.1	1.2	20
NOV	8.18	27.96	124	7.7	1.4	9.36
DEC	8.38	28.59	128	8.2	1.3	20
JAN	8.13	25.99	136	7.9	1.4	9.88
FEB	7.87	31.53	150	7.8	1.5	19.88
MARCH	7.88	28.92	154	7.9	1.3	10

Table.14. Water quality index throughout the year near Korighat Ghat (Upstream) (2016-17)

Table No. 15: literature review

Classification	**1**	**2**	**3**
Title	1. Restoration plan of Narmada River with Designated best use classification of surface water quality based on river expedition, monitoring and quality assessment	Karnophuli River Front Development, Chittagong, Bangladesh	1. Narmada River water: Pollution and its impact on the human health, Mukesh Katakwar International Journal of Chemical Studies 2016
Name of the Journal	Open access e-Journal Earth Science India	American Journal of Engineering Research (AJER)	International Journal of Chemical Studies 2016
Objective	To reclassify the designated best use of water quality based upon river expedition carried out from March 27 to April 2011 in the entire 30 different segments.	To develop activities on the riverside in the west of Karnophuli river of Chittagong commercial and pedestrian site beautification.	To find out the pollution situation of Narmada River and the health problem of the surrounding residents.
Context of Study	To examine the existing situation and preparation of	To propose development	To find out the level various levels of different

	a restoration plan for the river.	activities in the front side of the west of the Karnophuli river of Chittagong.	chemical present in the water to check the status of water
Geographical Context	The study takes place at tehsil level (Kheda Itarsi)	The study undertaken is at a city level thus, correlating all the factors related to a city itself, Chittagong, Bangladesh	The study took place only on specific locations which were suspected to have high level of pollutants in water
Approaches and Framework	Comparing the satellite images of LANDSAT 1978 and LISS III 2008 it can be clearly seen reduction in the forest cover and wetlands in the entire Gomti basin due to rapid land use change	Analysing the location, listing the problems, cause of pollution.	
Tools and Techniques	GIS and LANDSET and Google images	Site survey and problem identification	Taking samples from different sites and
Parameters	• Change of land use • Rapidly decreasing forest cover.	• Marine pollution • Pollution by waste disposal • Erosion • Illegal activities	
Sampling Strategy	Comparing between the satellite images	Site survey	Colour, Ph level

	and secondary data.		
Findings	Quality of the water has deteriorated due to discharge of untreated wastewater and	Failure of the Bangladesh government and the responsible institutions, specifically to enforce the regulations and guidelines, has resulted in unsuccessful riverfront developments in this country. Therefore, in order to strengthen regulations and guidelines for riverfront developments in Chittagong, the government and the policy makers are required to do more with the regulations in the future.	The study provides evidence that local communities are suffering from a variety of health problems that could be a direct or indirect such as skin problems, stomach problems, gastric ulcers, diarrhoea, dysentery, yellow fever, cholera, dengue, malaria and other epidemic disease also available in this area.
Applicability in your context	The study is useful in planning approach towards the problem and	This paper is helpful in deciding the type of proposals which will	The study will help in defining methodology for the analysis

	can help in pointing out the important aspects	be given on the basis of the analysis.	

ANNEXURE II

Checklist for agricultural activities

For Agricultural activities
Group discussion with

1. Panchayati raj institutions
   - Sarpanch
   - Secretary
   - Gram Rozgar Shayak

Primary survey with the farmers:

Questionnaire No.: _____ **Date of Interview:**___/___/_____ **ID of Interviewer:** _____

District: 1 . Rajshahi / 2. Moulvibazar **Location of the business (town/village):** _____

Population of village/town _____ **Location:** 1. Urban / 2. Rural

Name of enterprise: _____

Address of enterprise: _____

Phone number (mobile, if available) _____

Gender of the respondent: 1. Male / 2. Female