Arth Ganga Project: District Munger

Submitted to:

National Mission for Clean Ganga (NMCG)

Submitted by:

IIM Lucknow

IIT Roorkee

JUNE-2022

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Munger, a city in the state of Bihar, is known for its religious, historical and industrial importance. The city is situated on the bank of the river Ganga.

The total geographical area of the district is 1398.40 km^2. The primary sector grew by 2.58% per annum during 2007-08 to 2013-14 is 2.58%. Its share went down from 25.96% in 2007-08 to 17.51% in 2013-14, as the other sectors grew faster. The share of the secondary sector increased from 22.89% in 2007-08 to 34.96% in 2013-14, with an impressive average annual growth rate of 17.10%. The tertiary sector occupies, on average, a 49.50% share in the district economy. It grew with a moderate annual growth rate of 7.71%; consequently, its share decreased from 51.15% in 2007-08 to 47.53% in 2013-14. Overall, the district economy grew with an average annual growth rate of 8.99% during the study period.

The cropping intensity of the district is 115.33%. Munger is categorized under Agro-climatic zone III A i.e. the Southern east zone. The district has sandy loam , clay loam, loam, clay types of soil with pH between 6.5-8.0. Major crop types are wheat, rice, maize, pulses like a variety of gram, lentil, etc. along with oilseeds, mustard, etc. The livestock consists of cattle (indigenous and crossbred), buffalos (indigenous and crossbred), pigs (indigenous and crossbred), goats; poultry, and fisheries. In 2018-19, the district's percentage of net and gross irrigated areas were 59.65% and 85.65%, respectively.

The share of cultivable wasteland remained constant at 0.64% between 2011-12 to 2019-20. The share of barren and uncultivable land remained constant (8.15%) over the years. The fallow land significantly increased from 15.59% in 2011-12 to 18.38% in 2019-20, a matter of concern for the district economy. The net sown area decreased over the years, from 31.90% in 2011-12 to 29.40% in 2019-20. The area for non-agricultural use slightly decelerated from 22.60% in 2011-12 to 22.39% in 2019-20. In 2019-20, the nitrogen and potassium share has decreased to 66.71% and 6.84% respectively, while the phosphorus share has increased to 26.44%. The use of nitrogen is more than the recommended ratio, while the Phosphorous and potassium usage is less than the recommended ratio. As the overall use of chemical fertilizers increased from 145.94 kg/ ha GSA in 2013-14 to 257.07 kg/ ha GSA in 2019-20.

According to the 2021 Forest survey, forests cover of the district is 20.16 with increase in the forest area of the district by 2.41 sq. km. The district has a total of 286.01 sq. km. under the forests out of which 37.97 sq. km. is under dense forests, 223.61 sq. km. is under moderately dense forests and 24.43 sq. km under the open forests. The district does not 9.43 sq. km. of area under scrubs. However, the area under trees and gardens remained constant at 0.43% between 2011-12 and 2019-20.

Munger is known for its historical, cultural, mythological, religious as well as natural importance The district is famous for Chandi Asthan. Tomb of Shah Pir-Nafah Dargah, Munger Fort, Karan Chaoura, I.T.C. Hot Spring Sita Kund, Hot water fall at Sringe Rishi at Ratanpur, Yoga Ashram, Sri Krishna Seva Sadan, Pri Pahari, Mir Qasim Tunnel (Sri Krishna Vatika) Kashtaharni Ghat, Sit Charn, Goenka Shivalya, Ucheshwernath, Shaheed Smarak, Kharagpur Lake, etc. In the district, kerosene is used by majority of the population, which is 64.50% of the households in the district as a source of lightning. Electricity is the second most popular source of lightning in the district with 34.30% households using it. Solar energy is consumed by 0.40% of the households in the district.

45.20% of the households use fire-wood, 20.80% of the households use cow-dung cake, 18.60% of the households use LPG/PNG, and 12.60% of the households use crop residue for cooking.

The total number of wetlands existing in the district is 195 consisting of both Man-made and Natural. Most of them are river/streams and waterlogged. The district's biodiversity data includes various crop production, livestock population, bird species, and forest cover with 339 bird species and 20 threatened/rare species of bird in the district. Biogas potential from animal waste is calculated approximately as fifty eight lakhs m3/year and one crores m3/year from agricultural waste. No hydropower plant exists in the district.
To promote sustainable development creating awareness, educating people about renewable energies, sanitation, maintaining decorum of the properties by not destroying or keeping them clean, Adopting Public-Private partnerships, upgrading staff and facilities, etc. Drip and Sprinkler irrigation, introducing Vermicomposting, use of high-yielding seeds, micro-irrigation, constructing and maintaining harvesting structures, adopting greenhouse farming with organic farming, and encouraging farmers for adapting different crop cultivation and various irrigation methods, adopt resources conservation technologies, Various measures such as eco-tourism should be taken to improve tourism and enhance the use of renewable energy especially by creating awareness. Along with focusing on agriculture practices Bee culture, dairy, poultry, fisheries, etc. needs encouragement as they have high economic potential. Monitoring and training programs and awareness and introducing Pradhan Mantri Matsya Sampada Yojana, KVKs instruction, subsidized crop insurance system, branding effort under the National Organic Foods Market, etc.

1. DISTRICT OVERVIEW

1.1 INTRODUCTION

Munger district is located on global map between 24°57' and 25°29' North latitude and 86°21' and 86°42' East longitude. The district occupies an area of 1,419 square kilometers. The rank of the district in comparison to other districts of Bihar in terms of area is 33rd. The two subdivision of Munger District Munger Sadar and Tarapur constitutes of a part of all alluvial north Bihar plain and a part of Kharagpur subdivision has hilly area. The two subdivision of Munger District Munger Sadar and Tarapur constitutes of a part of all alluvial north Bihar plain and a part of Kharagpur subdivision has hilly area.

The population of the Munger district during 2011 was 1,367,765. Munger district lies in the eastern part of the state. It is most ancient place. It consists of 3 subdivision Munger sadar, Kharagpur and Tarapur Containing,03 statutory towns, 04 census towns, 09 Blocks with 101 panchayats constituting 858 villages. work participation rate (WPR) in the district is 17.06 percent for main workers and 14.13 percent for marginal workers. Proportion of non-workers in the district is 68.81 percent.

Agriculture is the main occupation of the people of the district and also the main source of livelihood of the people. Rice and Wheat are the major crops grown in the district. Non-food crops coca a very small proportion and comprises mostly oil- seeds. Agricultural conditions are quite different in the north and south of the district. To the north is a fertile alluvial plain devoid of hills or natural fertile eminences. In the portion south of the Ganges

the cultivated area lies chiefly in the basin of the kiul river and its tributaries. In the centre are the Kharagpur Hills, a mass of rock and jungle with occasional patches of cultivation in the valleys.

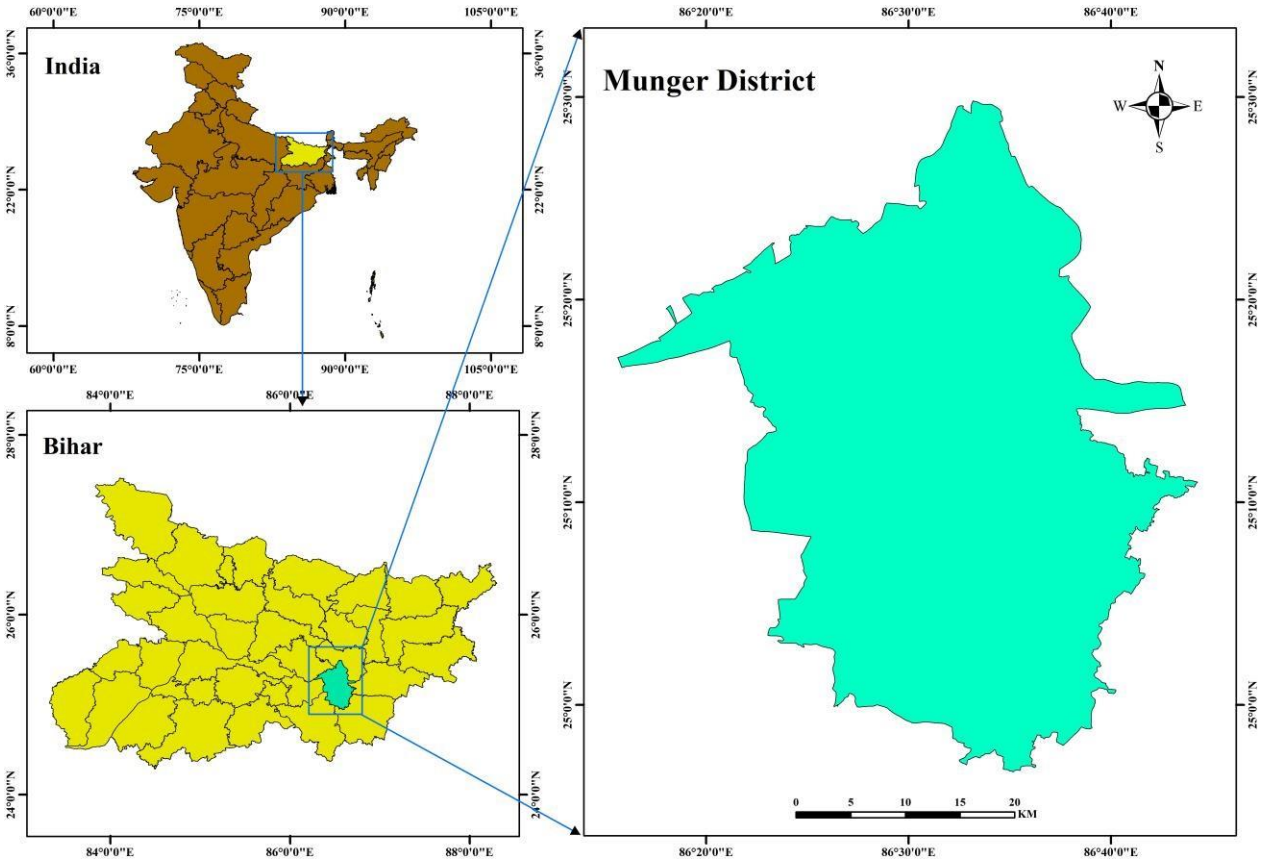


Figure 1 Map of the district

1.2 DEMOGRAPHIC PROFILE OF MUNGER

Munger district came into existence on 1832, prior to that it was a part of Bhagalpur district. Munger district lies between a latitude of 25°45' to 25°15' North and between a longitude of 85°45' to 85°45' East. The district has an aggregate area of 1419.7 sq.km. The district is surrounded by river Ganga Begusarai district and Kahgaria district in the north, Lakhisarai in the North-West, Bagalpur in the East, Banka and Jamui in the South. The rivers flowing in the district are Ganga, Mohane, Harohar and Kiul. There are a total 903 villages (inhabited) in the district, and among those 534 are electrified. The district headquarters is situated in Munger town. There are 3 subdivisions and 9 blocks. The 3 subdivisions are Munger Sadar, Kharagpur and Tarapur. The 9 blocks in the district are Munger Sadar, Bariarpur, Jamalpur, Dharahara, Kharagpur, Tetia Bambar, Tarapur, Asarganj, and Sangrampur.

According to the Census 2011, the population of the district is 1367765, and out of this 27.79% of the population lives in the urban areas, which is 380120 and the rest 72.20% which is around 987645 lives in the rural areas. Around 53.30% of the population is male, which means 729041 is male population and the rest 46.69% of the population is female, which means 638724 is the female population in the district. The sex ratio in the state is 876 females per thousand males. Total literacy ratio in the state is 76.87%, total literacy ratio among males in the state is 77.74%, and total literacy among female population is 62.08%.

The total cultivable land in the district is 8600 hectares and the net sown area is 51846 hectares. According to the Input Survey 2016-17, the total irrigated net sown land is 20162 hectares and the unirrigated land is 31684 hectares, the most common irrigation method techniques are irrigation by canals, wells, tube-well, pond, and through lift irrigation. The total forest area is 2375.9 hectares.

The economy of the district depends upon the agriculture sector. Other than that, only tobacco, gun making and Easter railway coach factory has been profitable and the rest secondary and tertiary sector is underdeveloped. There are three industrial regions in the district which are namely; Munger, Jamalpur and Sitakund.

1.3 ECONOMIC PROFILE OF MUNGER

The primary sector contributes, on average, 20.84% to the district GDP. However, it grew by 2.58% per annum during 2007-08 to 2013-14 is 2.58%. Its share went down from 25.96% in 2007-08 to 17.51% in 2013-14, as the other sectors grew faster. The share of the secondary sector increased from 22.89% in 2007-08 to 34.96% in 2013-14, with an impressive average annual growth rate of 17.10%. The tertiary sector occupies, on average, a 49.50% share in the district economy. It grew with a moderate annual growth rate of 7.71%; consequently, its share decreased from 51.15% in 2007-08 to 47.53% in 2013-14. Overall, the district economy grew with an average annual growth rate of 8.99% during the study period. The growth in the primary sector is less than in the other two sectors. Steps should be taken to increase the productivity of the primary sector so that it can grow at a higher rate.

Table 1: Trends in Gross District Domestic product in Munger at Constant Prices (base 2004-05), Millions in Rs

Year	Sector-wise GDDP				Annual Growth Rates			
	PRIMARY SECTOR	SECONDARY SECTOR	TERTIARY SECTOR	TOTAL GDDP	PRIMARY SECTOR	SECONDARY SECTOR	TERTIARY SECTOR	TOT GDI
2007 -08	4206 (25.96)	3709 (22.89)	8289 (51.15)	16204 (100)	-	-	-	-
2008-09	4505	4349	9038	17892	7.11	17.26	9.04	10.4

	(25.18)	(24.31)	(50.51)	(100)				
	3702	5422	10157	19281	-17.82	24.67	12.38	7.76
2009 -10	(19.20)	(28.12)	(52.68)	(100)				
	4169	6854	10590	21613	12.61	26.41	4.26	12.09
2010-11	(19.29)	(31.71)	(49.00)	(100)				
	4526	7439	10862	22828	8.56	8.54	2.57	5.62
2011 -12	(19.83)	(32.59)	(47.58)	(100)				
	4833	8439	12276	25548	6.78	13.44	13.02	11.92
2012 -13	(18.92)	(33.03)	(48.05)	(100)				
	4748	9478	12887	27113	-1.76	12.31	4.98	6.13
2013-14	(17.51)	(34.96)	(47.53)	(100)				
Average Growth Rate					2.58	17.10	7.71	8.99

Source: http://data.icrisat.org/district-level-data/
Note: Figures in Parenthesis are percentage share of total GDDP

2. Quantitative Data Analysis

2.1 Agriculture and Allied Activities

The total declared area of the district is 1398.40 sq. km². The Forest area represents 20.39% of the total reported area. The share of cultivable wasteland remained constant at 0.64% between 2011-12 to 2019-20. The share of barren and uncultivable land remained constant (8.15%) over the years. The fallow land significantly increased from 15.59% in 2011-12 to 18.38% in 2019-20, a matter of concern for the district economy. Moreover, the net sown area (NSA) decreased over the years, from 31.90% in 2011-12 to 29.40% in 2019-20. The area for non-agricultural use slightly decelerated from 22.60% in 2011-12 to 22.39% in 2019-20 (Table 2). However, the area under trees and gardens remained constant at 0.43% between 2011-12 and 2019-20, which should be increased to achieve sustainable development goals. Overall, the land use pattern shows that the area under fallow land significantly increased while the NSA decreased over the years.

Table2: Trends in land use pattern in Munger (as % of the total reported area)

Year	TOTAL REPORTED AREA (in 1000 Ha)	AREA UNDER FOREST	CULTIVABLE WASTELAND	TOTAL FALLOW	BARREN AND UNCULTIVABLE LAND	OTHER LAND THAN AGRICULTURE	PASTURE LAND	AREA UNDER TREES AND GARDENS	NET SOWN AREA
1	2	3	4	5	6	7	8	9	10
2011-12	139.8	20.39	0.64	15.59	8.15	22.60	0.14	0.43	31.90
2012-13	139.8	20.39	0.64	15.59	8.15	22.68	0.14	0.43	31.90
2013-14	139.8	20.39	0.64	16.24	8.15	22.75	0.14	0.43	31.12
2014-15	139.8	20.39	0.64	18.81	8.15	22.89	0.14	0.43	28.47
2015-16	139.8	20.39	0.64	14.88	8.15	22.89	0.14	0.43	32.40
2016-17	139.8	20.39	0.64	17.17	8.15	22.89	0.14	0.43	30.11

2017-18	139.8	20.39	0.64	16.95	8.15	22.89	0.14	0.43	30.33
2018-19	139.8	20.39	0.64	18.45	8.15	22.39	0.14	0.43	29.33
2019-20	139.8	20.39	0.64	18.38	8.15	22.39	0.14	0.43	29.40
Source: http://dse.bihar.gov.in/ and http://data.icrisat.org/district-level-data/									

2.3.2 Trends in Operational Land Holdings

In Munger district, the total number of operational farms increased from 155 thousand in 2010-11 to 161 thousand in 2015-16, a net increase of 3.87%. While in the state, their numbers increased from 16191 thousand in 2010-11 to 16412 thousand in 2015-16, a net increase of 1.36%. Most land positions in the district are marginal and small. These two size categories represented 96.71% in the district in 2015-16, while the corresponding proportion in the state was 96.96% (Table 3). There is a slight decline in the percentage share across the marginal and medium land holdings, while the share of the small, semi-medium, and large land holdings increased.

Table3: Distribution of Operational Holdings by Size-categories of farms (in %) in Munger

	Agri Census	Marginal Holdings (0-1 Ha)	Small Holdings (1-2 Ha)	Semi-Medium Holdings (2-4 Ha)	Medium Holdings (4-10 Ha)	Large Holdings (10 & above Ha)	Total Holdings ('000 No.)
Munger	2010-11	93.59	4.35	1.74	0.33	0	155
	2015-16	92.01	4.7	3.16	0.13	0.01	161
							[3.87]
Bihar	2010-11	91.06	5.86	2.56	0.5	0.02	16191
	2015-16	91.21	5.75	2.52	0.5	0.02	16412
							[1.36]

Source: Compiled from https://agcensus.nic.in/. Figures in [] are percentage increase/ decrease in 2015-16 over 2010-11.

2.3.3 Trends in Area, Production, and Yield of Principal Crops

2.3.3.1 The Trend in Cropping Patterns

Rice and Wheat dominate the agriculture of the district. Table 4 shows the area devoted to various crops over the last seven years. In 2019-20, Rice made up the highest share of GCA (55.06%), followed by Wheat (28.90%). These two crops constitute around 83.96% of the GCA. The area under total cereals decreased from 90.14% in 2013-14 to 88.82% in 2019-20. The main pulses produced are Gram and Masoor (Lentil). The total pulses acreage increased from 4.23% in 2013-14 to 5.06% in 2019-20. The food grains acreage slightly decreased from 94.37% in 2013-14 to 93.88% in 2019-20. However, the food grains cover a majority (average, 93.97%) of the GCA. Mustard is the only major oilseeds crop produced, and the total oilseed acreage increased from 1.21% in 2013-14 to 1.27% in 2018-19. In general, there was no significant change in the cultivation pattern reported in the district during the study period. The average cropping intensity in the district is quite low at 114.96.

Table 4: Trends in cropping pattern (as % GSA) and cropping intensity

Crop/Year	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20

Rice	51.51	48.37	53.10	53.06	55.85	54.55	55.06
Wheat	31.99	30.80	27.91	29.55	28.54	29.39	28.90
Other Cereals	6.64	9.98	8.72	6.60	4.52	4.86	4.85
Total Cereals	90.14	89.15	89.73	89.21	88.91	88.79	88.82
Gram	1.61	1.74	1.74	1.75	1.85	1.90	1.69
Masoor (Lentil)	1.41	1.52	1.36	1.44	1.44	1.48	1.48
Other Pulses	1.21	1.52	1.36	1.51	1.44	1.69	1.90
Total Pulses	4.23	4.77	4.46	4.71	4.72	5.07	5.06
Total Food Grains	94.37	93.93	94.19	93.92	93.63	93.87	93.88
Mustard	1.01	1.08	0.97	1.03	1.03	1.06	1.05
Other Oilseeds	0.20	0.22	0.19	0.21	0.21	0.21	0.21
Total Oilseeds	1.21	1.30	1.16	1.24	1.23	1.27	1.27
Net Sown Area	87.53	86.33	87.79	86.80	87.06	86.68	86.71
Gross Sown Area (in 1000 Ha)	49.70	46.10	51.60	48.50	48.70	47.30	47.40
Cropping Intensity	114.25	115.83	113.91	115.20	114.86	115.37	115.33
Source: Compiled from http://dse.bihar.gov.in/ and http://data.icrisat.org/district-level-data/							

2.3.3.2 Trends in per hectare yield of principal crops

Table 5 shows that the yield per hectare of most crops varies yearly. Wheat and Rice are the major crops, and their per-hectare yields, 25.33 qtls, and 21.38 qtls, respectively, in 2019-20 are quite low. The yield of total cereals decreased from 25.54 qtls in 2013-14 to 23.35 qtls in 2019-20, mainly due to a decrease in Rice yield. On the other hand, the per hectare yield of total pulses decreased from 11.43 qtls in 2013-14 to 8.75 qtls in 2019-20. The yield of total oilseeds also declined from 13.33 qtls in 2013-14 to 10.00 qtls in 2019-20. Moreover, the yield of total food grains went down from 24.90 qtls in 2013-14 to 22.56 qtls in 2019-20. In summary, all crop yields show year-over-year fluctuations, with a sudden fall observed in the yield of pulses and total oilseeds in the latter years of the study. The lack of stability in the yields makes farmers' income riskier and more unstable, requiring a solid insurance protection measure.

Table 5: Trends in yield of Principal Crops in Munger District (in Qty per Ha)

Crop/Year	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Rice	25.86	27.71	26.20	23.87	28.20	14.03	21.38
Wheat	24.84	16.27	16.94	23.12	27.91	27.55	25.33
Total Cereals	25.54	23.87	22.87	23.81	28.20	18.90	23.35
Gram	11.25	8.75	12.22	10.20	10.00	10.00	8.75
Masoor (Lentil)	11.43	7.14	8.57	8.33	8.57	7.14	7.14
Total Pulses	11.43	8.64	10.87	9.71	9.57	9.17	8.75
Total Food Grains	24.90	23.09	22.30	23.11	27.26	18.38	22.56
Mustard	14.00	14.00	16.00	12.67	12.00	10.00	10.00
Total Oilseeds	13.33	13.33	15.00	12.22	11.67	10.00	10.00
Source: Compiled from http://dse.bihar.gov.in/ and http://data.icrisat.org/district-level-data/							

2.3.3.3 Trends in Production of Principal Crops

Table 6 shows the trends in the production of the main crops over the years. Rice and Wheat dominate the production. In 2019-20, Rice (55.8 thousand tons), and Wheat (34.7 thousand tons) formed a major part of the total cereal production (98.3 thousand tonnes). However, there is a significant decrease in the production of total cereals from 114 thousand tons in 2013-14 to 98 thousand tons in 2019-20. Coming to pulses, Gram and Masoor (lentils) occupied the highest production, with their production being 0.7 thousand tons and 0.5 thousand tons, respectively, in 2019-20. Although these pulses show variation in the production across years, they still represent 57.14% of the total pulse production. Mustard production was 0.5 thousand tons, representing 83.33% of the total oilseed production in 2019-20. Looking at the annual production data of various crops, we find that cereals, pulses, and oilseeds production significantly declined. Proper insurance arrangements are needed to get assured income, take more risks and diversify production.

Table 6: Trends in Production of Principal Crops in Munger District (in 1000 Tons)

Crop/Year	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Rice	66.2	61.8	71.8	61.4	76.7	36.2	55.8
Wheat	39.5	23.1	24.4	33.1	38.8	38.3	34.7
Other Cereals	8.7	13.2	9.7	8.5	6.6	4.9	7.8
Total Cereals	114.4	98.1	105.9	103.0	122.1	79.4	98.3
Gram	0.9	0.7	1.1	0.9	0.9	0.9	0.7
Masoor (Lentil)	0.8	0.5	0.6	0.6	0.6	0.5	0.5
Other Pulses	0.7	0.7	0.8	0.8	0.7	0.8	0.9
Total Pulses	2.4	1.9	2.5	2.2	2.2	2.2	2.1
Total Food Grains	116.8	100	108.4	105.3	124.3	81.6	100.4
Mustard	0.7	0.7	0.8	0.6	0.6	0.5	0.5
Other Oilseeds	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total Oilseeds	0.8	0.8	0.9	0.7	0.7	0.6	0.6

Source: Compiled from http://dse.bihar.gov.in/ and http://data.icrisat.org/district-level-data/

2.3.3.4 Variability assessment in the area, production, and yield

To understand the variability across the years (Table 7), we calculated the mean, standard deviation (SD), and coefficient of variation (COV) in the area, production, and yield of the main crops. Among different crops, the lowest variability in the area is observed in Masoor and Mustard (0.00%), followed by Wheat (5.14%), and the highest in Rice (6.52%). The variability in the area under total pulses (4.67%) is higher than in the area under total cereals (4.14%).

Table 7: Variability in Area, Production and Yield of Principal Crops (2013-14 to 2019-20)

	Area (1000 Ha)			Production (1000 Ha)			Yield (Qty/Ha)		
Crop	**Average**	**SD**	**COV**	**Average**	**SD**	**COV**	**Average**	**SD**	**COV**
Rice	25.73	1.68	6.52	61.42	13.11	21.35	23.89	4.93	20.64
Wheat	14.33	0.74	5.14	33.13	6.82	20.57	23.14	4.75	20.54
Total Cereals	43.27	1.79	4.14	103.03	13.58	13.18	23.79	2.81	11.81
Gram	0.85	0.05	5.88	0.87	0.14	15.86	10.17	1.26	12.36

Masoor (Lentil)	0.70	0.00	0.00	0.58	0.11	18.29	8.33	1.52	18.29
Total Pulses	2.28	0.11	4.67	2.22	0.20	8.80	9.73	1.06	10.85
Total Food Grains	45.55	1.76	3.87	105.25	13.64	12.96	23.09	2.70	11.70
Mustard	0.50	0.00	0.00	0.63	0.11	17.46	12.67	2.21	17.46
Total Oilseeds	0.60	0.00	0.00	0.73	0.11	15.08	12.22	1.84	15.08
Source: Compiled from http://dse.bihar.gov.in/ and http://data.icrisat.org/district-level-data/									

The variability in production depends on the variability of the cultivated area and the variability of the yield. The highest variability in production is observed in Rice (21.35%), followed by Wheat (20.57%), Masoor (18.29%) and Mustard (17.46%). The variability in the production of total oilseeds is 15.08%. Improvement in crop insurance conditions and better market accessibility can lower this variation. Variability is lowest in grams (15.86%).

In the case of yield, the highest variability is estimated in Rice (20.64%), closely followed by Wheat (20.54%) and Masoor (18.29%). Yield variability in total pulses (10.85%) is lower in total cereals (11.81%). The tale indicates that variability in the production of various crops is mainly due to variation in the yields as areas under different crops are more stable. Several factors, such as climate change, market prices, rainfall patterns, etc., influence the variability in agricultural production.

2.3.4 Consumption of Chemical Fertilizers

Table 8 shows the trends in the use of chemical fertilizers in agriculture. The recommended nitrogen to phosphorus and potassium ratio is 4:2:1, which is not maintained in the district. For example, in 2013-14, nitrogen represented 82.56% of the total fertilizers used, while the proportions of phosphorus and potassium were 10.57% and 6.88%, respectively. In 2019-20, however, the nitrogen and potassium share has decreased to 66.71% and 6.84% respectively, while the phosphorus share has increased to 26.44%. The use of nitrogen is more than the recommended ratio, while the Phosphorous and potassium usage is less than the recommended ratio. The table also shows that fertilizer consumption varies yearly, which can be due to several factors such as rainfall patterns, cultivation patterns, etc. As the overall use of chemical fertilizers increased from 145.94 kg/ ha GSA in 2013-14 to 257.07 kg/ ha GSA in 2019-20, the authorities should take steps to reduce their consumption as the chemicalization of agriculture degrades soils and water resources. There is a need to incentivize the farmers to use organic and bio fertilizers.

Table 8: Trends in Use of Chemical Fertilizers in Agriculture (Kgs/per ha GSA)

Fertilizer/Year	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Nitrogen	120.48	173.51	171.20	147.34	160.99	163.49	171.50
Phosphorous	15.43	24.69	27.87	22.66	39.53	52.81	67.97
Potassium	10.04	14.95	15.23	24.19	19.34	8.27	17.59
Total	145.94	213.15	214.32	194.16	219.88	224.55	257.07
GSA (1000 Ha)	49.7	46.1	51.6	48.5	48.7	47.3	47.4
Source: Compiled from http://dse.bihar.gov.in/ and http://data.icrisat.org/district-level-data/							

2.3.5 Irrigation Structure and Status

2.3.5.1 Source-wise area under irrigation

Canals and groundwater (GW) both are the main sources of irrigation. The canal's share in the NIA (average, 60.50%) and the share of wells and tube wells in NIA (average, 38.66%) remained almost consistent over the years. The district's percentage of net irrigated areas decreased over the years, while the percentage of the gross irrigated area increased.

Table 9: Source-wise Area under Irrigation in Munger (in % of NIA)

Source/Year	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
CANALS	60.21	60.74	60.42	60.29	60.55	60.63	60.63	60.58	60.41
Wells and Tube Wells	38.38	38.84	38.75	38.73	38.67	38.58	38.58	38.59	38.78
Other Sources	1.41	0.41	0.83	0.98	0.78	0.79	0.79	0.83	0.82
NIA (1000 Ha)	28.40	24.20	24.00	20.40	25.60	25.40	25.40	24.10	24.50
GIA (1000 Ha)	42.40	36.70	37.90	33.80	39.40	38.60	38.80	37.40	40.60
% of NIA	63.68	54.26	55.17	51.26	56.51	60.33	59.91	58.78	59.61
% of GIA	74.26	72.96	76.26	73.32	76.36	79.59	79.67	79.07	85.65

Source: Compiled from http://dse.bihar.gov.in/ and http://data.icrisat.org/district-level-data/

2.3.6 Status of Organic Farming

To promote sustainable agricultural practices and improve the farmers' livelihood, the Government of India launched PKVY and Namami Gange schemes. Under these schemes, farmers are incentivized to form groups to do organic farming and sell their products with PGS certification. The transition period for the full conversion from conventional to organic is considered three years. During this period, crop yield, on average, is expected to decline by 10—15 percent. But after three years, it may reach its original level. Financial assistance received by the beneficiary farmers seems to be adequate to compensate for the yield losses and motivate them to do organic farming. There is a need to set up an integrated processing unit for organic products. Monitoring of the project should be periodically done through MIS, Geo-tagging, and monthly physical and financial reports.

There may be a possibility that in the absence of the regulatory framework, the beneficiary farmers may revert to conventional farming. In this context, two things need to be thought of—a well-designed regulatory and monitoring framework and the introduction of payments for ecosystem services for the organic farmers after the transition period so that they may carry on the activity sustainably. Organic and zero-budget farming will provide ecological services in terms of soil health, human and animal health, water-saving, biodiversity protection, etc. A long-term system of payments for ecological services may be evolved to retain the existing farmers and motivate others to move towards this sustainable farming system. There is no assured market for these products, and farmers do not get premium prices. Certification and quality check and monitoring mechanisms are yet to be set up.

Table 10 shows the details of establishing organic clusters under the PKVY and Namami Gange scheme in the district. The district has 74 groups in five development blocks. The highest number of groups are in Bariyarpur (33), followed by Munger Sadar (24). Significantly high variation can be seen in the number of farmers per group. It is reported that the maximum limit of land under a cluster per farmer is 2.00 hectares. Hence, the majority of the beneficiary farmers are small and marginal. Groups should be further encouraged in other development blocks as well.

Table 10: Status of Organic Farming PGS Groups under PKVY and Namami Gange Schemes in Munger (as on June 6, 2022)

S. No.	Block	Scheme	No. of groups	No. of farmers in groups			
				Total	Average	Median	SD
1	**Asarganj**	PKVY	1	20	20	20	0
		PKVY	7	158	22.57	21	3.9
2	**Bariyarpur**	Namami Gange	26	517	19.88	19.5	9.78
		PKVY	1	32	32	32	0
3	**Dharhara**	Namami Gange	7	128	18.28	18	4.34
4	**Jamalpur**	Namami Gange	8	176	22	22	4.65
		PKVY	15	388	25.86	26	2.32
5	**Munger Sadar**	Namami Gange	9	153	17	16	9.96
		PKVY	24	598	24.91	25.5	3.57
		Namami Gange	50	974	19.48	19	8.53
6	**District Total**	Total	74	1572	21.24	22	7.71

Source: Compiled from https://pgsindia-ncof.gov.in/

Since per hectare use of chemical fertilizer is quite high, a gradual shift of farmers from conventional to organic farming systems is likely to positively impact water quality, soil health, and farm sustainability. However, organic farming being a knowledge-intensive system, farmers need proper training to know the practical details of the integrated sustainable farming system. Since economies of scale in both production and marketing matter in organic farming, there is a need for some institutional framework in the forms of SHGs/ farm cooperatives/PFOs/contract farming, etc.

Organic farming could be an economically viable option in the district if the government builds strong marketing networks linking farmers, processors, and distributors with the easy certification process and minimizes farmers' risk by protecting their farm income through payments of ecosystem services. A long-term system of incentives and regulation needs to be evolved to retain the existing farmers and motivate others to move toward a sustainable farming system in the district.

The major problem for the growth of organic farming observed are:

1. The major problem of the farmers was poor marketing of the organic products and the inability to fetch a premium. The problem of marketing is even more severe in the case of perishable vegetable crops. Contract farming companies and Farmer Producers' companies can be encouraged.
2. Scaling up the organic production is another problem.
3. Although organic farming clusters are formed, the farmers allocated a part of their lands to organic farming and practiced conventional farming in the rest of the area, which may contaminate the organic produce and fail the purpose of the cluster approach in organic farming.
4. The knowledge and awareness about organic farming practices were inadequate among farmers.

2.3.7 Trends in Livestock Sector

The total number of cattle increased in the district from 141 thousand in 2003 to 203 thousand in 2019, a net increase of 43.11%. However, the number of adult male cattle significantly decreased from 26 thousand to 5 thousand in the same period. The increase in total cattle has been due to an increase in adult female cattle (from 54 thousand to 93 thousand) and young cattle (from 61 thousand to 104 thousand) during the same period. Cattle

represent 76.48% of the total large ruminants. Moreover, cattle's share in large ruminants increased from 72.64% in 2003 to 82.39% in 2019. However, total buffaloes decreased from 53 thousand in 2003 to 43 thousand in 2019, a net decrease of 18.79%. This decline is driven by a decrease in adult female buffaloes (from 25 thousand in 2003 to 21 thousand in 2019) and young buffaloes (from 24 thousand in 2003 to 21 thousand in 2019). Buffaloes represent 23.51% of the total large ruminants. However, total Sheep increased from 0.71 thousand in 2003 to 2.76 thousand in 2019, a net increase of 288.73%. Total goats increased from 141 thousand in 2003 to 219 thousand in 2019, registering a net increase of 55.10%. Total pigs decreased from 6.39 thousand in 2003 to 2.33 thousand in 2019, a net decrease of 63.54%. The total livestock population went up from 342.59 thousand in 2003 to 469.18 thousand in 2019, a net increase of 36.95%.

Notably, the number of female cattle substantially increased over the period, indicating the growth of livestock products, including milk. The substantial decline in the number of male cattle and male buffaloes shows the rising farm mechanization and declining relevance of animal power, mainly because of the high maintenance cost of livestock.

Table 11:Trends in Livestock population (in 1000 numbers) in Munger

Category	2003	2007	2012	2019
CATTLE TOTAL	141.21	184.6	166.61	202.08
CATTLE ADULT MALE	25.76	25.11	17.94	5.17
CATTLE ADULT FEMALE	53.94	84.32	86.99	93.21
CATTLE YOUNG TOTAL	61.52	75.16	61.68	103.7
CATTLE SHARE IN LARGE RUMINANT (Percent)	72.64	74.81	76.09	82.39
BUFFALO TOTAL	53.18	62.15	52.35	43.19
BUFFALO ADULT MALE	4.75	5.27	2.85	1.05
BUFFALO ADULT FEMALE	24.66	34.46	29.32	21.17
BUFFALO YOUNG TOTAL	23.77	22.42	20.19	20.98
BUFFALO SHARE IN LARGE RUMINANT (Percent)	27.36	25.19	23.91	17.61
SHEEP TOTAL	0.71	0.49	0.28	2.76
SHEEP SHARE IN SMALL RUMINANT (Percent)	0.5	0.32	0.17	1.25
GOATS TOTAL	141.08	152.49	169.08	218.82
GOATS SHARE IN SMALL RUMINANT (Percent)	99.5	99.68	99.83	98.75
PIGS TOTAL	6.39	6.26	7.85	2.33
LIVESTOCK TOTAL	342.59	408.88	398.04	469.18

Source: http://dse.bihar.gov.in/ and http://data.icrisat.org/district-level-data/

2.3.8 Trends in Fishery Production

Table 12 shows the trends in Fish Production in Munger compared to the total fish production in Bihar. Fish Production was 5.2 thousand tons in 2011-12 in Munger, which increased to 9.2 thousand tons in 2017-18. The share of Munger district in fish production of the state went up marginally from 1.51% in 2011-12 to 1.57% in 2017-18.

Table12: Trends in fish production (1000 tons) in Munger

District/Year	2011-12	2013-14	2015-16	2017-18
Munger	5.2	4.83	9.4	9.2
Bihar	344.47	432.29	506.88	587.85
Source: http://dse.bihar.gov.in/ and http://data.icrisat.org/district-level-data/				

2.2 FORESTRY

Baseline Data

According to the Forest Survey 2021, the total Forest Cover in the State is 7380.79 sq. km which is 7.84 % of the State's geographical area. The state has 333.42 sq. km. under very dense forests, 3285.83 sq. km. under moderately dense forests and 3761.54 sq. km. under open forests. In recent years, massive plantation programs have been taken up in the State to increase the forest & tree cover.

According to the 2021 Forest survey, forests cover of the district is 20.16% out of the total geographical area which is 1419 sq. km. With respect to 2019 forest assessment there has increase in the forest area of the district by 2.41 sq. km.

The district has a total of 286.01 sq. km. under the forests out of which 37.97 sq. km. is under dense forests, 223.61 sq. km. is under moderately dense forests and 24.43 sq. km under the open forests. The district does not 9.43 sq. km. of area under scrubs as depicted in Fig. 1.

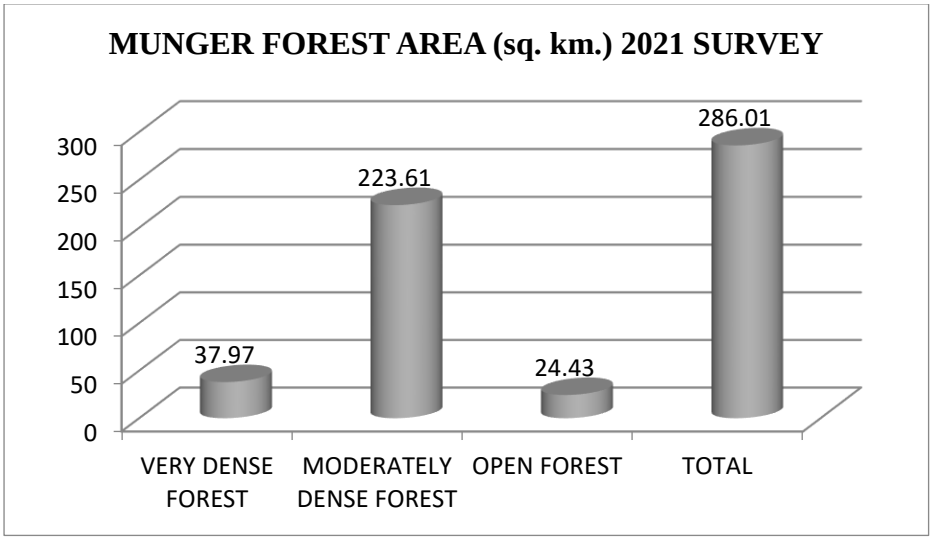


Fig. 1

The district has 6200 ha of cultivable wasteland, 6900 ha of current fallow and 7400 ha of other fallow land.

2.2.1. Biodiversity

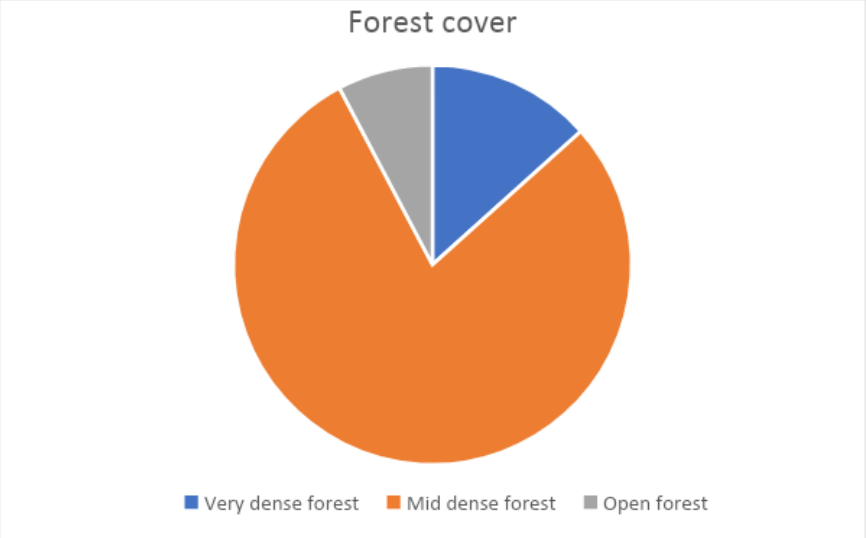
The district's biodiversity data includes crop production, livestock population, bird species, and forest cover. The district has a forest area of 19.99 square km, in which 79% area is mid-dense forest, 13% area us very dense forest and 8% area is open forest.

Table 1 Bird species recorded in the district.

Number of species	339
Number of rare/accidental species	20

Forest cover (in sq. km.)

Geographical area	Very dense forest	Mid dense forest	Open forest	Total	% of Geographical area `	Change with respect to 2017 assessment	Scrub
1419	37.97	223.67	21.96	283.60	19.99	-1.40	9.98



2.3 TOURISM

Tourism is the fastest growing industry and fashion of the modern world. Thousands of people every year travel from their native places to Munger in the form of tourism. Munger is one of the ancient and one of the Bihar's famous tourist centre, witness an uneven but tremendous tourist influx throughout the year. The tourism influx is very irregular in terms of Foreign as well as of Domestic in the Munger. In one year, region witnessed a very huge tourist influx and in very next year number of tourists decreased suddenly owing to prediction of heavy Flood, Crime and poor Infrastructure facilities. Tourism has been worst hit in 2020 **Covid Pandamic** ravaged Munger, caused a steep fall of **-84.71%** in tourist traffic. The tourist visits to Munger shows a very erratic growth from **233.66%** in the year **2002** to **-15.53** in **2003** while again it goes up to **70.05%** in **2009** and **106.82%** in **2019**. Though the numbers have gone up, the

percentage growth has shown inconsistence. This depicts that there is an imminent scope for Munger as a major tourist destination if its district potential and important places are well developed. The below table demonstrate that tourism influx is very irregular in the Munger District.

Table: 4 Munger: Year Wise Tourists Arrivals (2001 to 2020)

Year	Domestic	Growth	Foreign	Growth	Total	Overall Growth
2001	15414	0.00%	0	0%	15414	0
2002	51349	98.51%	82	0%	51431	233.66%
2003	43444	-23.01%	0	-100%	43444	-15.53%
2004	53832	-38.73%	0	0%	53832	23.91%
2005	46052	-24.71%	14	0%	46066	-14.43%
2006	51578	89.58%	0	-100%	51578	11.97%
2007	40498	4.37%	0	0%	40498	-21.48%
2008	38315	-51.27%	0	0%	38315	-5.39%
2009	65155	84.38%	0	0%	65155	70.05%
2010	65036	-65.24%	0	0%	65036	-0.18%
2011	88812	312.90%	0	0%	88812	36.56%
2012	101230	73.24%	0	0%	101230	13.98%
2013	81367	-53.38%	2025	0%	83392	-17.62%
2014	94325	-50.13%	0	-100%	94325	13.11%
2015	105506	228.38%	59	0%	105565	11.92%
2016	113470	4.24%	249	322%	113719	7.72%
2017	120508	3.12%	233	-6%	120741	6.17%
2018	126587	8.66%	249	7%	126836	5.05%
2019	261998	9.79%	322	29%	262320	106.82%
2020	40053	-97.84%	54	-83%	40107	-84.71%

Source: Data Compiled from Tourism Department of Bihar

Figure: 5 Munger: Year Wise Tourists Arrivals (2001 to 2020)

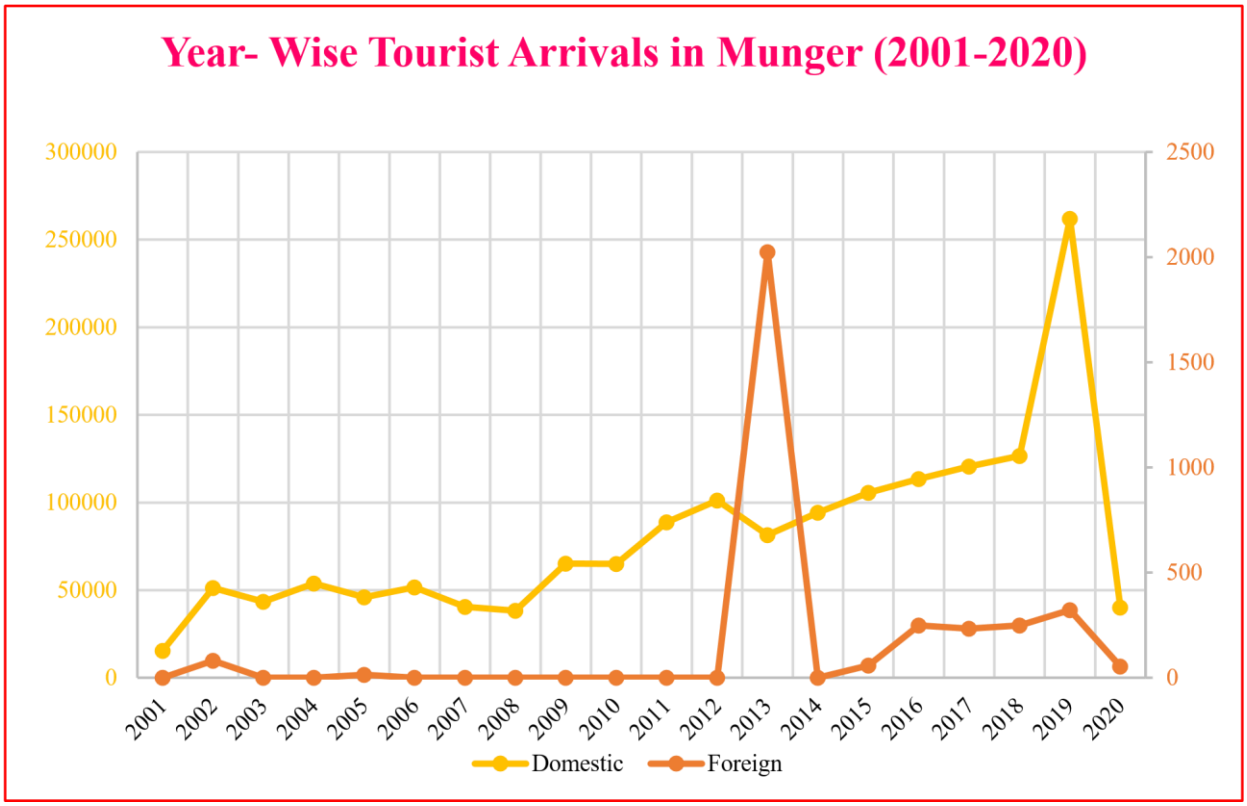


Figure: 6 Munger: Year Wise Domestic Tourists Arrivals (2001 to 2020)

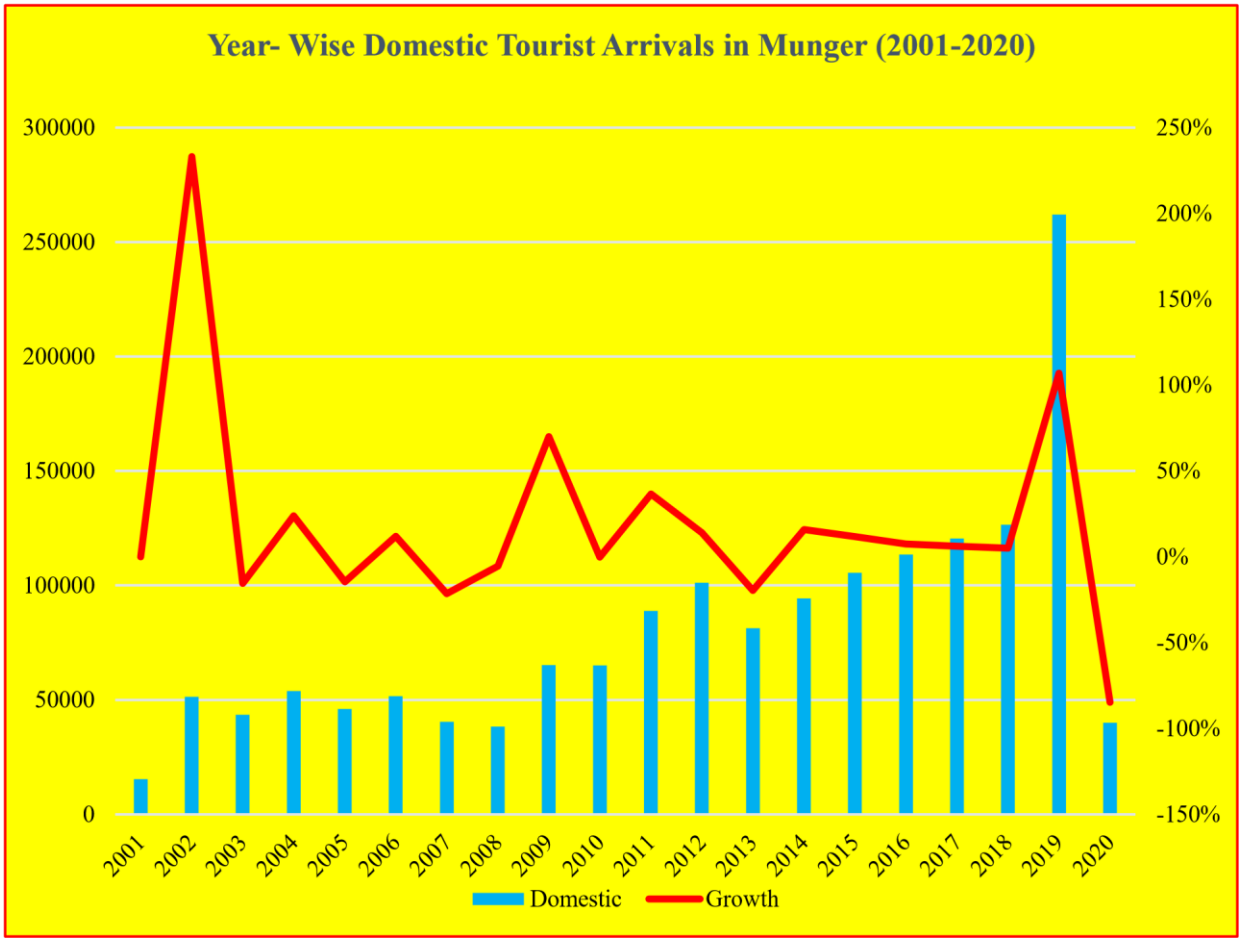


Figure: 7 Munger: Year Wise Foreign Tourists Arrivals (2001 to 2020)

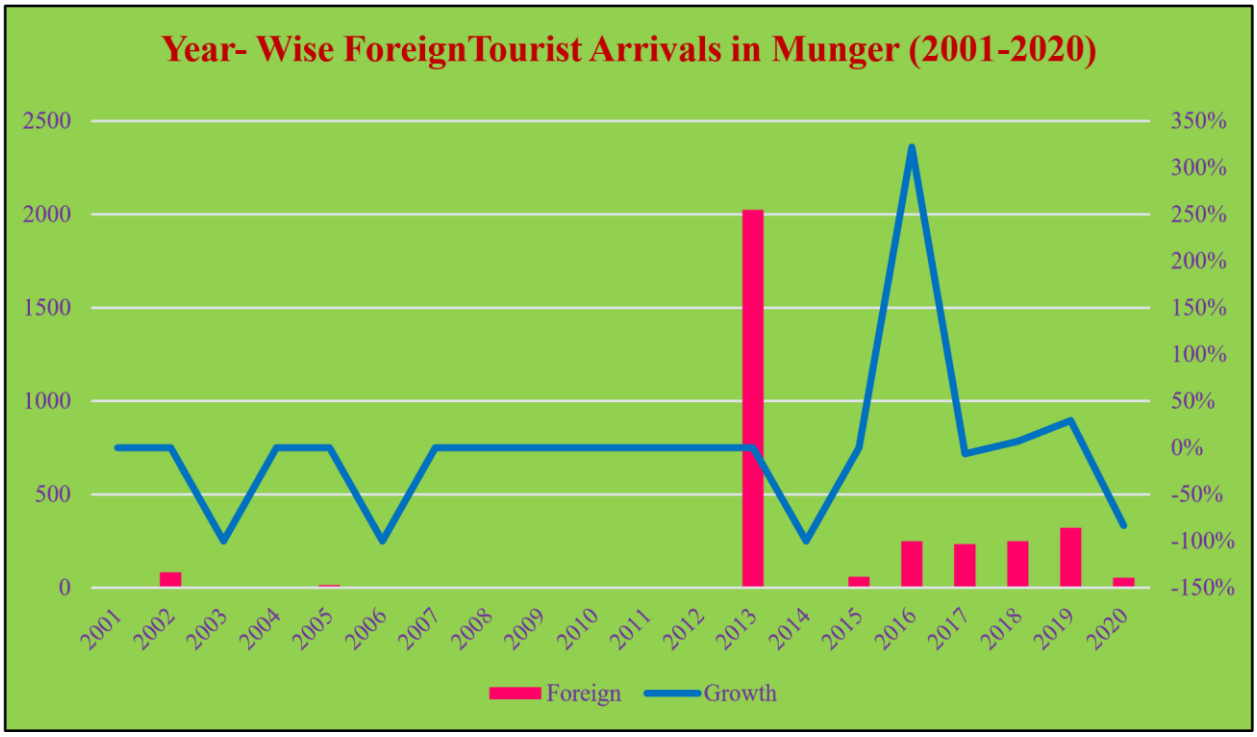
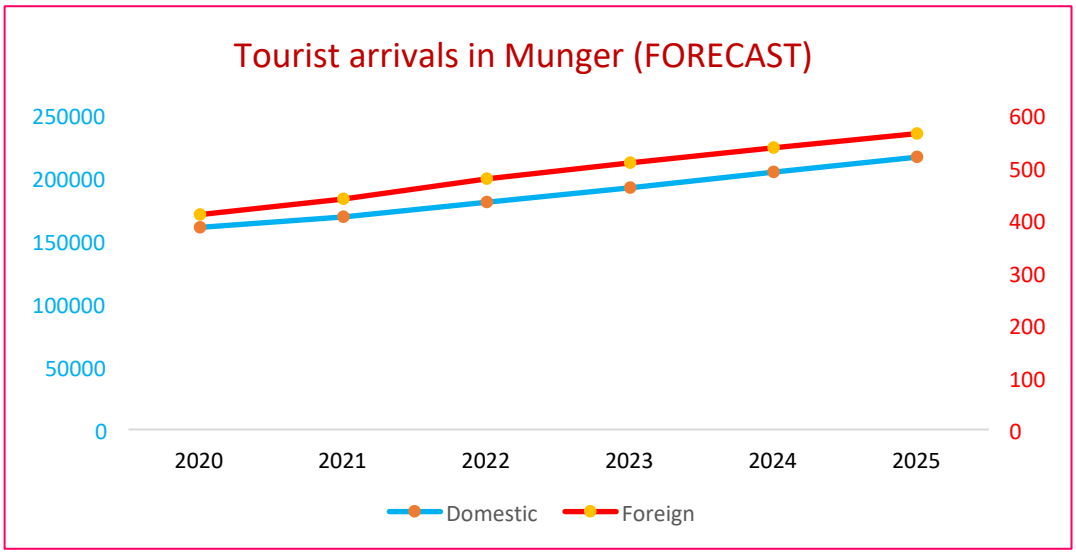


Table: 5 Munger: Year Wise Tourists Arrivals 2020 to 2025 (Forecast)

Year	Domestic	Foreign	Total
2020	160565	410	160975
2021	168814	439	169254
2022	180667	478	181145
2023	191983	508	192491
2024	204550	537	205087
2025	216383	564	216947

Source: Data Compiled Tourism Department of Bihar

Figure: 8 Munger: Year Wise Tourists Arrivals 2020 to 2025 (Forecast)



- **Munger: Sectoral Contribution to GSDP (1999-2000 to 2006-2007)**

Like Bihar as a state, the District of Munger has potential for Historical, Religious, Spritual, Adventure, Ghat and Ecotourism etc. and has scope to develop niche markets. Comparing the sectoral contribution to the state GDP, the contribution of tertiary sector in Munger is **(61.29%)**, whereas for the state it is **(53.88%)** in **1999-2000** while it exceeds to **(66.67%)** and **(56.05%)** in **2001-2002** respectively. Moreover, the contribution of Trade, repair, hotel, and restaurant **(5.26%)** outperforms in comparison to the state counterpart **(27.89%)** in **1999-2000**, however this gap further strengthen during **20062007** were Munger accounts **(13.59%)** that of state (**40.62%**). Thus, the contribution of Munger's Tertiary sector is increase faster than the state. Similarly, trade, repair, hotel, and restaurant also contribute in increasing manner.

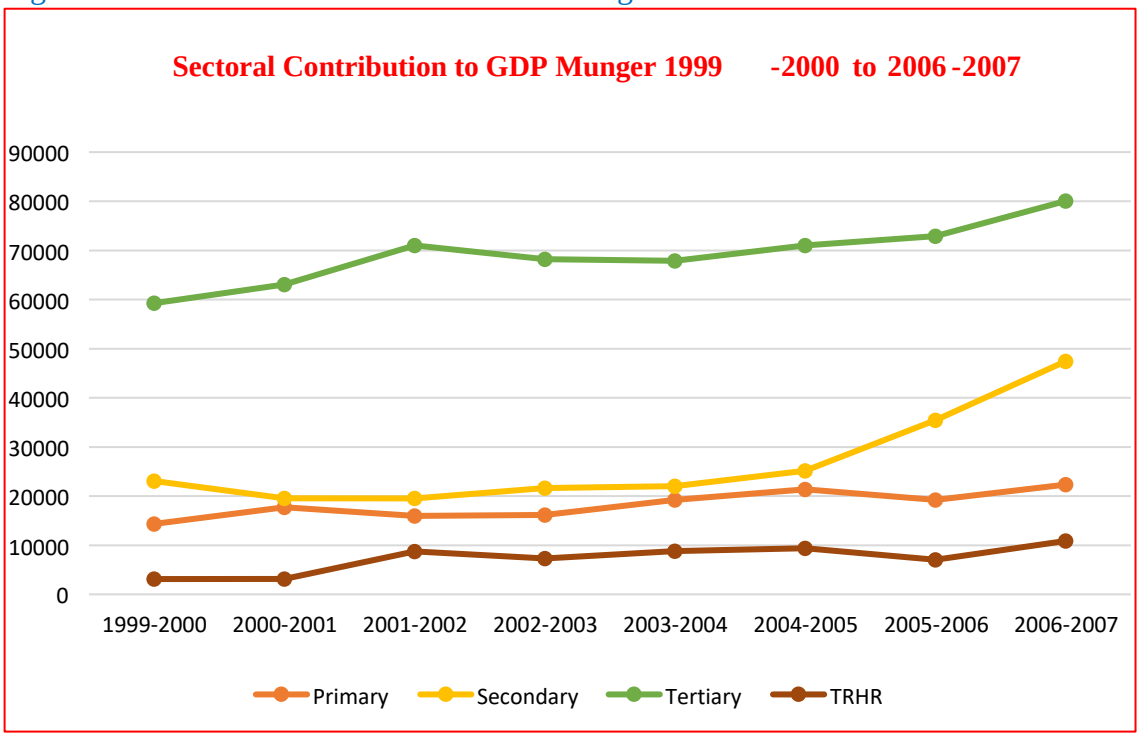
Table: 7 Sectoral Contribution to GDDP Munger 1999-2000 to 2006-2007

Year	Primary	Secondary	Tertiary	TRHR as % of Tertiary
1999-2000	14342 (14.83%)	23091 (23.88%)	59266 (61.29%)	3116 (5.26%)
2000-2001	17731 (17.68%)	19527 (19.47%)	63033 (62.85%)	3142 (4.98%)
2001-2002	15979 (15.00%)	19525 (18.33%)	71027 (66.67%)	8765 (12.34%)

2002-2003	16141 (15.23%)	21661 (20.44%)	68181 (64.33%)	7317 (10.73%)
2003-2004	19199 (17.60%)	22020 (20.18%)	67879 (62.22%)	8820 (12.99%)
2004-2005	21381 (18.19%)	25132 (21.38%)	71020 (60.43%)	9402 (13.24%)
2005-2006	19255 (15.09%)	35435 (27.77%)	72916 (57.14%)	7034 (9.65%)
2006-2007	2237 (14.91%)	47441 (31.66%)	80051 (53.43%)	10875 (13.59%)

- *Source: Data Compiled from dse.bihar.gov.in*

Figure: 10 Sectoral Contribution to GDDP Munger:1999-2000 to 2006-2007



Munger has great potential to contribute to the economy. Hence, tourism and hospitality sector in the district can further be promoted to harness its growth and benefits to the district economy. However, promoting tourism sector by considering its economic contribution may lead to bad policy decisions without noting the natural disaster as well as tourism infrastructure and crime

and implementation policy. Taking a time series data set on tourism foot falls with disasters, Crime & Security, and infrastructure etc. their correlation may be conjectured. Moreover, development of projects and strong research is mandatory to know the detailed information on disaster, Crime, tourism infrastructure, tourist foot fall etc.

Therefore, the number of tourists can be controlled and managed in each of the Archaeological, Religious and Adventure sites by introducing entry fee/user charges which can serve as double weapon of protecting the Archaeological sites and earning exchequer for the development and protection of the site. Hence, appropriate policy decisions must be made for finding 'where to stop rule' or 'what is that number' like putting a cap on the tourists' size in each site-specific ecosystems taking anthropogenic pressure, carrying capacity of that site and measuring their impacts through adequate research.

Munger: GDDP Growth Rate at Constant Price (1999-2000 to 2006-

- 2007)

The impact of the Disaster, High Crime rate, Poor Infrastructure, Under-investments, Poor Economic Policy and Poor Political Vision etc. has been reflected in terms of reducing the annual growth rate of the district from **(6.22%)** in **2001-2002 to (-0.51%)** in **2002-2003**. The district annual growth was again rise up to **(7.73%)** in **2004-2005**. This states that impact of the Disaster, High Crime rate, Poor Infrastructure, Underinvestments, Poor Economic Policy and Poor Political Vision etc. largely has severe regional impacts in reducing the annual growth rate of the district, hence disaster and development related policies must be made be made taking into account micro regional contexts and be site specific. However, during **2005-2006 Munger** accounts **8.57%** as compare with state growth rate **1.49%**. Similarly, during **2006-2007** in **17.41%** while state accounts **22.00%**. This is because of the difference in Socio-economic and geographical difference that exists across Bhagalpur districts in the state of Bihar. Hence, district specific plans must be developed rather than state specific.

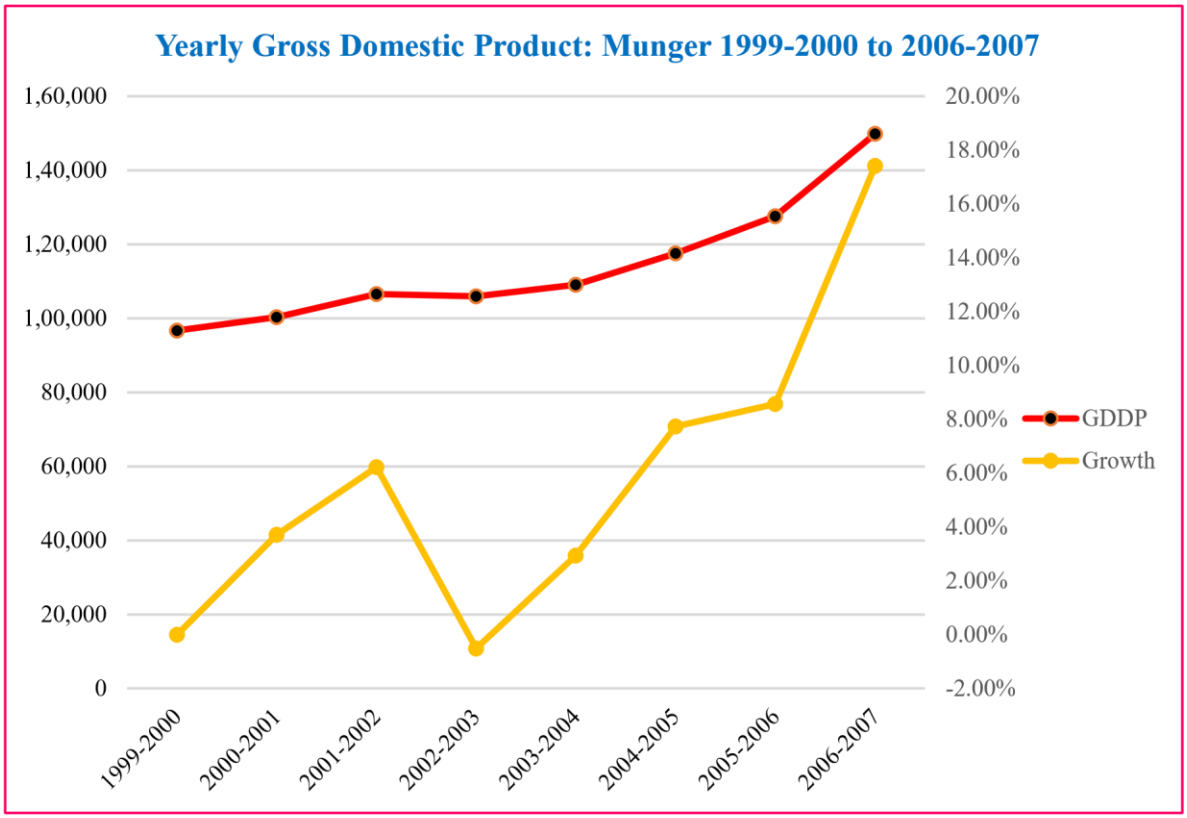
Table: 9 GDDP Growth Rate at Constant Price: Munger 1999-2000 to 2006-2007

Year	GDDP	Growth in %
1999-2000	96700	0
2000-2001	100291	3.71%
2001-2002	106531	6.22%

2002-2003	105984	-0.51%
2003-2004	109098	2.94%
2004-2005	117532	7.73%
2005-2006	127607	8.57%
2006-2007	149829	17.41%

- *Source: Data Compiled from dse.bihar.gov.in*

Figure: 12 GDDP Growth Rate at Constant Price: Munger 1999-2000 to 2006-2007



Source: Data Compiled from dse.bihar.gov.in

- 15. Munger: Contribution of TRHR to the GDDP at Constant Price (1999 to 2025)

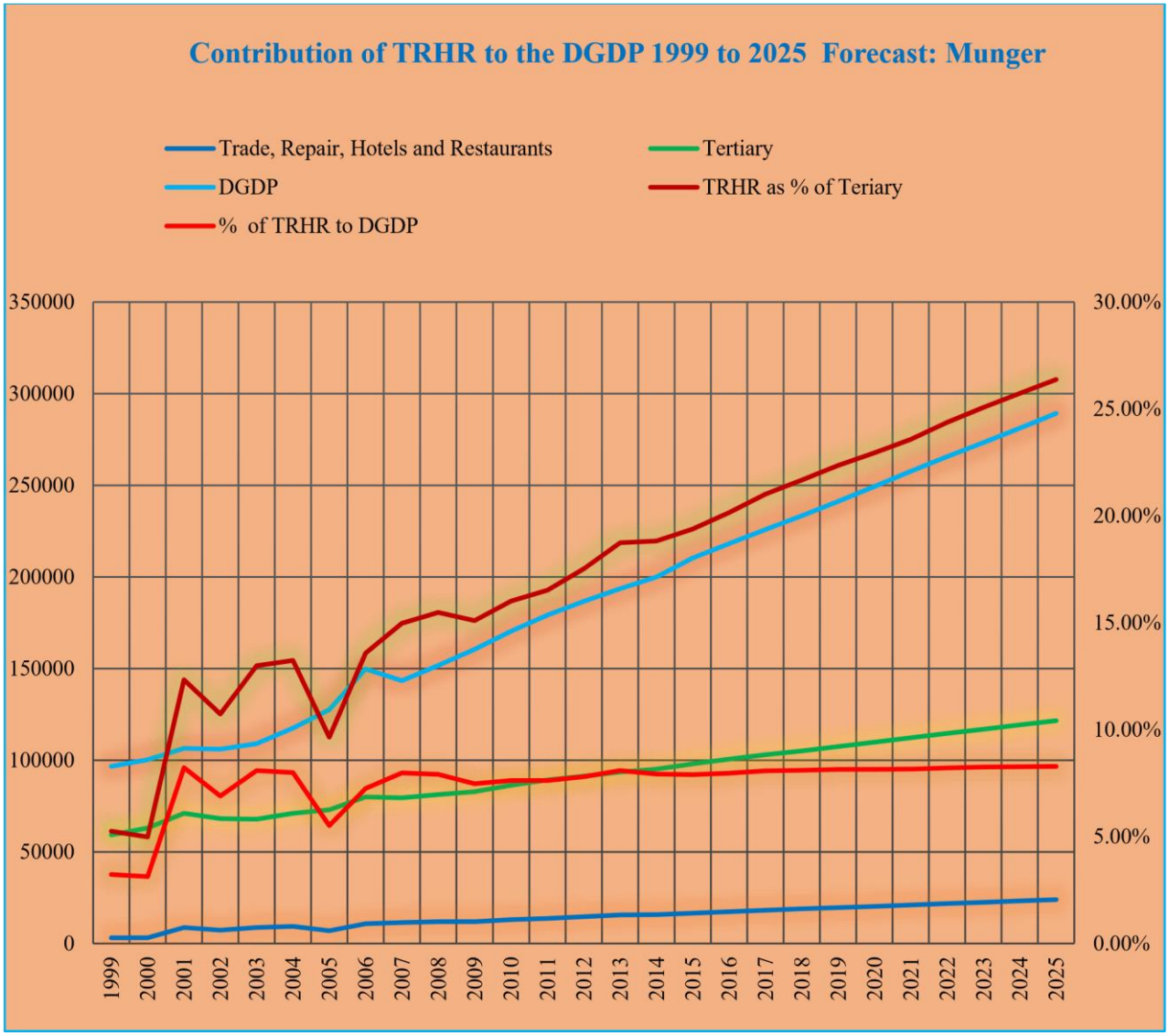
Table: 10 Contribution of TRHR to the GDDP at Constant Price Munger (1999 to 2025)

Year	Trade, Repair, Hotels and Restaurants	Tertiary	TRHR as % of Tertiary	DGDP	% of TRHR to DGDP
1999	3116	59266	5.26%	96700	3.22%
2000	3142	63033	4.98%	100291	3.13%
2001	8765	71027	12.34%	106531	8.23%
2002	7317	68181	10.73%	105984	6.90%
2003	8820	67879	12.99%	109098	8.08%
2004	9402	71020	13.24%	117532	8.00%
2005	7034	72916	9.65%	127607	5.51%
2006	10875	80051	13.59%	149829	7.26%
2007 (Forecast)	11444	79596	14.98%	143372	7.98%
2008	12014	81270	15.49%	151710	7.92%
2009	11986	82949	15.10%	160500	7.47%
2010	13002	86368	16.02%	170405	7.63%

2011	13663	89203	16.53%	179284	7.62%
2012	14583	91399	17.53%	186812	7.81%
2013	15652	93530	18.75%	193597	8.08%
2014	15854	95220	18.83%	199950	7.93%
2015	16606	98095	19.39%	210345	7.89%
2016	17403	100619	20.16%	218261	7.97%
2017	18250	103022	21.02%	225937	8.08%
2018	18932	105152	21.68%	233461	8.11%
2019	19648	107417	22.36%	241273	8.14%
2020	20321	109816	22.96%	249406	8.15%
2021	21020	112246	23.58%	257652	8.16%
2022	21834	114679	24.37%	265738	8.22%
2023	22552	116927	25.07%	273273	8.25%
2024	23258	119241	25.73%	281239	8.27%
2025	23963	121596	26.38%	289273	8.28%

- *Source: Data Compiled from dse.bihar.gov.in*

Figure: 13 Contribution of TRHR to the GDDP at Constant Price Munger (1999 to 2025)



2.4 WETLANDS

The district has vast wetlands; the majority of them are river/streams and waterlogged. Table 1 shows the number of wetlands and their area representation in the district.

Table 1: Wetland Data of Munger district

	Total Number of		
	Wetlands:	Area (ha)	Aquatic Vegetation

Natural Wetlands	NRCD	NWIA	Diff.	<2.25	<5	<10	<20	<50	<200	<500	<1000	>1000	
Lake/ponds	2	3	1	0	0	1	1	0	0	0	0	0	2
Ox-bow lakes/cut-off meanders	1	1	0	0	1	0	0	0	0	0	0	0	1
High altitude Wetlands	0	0	0	0	0	0	0	0	0	0	0	0	0
Riverine Wetlands	16	19	3	0	5	5	3	3	0	0	0	0	16
Waterlogged	1	1	0	0	1	0	0	0	0	0	0	0	1
River/Stream	0	13	13	0	0	0	0	0	0	0	0	0	0
Man-made Wetlands	**NRCD**	**NWIA**	**Diff.**	**<2.25**	**<5**	**<10**	**<20**	**<50**	**<200**	**<500**	**<1000**	**>1000**	**AV**
Reservoirs/Barrages	3	3	0	0	1	0	1	0	0	1	0	0	2
Tanks/ponds	29	31	2	0	25	3	1	0	0	0	0	0	22
Waterlogged	0	0	0	0	0	0	0	0	0	0	0	0	0
Salt pans	0	0	0	0	0	0	0	0	0	0	0	0	0
Total (195)	**52**	**71**	**19**	**124**	**33**	**9**	**6**	**3**	**0**	**1**	**0**	**0**	**44**

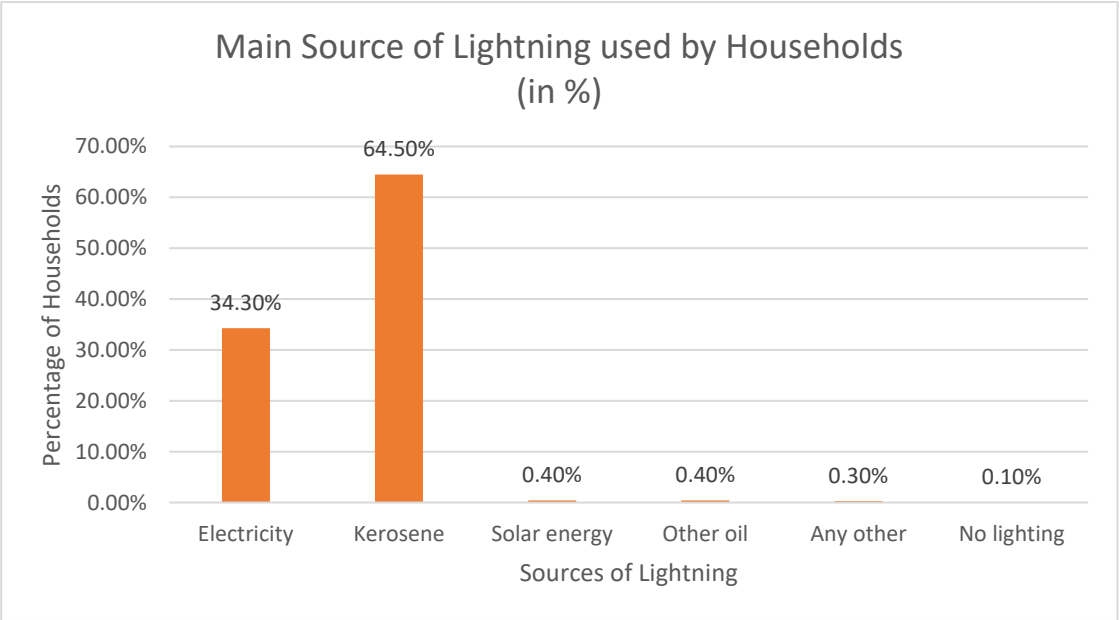
Source: National River Conservation Directorate (NRCD), National Wetland Inventory and Assessment (NWIA) Atlas

2.5. ENERGY

2.5.1. Solar

Bihar Renewable Energy Development Agency (BREDA) has been responsible for the promotion of non-conventional sources of energy in Bihar, and has an aim to provide complete electrification to the villages of the state.

According to the Census 2011, the major sources of lightning in the district used by the households are pictorially shown in the diagram below. Kerosene is used by majority of the population, which is 64.50% of the households in the district as a source of lightning. Electricity is the second most popular source of lightning in the district with 34.30% households using it. Solar energy is consumed by 0.40% of the households in the district. Other oil is used by 0.40% of the households for lightning and other sources of lightning are being used by 0.30% of households. 0.10% of the households have no lightning sources.



2.5.2. Biomass

BREDA or Bihar Renewable Energy Development Agency is responsible for the promotion of non-conventional sources of energy in Bihar. It is the nodal agency to advance electrification of villages.

The net grown area of Munger district is 60300 hectares, area sown more than once is 19700, and gross cropped area is 80100 hectares. The cropping intensity is 132.8%. The total forest area is 32700 hectares.

The crops which are majorly grown in the district are rice, maize, pigeon pea, wheat, rabi crops, and oilseeds. Wheat has the highest productivity of 2105 kg/ha in the district.

Crop	**Productivity (kg/ha)**
Rice	2014
Maize	1977
Pigeon Pea	214
Wheat	2105
Rabi Crops	224
Oilseed	147

Table 1

The data for type of fuel used by the households for cooking has been taken from Census 2011 and a pie-chart has been constructed. It is evident that 45.20% of the households use fire-wood, 20.80% of the households use cow-dung cake, 18.60% of the households use LPG/PNG, and 12.60% of the households use crop residue for cooking.

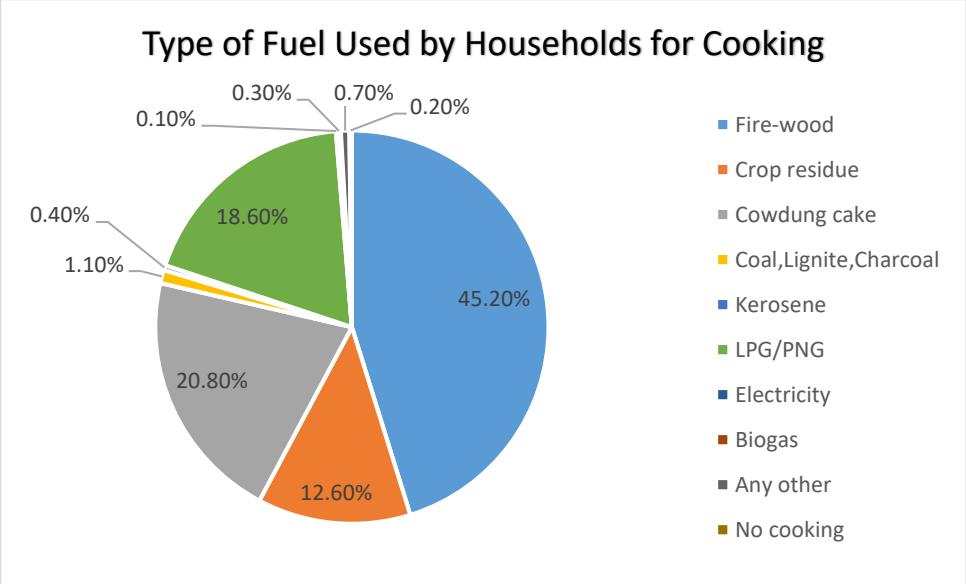


Table 1

The normalised value of the total available biomass in Munger district is 0.1630 (D, K, Mishra, & Bhattacharyya, 2016).

2.5.3. Biogas

Either the biogas data is not available for the district, or no plants exist in the district. Biogas potential has been evaluated by average livestock and agricultural waste production. Biogas potential from animal waste is calculated approximately as fifty eight lakhs m3/year and one crores m3/year from agricultural waste. This amount of biogas generation can efficiently complete the energy demand of the district.

2.5.4. Hydro Power

Munger district is located in the middle Ganga plain. No hydropower plant exists in the district; nor any project sites have been identified for small hydropower projects.

3 QUALITATIVE DATA ANALYSIS

3.1 FORESTRY

The district is covered with forest. Many kinds of trees are found in this forest. Teak, Sisam, paisar, Saresh, Sever, Neem and Gamhar trees are abundant in quantity in the forest here. Kendu, Amla, Mahua and Mango trees are also available in the district.

Munger is categorized under Agro-climatic zone III A i.e. the Southern east zone. The district has sandy loam , clay loam, loam, clay types of soil with pH between 6.5-8.0.

3.1.1 Biodivesity

From 2010 to 2021, Munger lost 4ha of tree cover, equivalent to a 0.039% decrease in tree cover since 2010, and 1.50kt of CO_2e emissions. Between 10th of June 2019 and 6th of June 2022 Munger experienced a total of 131 VIIRS Alerts fire alerts.

The Bhimbandh Wildlife Sanctuary is bordered by human settlement and has a forest cover of 681.99 km^2. Tigers (Panthera tigris), Leopards (Panthera pardus), Sloth Bears (Melursus ursinus), Sambars (Rusa unicolor), Four-horned antelopes (Tetracerus quadricornis), and Chitals (Axis axis) have all been spotted in the sanctuary. Over 100 species of birds have been documented from here, including a number of winters migrating birds that find refuge in the Sanctuary's water features.

3.2. ENERGY:

3.2.1. Solar

According to the CEEW report 2020, Munger district has a limited access to banks and financial institutions, especially in the rural and semi-rural areas, which hampers the availability of credit to the people of the district. There is a high percentage of small and marginal farmers in the district. Apart from that, the crop reveneue per holding is less which causes difficultly in purchasing an individual solar pumps without government support.

Further, according to CEEW report 2020, feeder solarisation could be a feasible option in the district because there is high proportion of electric pumps in the district and substantial amount of feeder segregation and DISCOMS incurs relatively small cost in supplying power. And also it is realizable because the power purchase rate of DISCOMs increases going forward.

According to the Input survey of 2016-17, the total net sown area of the district is 51846 hectares, out of this, 20162 hectares is irrigated net sown area, which is 38.88% of the net sown area, and 31684 hectares is unirrigated net sown area, which is 61.11% of the net sown area.

3.2.2. Biomass

The total Biomass rice husk potential in the district is 5244 MT/Year (The World Bank, 2014).

In August 2015, Biomass-fired boiler plant was set up by Thermax Onsite Energy Solutions Limited (TOESL) of ITC in Munger district, to supply steam for milk processing. It is the first steam processing biomass boiler for milk in Munger district. This was established to generate sustainable livelihoods through livestock development program in the village, as a part of CSR scheme. By January 2019, the ITC-Munger Dairy division has seen a decrease in carbon dioxide emissions by more than 7740 tonnes by incorporating biomass-fired boiler (Thermax Global).

There is not much biomass intake in the district. The reason of less renewable energy production in the district could be less renewable energy potential or lack of technical support in the district (D, K, Mishra, & Bhattacharyya, 2016). The technical support includes government support in building the necessary technology to carry out the work of the biomass plants and also human skills, so that they could help in maintenance and working of biomass plants.

3.2.3 Biogas:

The district has a lot of potential to generate bioenergy through biogas plant based on animal or agricultural waste. However, there is no data showing installation of biogas plant in the district.

3.2.4. Hydropower:

No hydroelectric power plant exists in the district, nor the site has been identified.

3.3 TOURISM

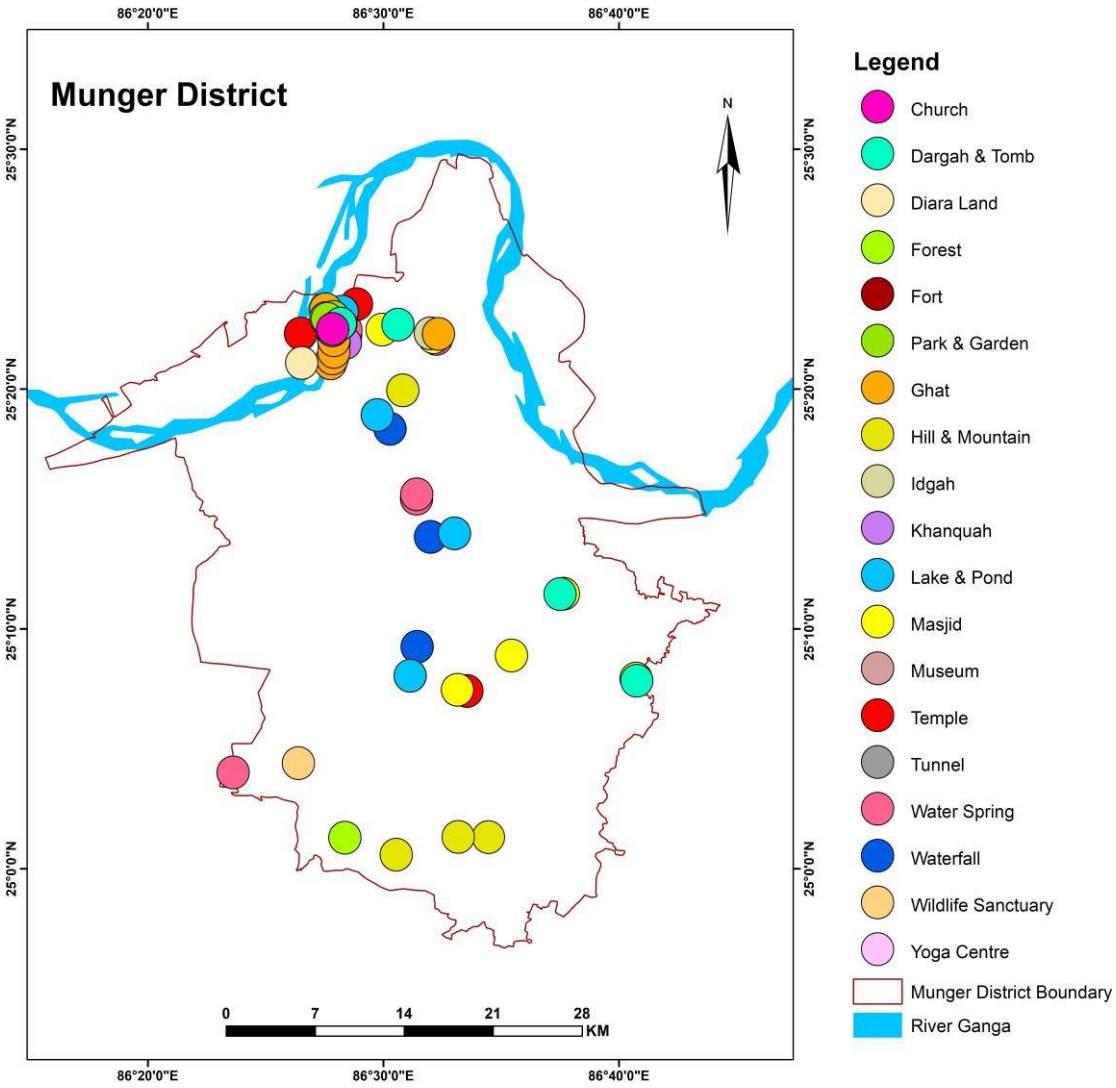
The district of Munger have incredible tourism potential with presence of numerous religious and heritage sites, varied industrial development opportunities and strength for international health education. The district is famous for Chandi Asthan. Tomb of Shah Pir-Nafah Dargah, Munger Fort, Karan Chaoura, Gun Fctory, Railway Workshop, I.T.C. Hot Spring Sita Kund, Hot water fall at Sringe Rishi at Ratanpur, Yoga Ashram, Sri Krishna Seva Sadan, Pri Pahari, Mir Qasim Tunnel (Sri Krishna Vatika) Kashtaharni Ghat, Sit Charn, Goenka Shivalya, Ucheshwernath, Shaheed Smarak, Kharagpur Lake etc. (*Munger*, n.d.).

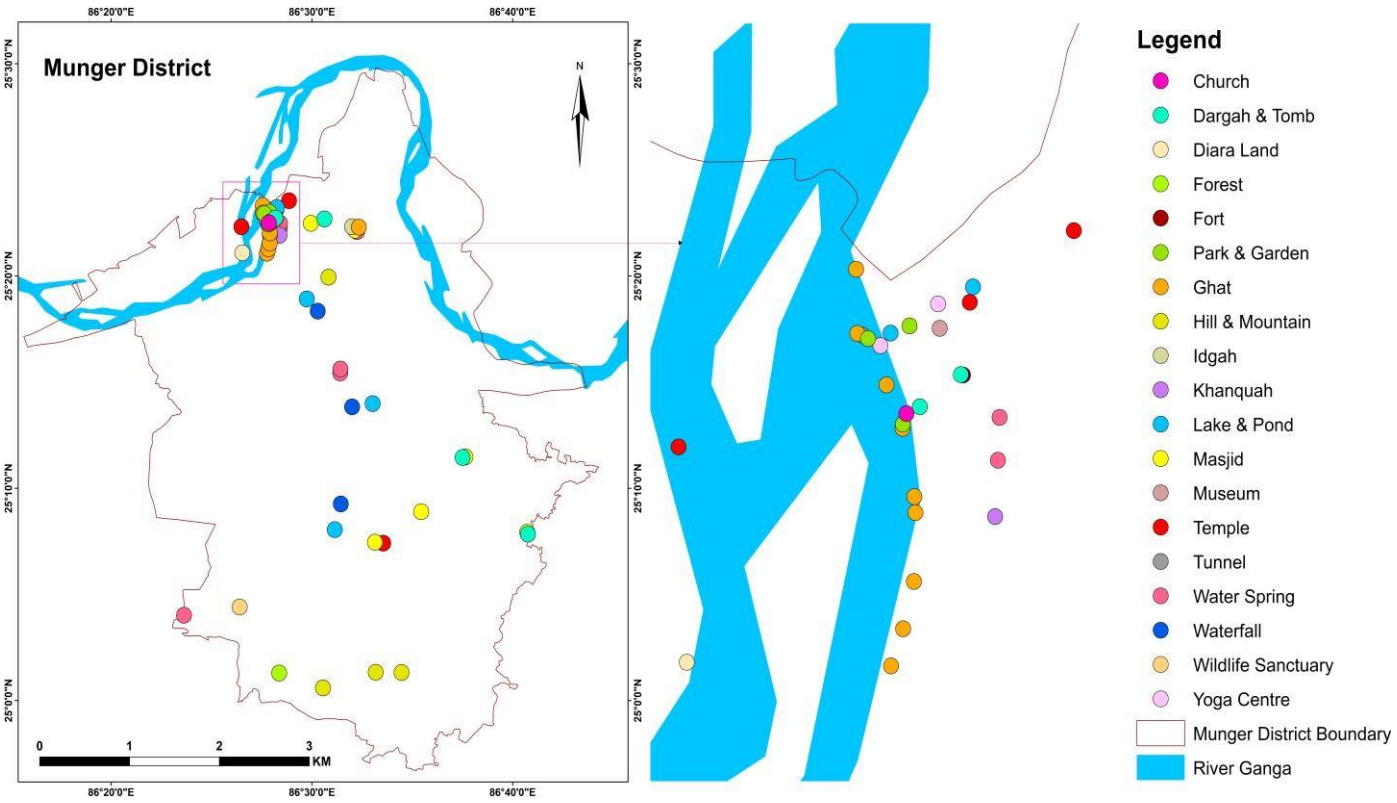
Munger district has a lot of potential for Religious, Adventure and Archaeological tourism. There are number of heritage structures present in the district. These structures include buildings, temples, shrines, etc. Incentive based policy should be formulated to protect these structures from further decay. Some of the heritage buildings are Munger Chamber of Commerce building, State Bank of India building, the Ganga Temple at Kashtaharni Ghat, old temples at Sojhi Ghat, Munger Fort Gate and a number of privately owned buildings, etc. The district has an immense scope to be exploited, Munger district can be promoted as a popular destination for religious tourism. The river Ganga in itself attracts a vast number of devotees from the surrounding area for Ganga dip. (*Final CDP Munger*, n.d.)

The district of Munger consists of a number of tourist sites. These sites possess various historical, cultural, mythological, religious as well as natural importance. Some of the major tourist spots in the district are: Kashtaharni Ghat, Meer Kasim Tunnel, Jail Ghat, Babua Ghat, Sojhi Ghat, Kankar Ghat, Machhli Talab, Karnchaura/ Yoga Ashram, Chandi Asthan. Tomb of Shah Pir-Nafah Dargah, Munger Fort, Karan Chaoura, Gun Fctory, Railway Workshop, I.T.C. Hot Spring Sita Kund, Hot water fall at Sringe Rishi at Ratanpur, Yoga Ashram, Sri Krishna Seva Sadan, Pri Pahari, Mir Qasim Tunnel (Sri Krishna Vatika) Kashtaharni Ghat, Sit Charn, Goenka Shivalya, Ucheshwernath, Shaheed Smarak, Kharagpur Lake etc. (*Final CDP Munger*, n.d.); (*Munger*, n.d.).

The Bihar State Tourism Development Corporation Ltd. is the agency that is responsible for all tourism activities in the state. Though there is no much evidence from the state tourism department that shows the tourist in-flow to Munger, there is a promising tourism in Munger. The tourism potential is yet to be tapped by the Government.

Map: 2 Tourism Sites of Munger District


Munger District
N
86°20'0"E
86°30'0"E
86°40'0"E
25°30'0"N
25°20'0"N
25°10'0"N
25°0'0"N
0
7
14
21
28
KM
Legend
Church
Dargah & Tomb
Diara Land
Forest
Fort
Park & Garden
Ghat
Hill & Mountain
Idgah
Khanquah
Lake & Pond
Masjid
Museum
Temple
Tunnel
Water Spring
Waterfall
Wildlife Sanctuary
Yoga Centre
Munger District Boundary
River Ganga



Source: Prepared by Author

ARCHAEOLOGICAL & HISTORICAL TOURISM

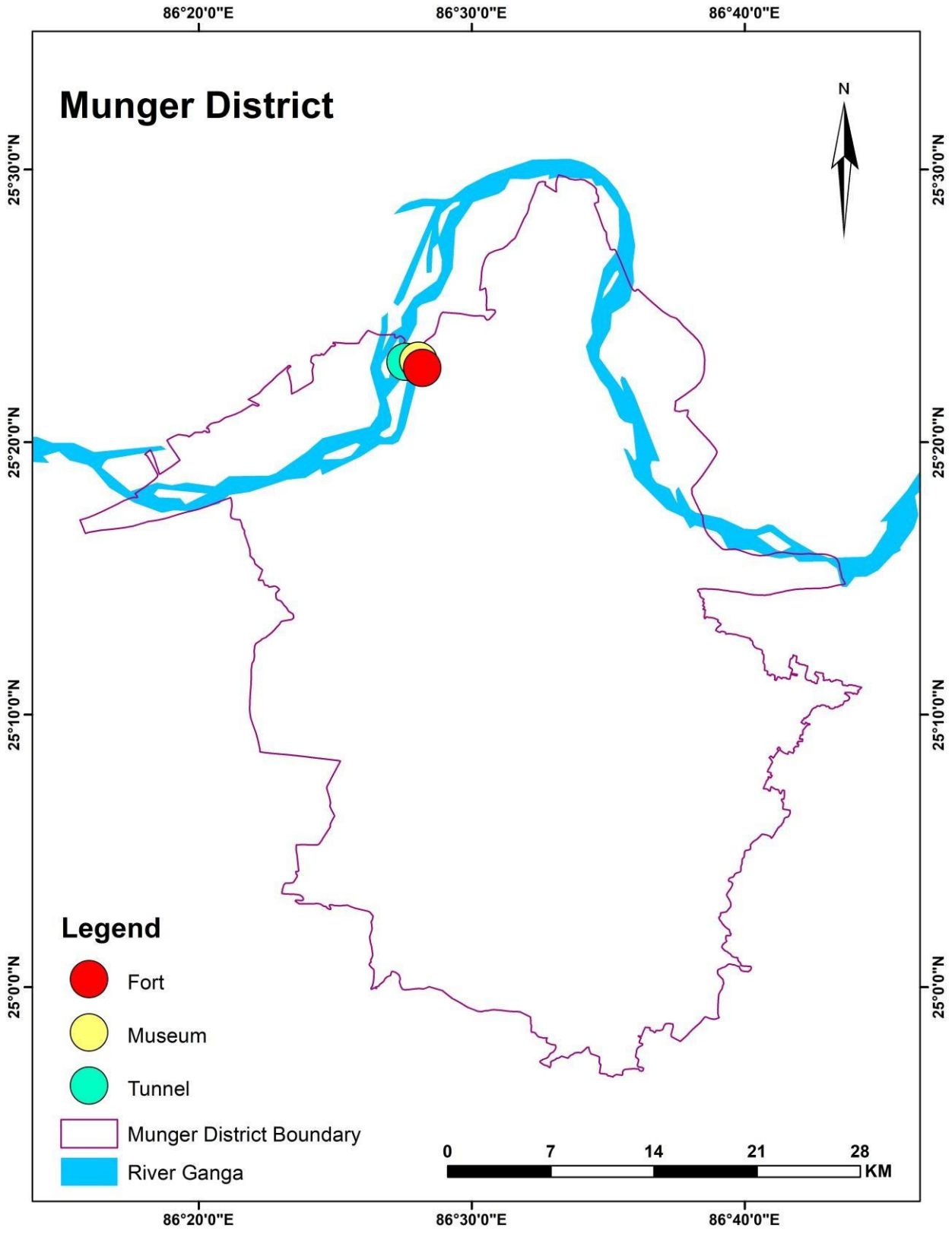
Munger has several archaeological sites, monuments that have historic value. Munger Fort, Mir Qasim Tunnel, Munger Museum and several medieval Mosques are architectural heritage of the Munger. There are several mosques which are the remains of the Mughal architecture.

- ★ **Mir Qasim Tunnel:** It is said that Princess Gul and Prince Bahar used to hide under the tunnels by the riverside in order to weak vengeance upon the British officers. They used to clothe themselves with tiger skins during the nights. Once Bahar, on his rounded in a dark might was caught sight of by a British officer who instantaneously shot the Prince dead. The truth was reveled next morning and the Prince was said to have been buried by the darga of Pir Shah-Nafah-Gul. The Prince was found dead in a man's attire by the side of her brother's tomb, where she was also buried. The officer, responsible for Bahar's and incidentally Gul's death ordered for a daily salute of guns in the evening to mourn the loss of these children. (*Mir Kasim Tunnel*, n.d.)
- ★ **Munger Fort:** Munger fort is the most important ancient monument. It is built on a rocky eminence projecting into the river Ganges. It protects the fort from west and partly from the north. The fort is encircled with rampart. The four gateways from four directions

provide the entry to fort. However presently only the northern gate, called Lal Darwaza is preserved with some carved stones. The provision of circular or octagonal bastions at regular intervals is symbol of battlements. (*Munger Fort*, n.d.)

- ★ **Munger Museum:** Munger Museum is located at Munger Fort. It is one of the top and best destinations for tourist whose interest in the field of Art Museum, Art gallery and Art category in Munger. There are good collection of prehistorical idols of lord Ganesha, lord Buddha besides a large number of gods and goddesses and exchanged ideas with the curator of the museum. (Prasad, 2013)
- ★ **Tomb of Mullah Muhammad Said:** Tomb of Mullah Mohammed Said was situated on the bastion at the south-west of the fort but has since been removed. Mulla Mohammed Said hailing from Mazandran near the Caspian Sea, was a Persian poet (under the nomde-plume of Ashraf). He was employed by Emperor Aurangzeb to tutor his daughter Zebunnisa Begum. He was also under the employment of Azim Shah, grandson of Aurangzeb, and who was the viceroy of Bihar. The Mullah, while on his way from Bengal to Mecca, died at Munger fort in 1704 and his tomb existed inside the fort.

Map: 3 Archaeological & Historical Tourism Sites of Munger District



Source: Prepared by Author

RELIGIOUS & SPIRITUAL TOURISM

Munger has acquired national and global stature for owning spiritual heritage and its surrounding areas. Every portion of this district has its own story to narrate. From ancient temples to grand mosques and church we can find all and more in this district of Bihar. The feeling of cultural ambiance can be witnessed in spiritual atmosphere of Munger where Hindus, Muslims, Jains, Buddhists and the followers of several other religions live together in harmony. Its location on the banks of sacred river Ganges makes this city religiously important. (*Culture and Heritage*, n.d.). During the medieval period, the spiritualistic aura enjoyed by Munger attracted many Sufi saints who preached in a very humanistic way that made the region a hub of pilgrimage for the devotees of all religions. This led to the development of many Masjids and Khanqah across the Munger District. (*Famous Sufi Circuit Attractions*, n.d.)

- ★ **Chandi Asthan:** Chandi Asthan is a temple on the northeast corner, two kilometres away from the Munger Town. It is one of the fifty-one Shakti Peethas, places of worship consecrated to the goddess Shakti. Godess Chandi also known as Vikrama Chandi is popular for her benediction at devotees. The pindi of Godess inside the rock cave is wonder for devotees. The famous legend of king Karna and Vikrama is associated with this place. (*Chandi Asthan*, n.d.);(*Chandi Sthan*, n.d.)
- ★ **Goyanka Shivalaya:** In the chain of beautiful temples Goenka Shivalaya is one of the brightest name. Being one of the oldest, it is one of the acknowledged places for Hindu pilgrims. The Shiv temple is built in the midst of a big water tank, which is full of big and beautiful fishes. A rock-solid bridge road of white marble joins it from the main campus. Around the temple a very beautiful garden with flowers and greeneries are kept fully maintained. On festive days specially associated with Lord Shiva, the campus remains full of visitors and gives the impression of a mini mela. (*Goyanka Shivalaya*, n.d.)
- ★ **Ucheswar Nath Temple:** In Kharagpur area, there is a very important temple of Lord Shiva which is famous as Ucheswar Nath. It is also important for Santhals and a public fair is held here,where is Santhal boys and a girls marry, according to their tribal custom. (Munger District, 2013)
- ★ **Manpatthar or Sita Charan:** It is located very close to Kastaharni Ghat. It is a rock in the bed of river about two miles away from the Munger fort. The Rock contains the impression of two feet, which is supposed to be the feet of Sita when she touched the rock in crossing the Ganga.(Munger District, 2013). It is 250 meter long and 30 meter wide. There is a small Mandir at this place.
- ★ **Tiger's Grave:** Tiger's Grave is located in Jamalpur, Munger. The grave consists of the Tiger as well as the Englishman- the soldier who shot the tiger and was, in turn, fatally injured by the beast. The field was later cleared and prepared as a golf course, for the frivolities of the ruling British, but the project was

abandoned and never completed. Spiritual aspirants still come from around the world to see and meditate on the grave. (*The*

Humans Meditate on the Tiger's Grave, n.d.)

- ★ **Maa Kali Pahadi Temple:** The hill named Kali Pahadi represents a temple of Maa Kali on its top. Pilgrimage can be developed in this location as the location offers an aerial picturesque environment of Jamalpur from this place. (*Final CDP Jamalpur*, n.d.)
- ★ **St. Mary's Church:** St. Mary Chuch: St Mary's Church was situated at Jamalpur in northeast India near to the main workshops of the East India Railway Company, built in 1862. St. Mary Church is well-maintained church just nearby famous golf club in Jamalpur. The congregation of this church were employees of the Company. Jamalpur was the first of the major railway towns in India, built and administered by the East India Railway

  Company and populated entirely by railway employees. (*St Mary's Church*, n.d.)
- ★ **Paduka Darshan Yoga:** Paduka Darshan is the sannyasa peeth of Bihar school of Yoga established by Swami Nirananjananda at Munger. It was called Ananda Bhavan and belonged to Goenkas family who gave it to Shir Swami Stayananda and Bihar school of yoga. It is situated on the banks of river Ganga.
- ★ **Ganga Darshan and International Yoga University:** Bihar School of Yoga, located at Ganga Darshan Vishwa Yogapeeth, Munger, is the karma bhumi of Sri Satyananda Saraswati, chosen and declared by him to be the epicenter of the yogic renaissance in the 21st century. It is located at the top of hill at the Ganga Darshan Complex, Munger and popular as spiritual centre at national and international level.
- ★ **Gurdwara Pakki Sangat:** 170 kilometres east of Patna Sahib by rail, where Guru Tegh Bahadur is known to have stayed during his eastward journey. It was during his stay here that he got the news of the birth of Guru Gobind Singh. The commemorative shrine Gurdwara Pakki (lit. firm or permanent) Sangat is in Belan Bazar area near the ld fort. Its old building also damaged badly by the 1934 earthquake was, however, rebuilt within a year. It is a rectangular room with a verandah in front and is served by Brahaman priests. Two relics, a cot and a pillow said to have been used by the Guru during his stay here, are kept in the same room where Guru Granth Sahib is seated.
- ★ **Pir Shah Nafah Shrine:** In the present fort area the oldest building inside the fort is a sacred Muhammdan shrine built on an elevated piece of ground near the southern gate. It is significant to note that the Dargah attracts not only the Muslims but also the Hindus of the town. It is said that it was a mazar of a Pir or Saint whose name is still unknown. He

is said to have traveled from Persia to Ajmer and from there came down to Munger under the instructions from Khwaja Moin-Uddin Chisti- the famous Sufi Saint and Lived at Munger for many years and also died here in 596 A.H, corresponding to 1177 A.D. He was buried in an obscure place near the ramparts and with the lapse of years exact burial place was forgotten. Ultimately, in 1497 A.D. when the ramparts of the fort being repaired by the Governor, Prince Danyal. (Kumar, n.d.)

- ★ **Pir Pahar:** It is located 5 km east of the Munger city. It provides a fine view of the surrounding country from top of the hill. It is named to an old Mohammedan saint or Pir. There are two old tombs side by side at the foot of the hill, on one of which there is an inscription to the memory of one Mary Anne Beckett, who died in 1832, while the other has a damaged inscription. (*The Sufi Spiritual Places in Bihar*, n.d.)
- ★ **Tomb of Mulla Muhammad Said:** Tomb of Mulla Mohammed Said is situated on the bastion at south-west of the fort. The Mulla was a Persian poet and had come to India from Mazandran near the Caspian Sea, during the reign of the emperor Aurangazeb, who employed him as a tutor to his daughter Zibunnisa Begum. The Mulla died in 1704 A.D. and his tomb existed till the early years of this century, when it was demolished and the grave removed.
- ★ **Dargah Gorho Sharif:** Dargah Gorho Sharif is located in Navtolia Village of Asarganj Block in Munger District.
- ★ **Dargah Shah Chandan Auliya:** It is located 196 km from Patna in near Devgarh road Lakhanpur, Munger. On 8th December 2021 his 566 Urs has been celebrated his original name is Khawaja Khuda Baksh. (*Lakhanpur Chandan Sha Auliya Dargah Sharif*, n.d.)
- ★ **Khanquah Rahmania:** Khanquah Rahmani was established in Munger in 1901 by the eminent scholar Hazrat Maulana Mohammad Ali Mungeri (r.A.), for the reformation of societies and purification of souls following the order of his Shaikh Hazrat Maulana Fazle-Rahman Ganj Muradabadi. Following his order, Maulana Mungeri left his birth place of Kanpur, U.P and migrated to Munger and established the Khanquah. (*Khanquah Rahmani*, n.d.)
- ★ **Shahi Masjid:** Shahi Masjid is located in Haveli Kharagpur. This mosque was built during the reign of the Mughal emperor. This mosque was built about 385 years ago in 1633 AD, at that time Raja Bahroz Singh This mosque has a huge courtyard whose area is 14 decimals, the length of the mosque is 78 feet while it is 55 feet. Apart from 3 big domes in the Shahi Masjid, there are 10 minarets, which are the best specimens of ancient

architecture, the best embroidery of the Mughal period in the walls made here. (*History of Shahi Masjid Haveli Kharagpur Munger Bihar*, 2018)

- ★ **Jama Masjid Lakhanpur:** It is located along Deogarh road in Lakhanpur of Munger district. This masjid has three domes structure of medieval and is one of the oldest and beautiful Mosque in this area.
- ★ **Gorho Sharif Masjid:** Masjid Gorho Sharif is located in Navtolia Village of Asarganj Block in Munger District. This mosque has three domes with one big in the centre.

★ **Jama Masjid Muzaffarganj:** Jama Masjid Muzaffarganj is one of the top Mosque of Munger. This Mosque have three domes representing medieval structure of Mughal era.

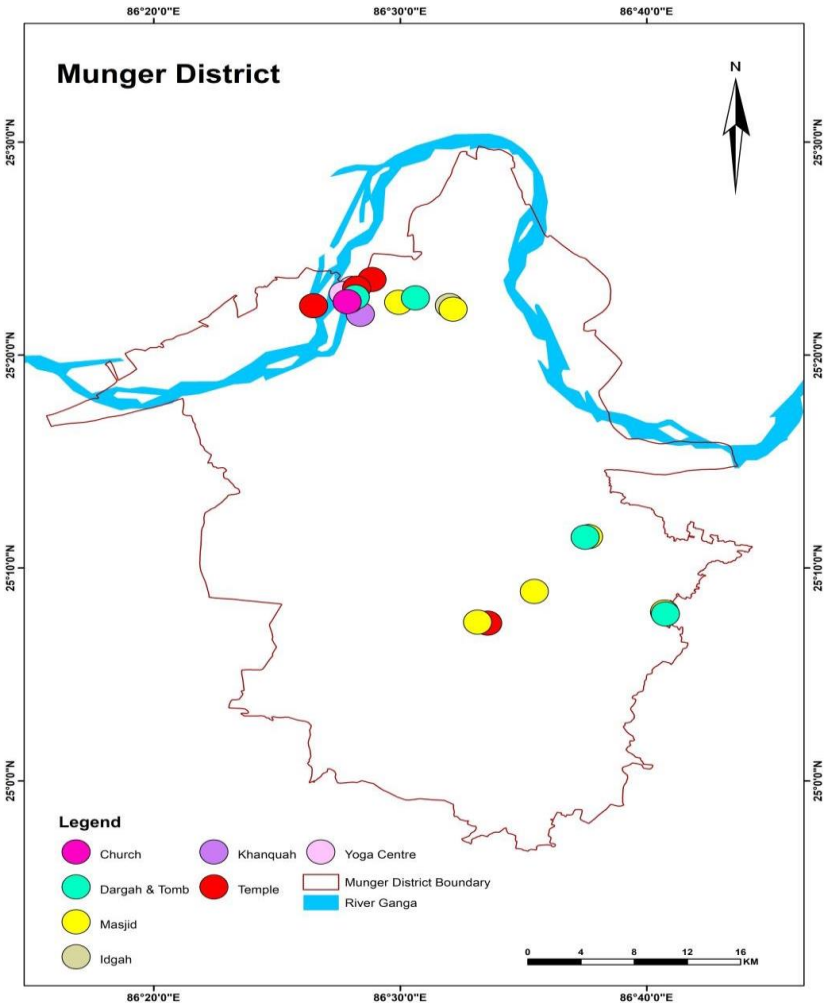
★ **Jama Masjid Mirzapur Bardah:** Jama Masjid Mirzapur is located near Sita kund. This Masjid has multiple domes.

★ **Masjid Ali Shujapur:** Masjid located in Sujawalpur, 1 km from Govt. Engineering college Munger.

★ **Eidgah Masjid:** Eidgah Masjid is located along Deogarh road Manikpur, Munger.

★ **Eidgah Mirzapur Bardah:** It is located 1 km from Mirzapur Ghat and Sita Kund.

Map: 4 Religious Tourism Sites of Munger District



Source: Prepared by Author

ADVENTURE, NATURE & ECO TOURISM

The Munger district is located on the southern bank of river Ganges. It is such a geographical region where the plain, plateau and mountainous area are found. Hills and forests are integral part of natural heritage of the Munger district. District is surrounded by hill and forest in the central, west and south. These hills are the abode of various types of flora and fauna too. Neelgai was found roaming in large number at these hills. Presence of waterfall adds to the natural beauty of the district. It is more prominent in rainy season. An ancient temple of Godess Kali at this hill attracts hundreds of devotees per day. (*Final CDP Munger*, n.d.). However stone quarries and widespread deforestation for firewood is a big threat for natural heritage of the district. There are several hot water springs in the district that maintain nearly the same temperature all year round. (*Beembandh Sanctuary*, n.d.). The district of Munger has great potential for adventure tourism like Trekking, Climbing, Hiking. Likewise of Nature & Eco tourism include experience of natural areas and their landscape, flora and fauna, birdwatching, photography, stargazing, camping, hunting, fishing, and visiting parks.

- ★ **Bhimbandh Wildlife Sanctuary:** It is located inside Bhimbandh Wildlife Sanctuary, 30 km of the south-west of Munger. Forests cover an area of 681.99 km² on the hills and undulating tract of Kharagpur Hills offers a splendid view of nature. (*Bhimbandh Wildlife Sanctuary*, n.d.-a). Besides being famous for its wildlife, the place is also well accounted for its hot water springs. Interestingly, these hot springs have the same temperature, ranging from about 52 degree to 65 degree, all year around, with nominal seasonal fluctuations. The hot springs at Bhimbandh are said to contain traces of radioactive matter. These hot springs are basically found at the valley portion and the foothills of Bhimbandh. (*Bhimbandh Wildlife Sanctuary*, n.d.-b)
- ★ **Gangta Forest:** Gangta forest is located along Kharagpur-Jamui Road in Munger. It is Naxal-affected forest. It was formerly a dense jungle sheltered many dangerous animals.
- ★ **Sita-Kund:** It is 6 km east of the Munger city contains a hot spring known as the SitaKund spring. It is associated with a legend of Lord Rama and Sita. The hot spring is enclosed in a masonry reservoir. It is visited by large number of pilgrims, especially at the full moon of Magh. The temperature of his spring varies in a remarkable manner and goes to the highest of 138°F and even above.

The water is beautifully clear and transparent and sends up numerous bubbles from its rocky bed. Besides this there is a Hindu temple and to the north is a reservoir of cold water, known as Ramkund, while to the west there were three more polls called after the three brothers of Ram, namely Lakshman Kund, Bharat Kund, and Satrughan Kund. (*Sita*

Kund, n.d.)

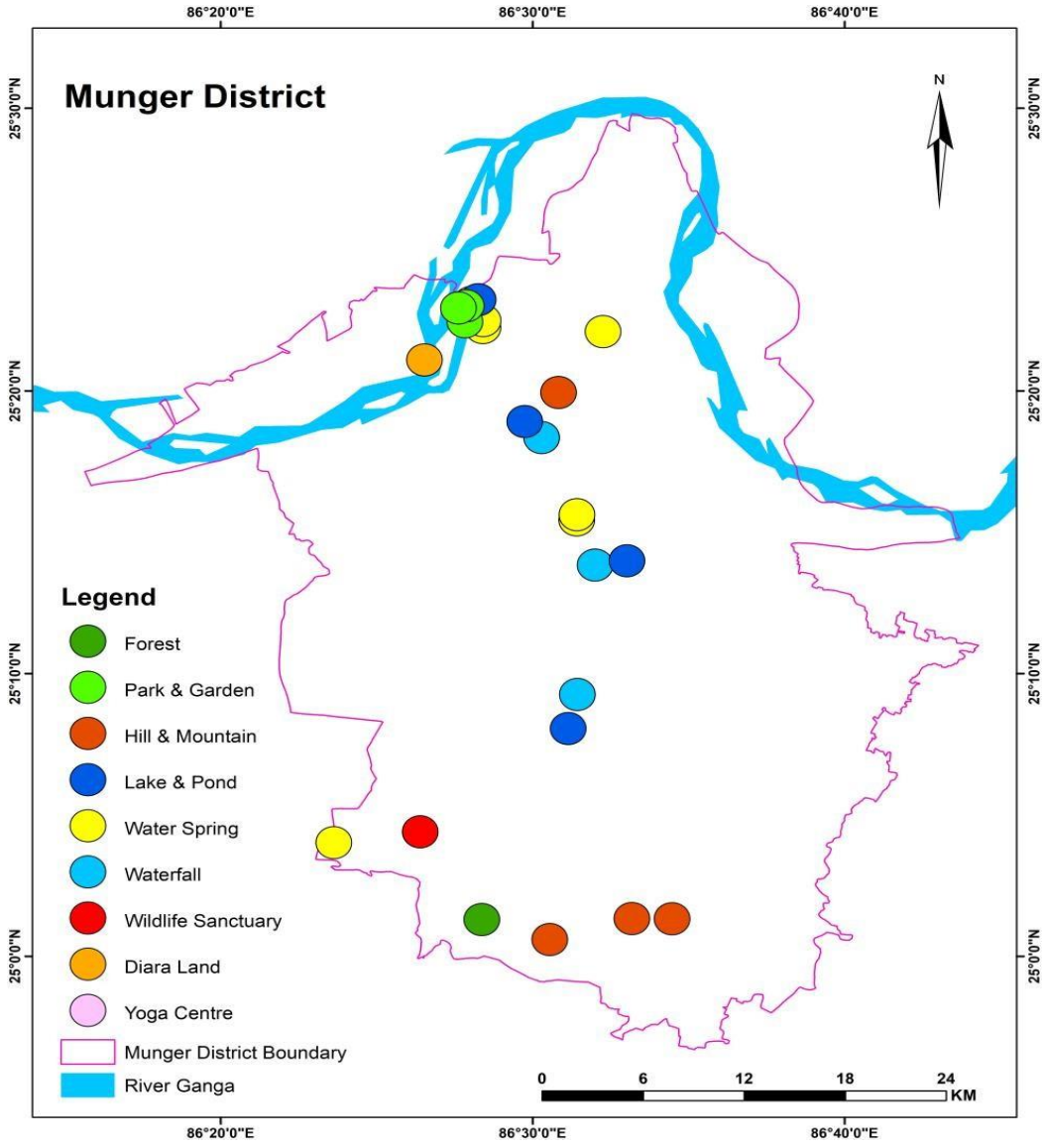
- ★ **Rameshwar Kund:** It is located at northwest corner of the Kharagpur Lake. According to the legend during muslim invasion one of the Generals camped at this site and dug the earth for water and accidentally a hot water spring came out. (*Final CDP Jamalpur*, n.d.)
- ★ **Rishi Kund:** It is situated about 6 km south-west of Ratanpura railway station and about 30 km north-west of Kharagpur 10 km south of Sitakund at the head of a picturesque little valley between two ridges of the Kharagpur Hills. It is a hot water spring. It has been made a place of worship and a reservoir, about 140 feet square, has been built to collect the water. The bottom is in some places sandy, in others rocky; and the water seems to issue all along the western side from numerous crevice in the rock. Bubble rise from the whole extent of the pool near the hill, and where the gas issues from among sand is formed cavities like minute craters. (*Final CDP Jamalpur*, n.d.)
- ★ **Bhaduria Bhur Kund:** This is a hot spring about 3 kms from Rishikund, on the other side of the Kharagpur range of hills, not far from the village of Dariyapur. The spring is much cooler than Rishikund and local people believe it to be a branch of the same spring. It emerges at the foot of the Bhaduria Hill from among masses of quartzite rocks, accompanied by gaseous bubbles, devoid of smell and un-inflammable. Men and cattle drink the water of this hot spring. (*Final CDP Jamalpur*, n.d.)
- ★ **Bhimband Kund:** Bhimbandh is famous for its hot springs which are known by the name Tatal Pani and are said to be the finest in the district. They are close to the forest village of Bimbandh. The first spring is about 300 yards north of the village, immediately under a small hill named Mahadeva. From the base of this hill the hot water issues in a fine stream. A few hundred yards farther to the north, at the foot of another hill called Damadama, one comes upon a whole region of hot springs. Hot water appears to be spouting from the ground in every direction. There are about eight or ten main springs all rising within a space of about 300 yards square. The united waters of all these hot springs are conveyed into a pool of cool water under an over-hanging rock in the river, called Bhimkund. This pool is sacred to Bhima and is a pilgrimage place. (*Final CDP Jamalpur*, n.d.)

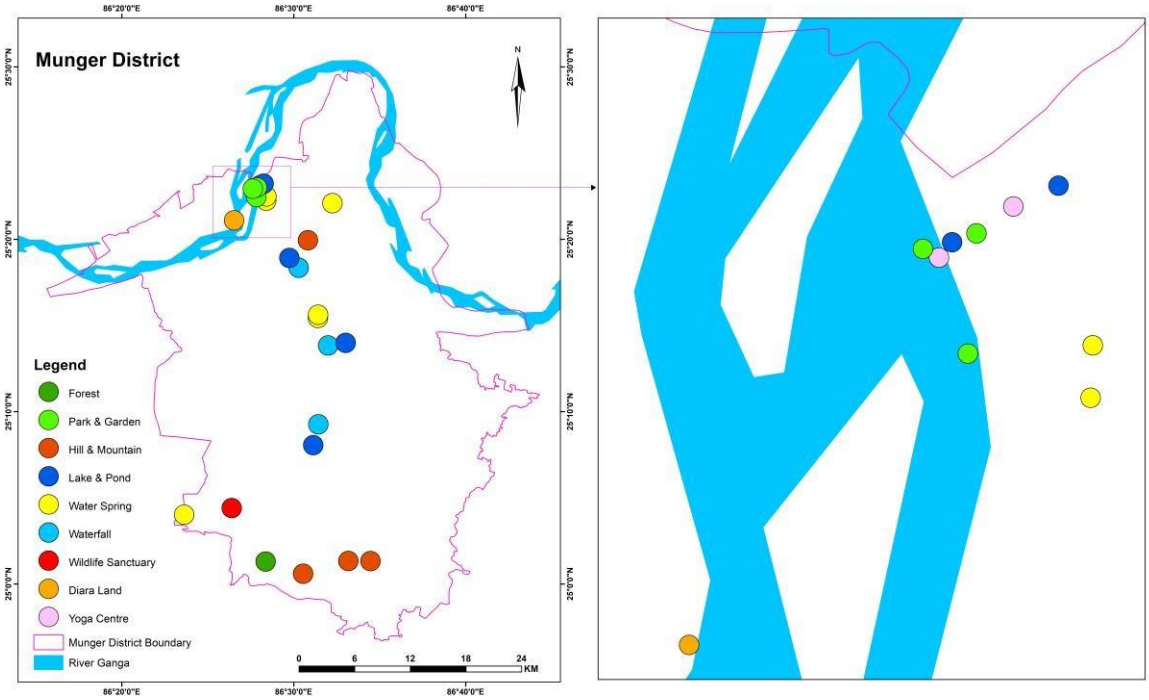
- ★ **Dolphin Eco Park:** Dolphin Eco Park is situated on the bank of holy Ganga near Sojhi Ganga Ghat in the Munger district. This is a best place for the tourists to see the adventures of dolphins in the Ganges by coming to this site. It has great potential to developed as a national aquatic fauna sightseeing.
- ★ **Company Garden:** Company Garden is also known as Jai Prakash Udayan. In the heart of the city, the most demanding picnic spot for the children during the new year is Jai Prakash Udayan, also called Company Garden. The place offers enough place for gardening and place to Picnic during new year and its heavily crowded as it is located inside the city The Surrounding has excellent natural beauty. The huge campus of Bihar School of Yoga looks amazing from the garden. (*10 Best Places to Visit in Munger during New Year*, n.d.)
- ★ **Sri Krishna Vatika:** It is named after the First Chief Minister of the Bihar, Dr. Srikrishna Sinha, it is a very beautiful, enclosed garden just opposite to Kashtaharni Ghat. It is one of the most interesting as well as adventurous place in Munger. (Munger District, 2013). Sri Krishna Vatika is also one of the most interesting as well as adventurous venue available in Munger as it has two "Surangs" (tunnels).
- ★ **Jamalpur Waterfall:** It is located near Kali Mandir. This waterfall is on a decline and the natural beauty is slowly tarnished as a result of unbriddled blasting at the stone quarries and also due to widespread deforestation for firewood.
- ★ **Jalkund Waterfall:** It is best place for nature lover, amazing waterfall and sunset here is mesmerising. It is visited by numerous visitors and tourists. Jalkund has an enormous capacity to provide irrigation to larger area but near Jalkund water disappears and insufficient quantity of water reaches to Jalkund Jalashay (water fall reservoir - which was built in 1967-68 with a total cost of 1.95 million rupees) (Chancellor, 2002)
- ★ **Daman Koh Waterfall:** Daman Koh is a Cold waterfall. It is loacted in Haveli Kharagpur in munger district.
- ★ **Bhusi Hill:** Hills of Jamalpur: Famous with the name of Kali Pahar, the spot has been a famous picnic place for the countrymen since long. Kali Pahar tops this list of best Picnics places in Munger because of its serene beauty and attraction. It is also called the most beautiful place in Munger District. The water filter, Lotus Lake, Death Valley, Kali Temple and much more to see at this hill.

- **Chill or Deoghara Hill:** It is located along Gaighat-Sangrampur road in Sangrampur, Munger. There is a small masonry temple of Lord Shiva at the summit of the hill, which is approachable with some difficulty. Another, stone and brick built temple is located at a lower height.A big mela is held in Fagun on Shivaratri day and it continues for three days.
- **Aama Hill:** Aama Hill is situated near Baba Sabalakh Mandir, Pahadpur in Munger. It is closed to Gangta Forest. This hill has potential to develop various adventure activites like Trekking, Hiking and Roack Climbing etc.
- **Chandanpura Hill:** It is located in Jamalpur block of Munger district. This is beautiful with natural enviroment and high potential for hiking, trekking
- **Kharagpur Lake:** Kharagpur Lake is located in Haveli Kharagpur. The large water body surrounded by a range of Kharagpur hills of is an awesome destination for a picnic spot in the outskirt of the city. Kharagpur is perhaps best known for a large reservoir constructed by Maharaja of Darbhanga. It is formed by a dam built, two miles west of Kharagpur across the main river, which at this point debauches through a narrow gorge in the hills.(Munger District, 2013)
- **Jamalpur Lake:** Don't know whether it's a natural or man-made lake but it's looks awesome from the top. People celebrate chath puja here and is major tourist attractions. Need proper management, ghat is also on the lake but it is almost dirty. No cleaning. People also do fishing here. Its huge lake. Lotus can be also found here. During rain the water level increase to outside areas. Best place to hangout durig evening or have a walk or even a bike ride is also a beautiful experience just beside the lake.
- **Jalkund Dam or Heart Lake:** Jaalkund Dam is also known as Heart Lake. It is located near Jalkund Waterfall. It was created from the water coming from the Jalkund Waterfall. It is natural spot for Landscape view and has potential to be develop as a tourist spot. Jalkund has an enormous capacity to provide irrigation to larger area but near Jalkund water disappears and insufficient quantity of water reaches to Jalkund Jalashay (water fall reservoir - which was built in 1967-68 with a total cost of 1.95 million rupees).
- Golkund Talab: Golkund Talab is located near Company Garden

- ★ Mirchi Talab: Mirchi Talab is pond located just behind the railway track near Bijli office. This pond would be a great site to be develop for tourist for adventure purpose.
- ★ **Ganga bridge Site:** The Morning and evening is very much pleasant at the site of Munger Ganga bridge. The mighty View of Ganga is amazing from the site. A small dam along the Ganga for protecting the near habitant also give a better experience when you walk along it.
- ★ **Herudiyara Island:** Munger has a large streatch of diara land such is Herudiyara, Such a land form is recognized as one of the most valuable natural resources which can used for Recreational, Adventure and Cultural activities like: Amusement Park, Picnic, River Island, Food Plaza and river beach etc.
- ★ **Paduka Darshan Yoga:** Paduka Darshan is the sannyasa peeth of Bihar school of Yoga established by Swami Nirananjananda at Munger. It was called Ananda Bhavan and belonged to Goenkas family who gave it to Shir Swami Stayananda and Bihar school of yoga. It is situated on the banks of river Ganga.

Map: 5 Adventure, Nature and Eco Tourism Sites of Munger District





Source: Prepared by Author

GHAT TOURISM

Every city has some specialty that is engraved in the heart of it. A visit to Munger cannot be complete without a visit to the ghats running along River Ganges. The ghats have been a source of inspiration for artists, film-makers, photographers, writers and musicians for centuries. As a dip in Ganga is considered holy in the Hindu religion, most of the ghats are dedicated to religious rituals. One of the more visually spectacular ghats is the Kastharni Ghat, Babua Ghat and Sojhi Ghat etc. Ghats in Munger are riverfront steps leading to the banks of the river Ganges. Most of the ghats are bathing, Puja ceremony ghats and cremation site. Earlier Morning boat ride on the Ganges across the ghats is a popular visitor's attraction.

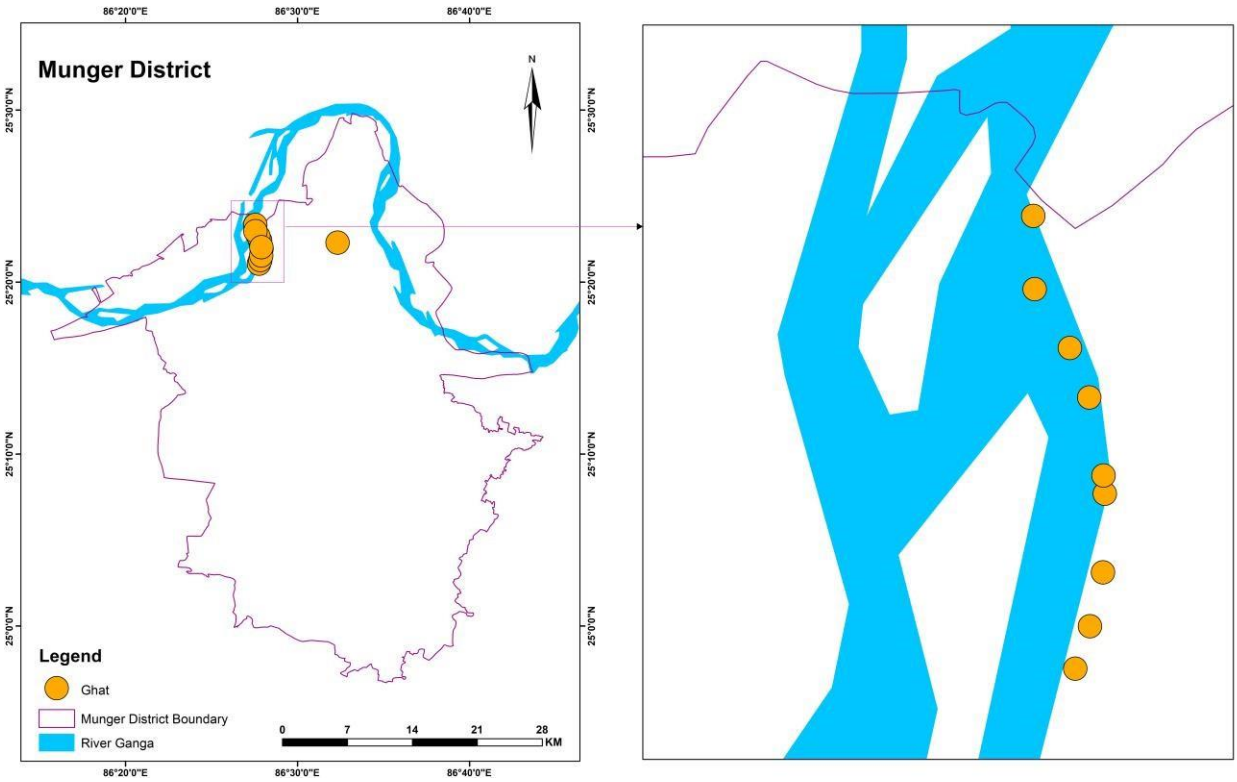
In order to develop the Ghat tourism in Munger we must consider these things: Ghats will be connected to each other by making river front will enhance the development of the district tourism, Benches will be set up for the people who come to visit ghat, Plantation will be done on the banks of the river, Greenery will be developed with the aim of promoting the environment, Lights will be installed on the side of the parking track, Laser and water screen show will be held to promote tourism. (*Final CDP Munger*, n.d.)

★ **Kashtaharni Ghat:** Kashtaharni Ghat, which literally means "The Bathing place which expels all pains". This Ghat is treated as a sacred place for Hindus. It is believed that on his return journey from Mithila to Ayodhya after marrying Sita, Sri Ram Chandra and

company took a dip in this water to relieve themselves from fatigue. It has northern flow, which is referred as “Uttar Vahani Ganga. (*Munger District*, n.d.-a)

- ★ **Belwa Ghat:** Belwa Ghat comes under the Belwa ghat Post office near Chaitola. Every year this ghat is used by thousands of Kanwariyas for their devotional journey. The Ghat have absence of a road connectivity within 3km. Belwa Ghat belongs to the Places of culture interest and its own importance especially for Chatt festival in Munger district.
- ★ **Domantha Ghat:** This is situated iin northern part of the district near Hiro Diara ghat. This Ghat belongs to the Places of culture interest and its own importance especially for Chatt festival in Munger district.
- ★ **Babua Ghat:** Babua Ghat is loacted near Dakshineshwari Kali Temple. Babua Ghat was constructed by former 'zamindars' during British rule for which they were honoured with titles of Rai Bahadur and Raja.
- ★ **Kankar Ghat:** Kankar Ghat is located near Panchmukhi Shiv Mandir, there is also Kali Mandir loacted near Kankar Ghat.
- ★ **Shoji Ghat:** Sojhi Ghat is located near Dolphin Eco Park, Munger. It is a ghat were tourist can see the beauty of ganga river aand heart catching Sunset.

Map: 6 Ghat Tourism Sites of Munger District



Source: Prepared by Author

CULTURE & ART TOURISM

Munger has a varied history of built, natural and living or cultural heritage. Munger has acquired national and global stature for owning spiritual and religious sites. The feeling of cultural ambiance can be witnessed in spiritual atmosphere of Munger where Hindus, Muslims, Jains, Buddhists and the followers of several other religions live together in harmony. The living heritage of Munger is perceived on the knowledge and practice of traditional arts of the region. Tourists who willing to explore true worth of Bihar's glorious past and cultural amalgamation can take tour of Munger which has a glorious past with promising future. This district has its own historic importance and wonderful cultural abundance. (*Culture and Heritage*, n.d.). One can witness the great levels of its cultural values in the many area's explored. From ancient times till the advent of medieval and modern era, Munger absorbed much from various quarters. with its rich past and a place of advanced culture, Munger still witnessed extremely rejuvenating culture of social and cultural richness. People celebrate their religious and social festival with keenness.

Hindu's, Muslims, Jain's, Buddhist and the believers of other religions celebrate their religious festivals in complete joviality. One of the most famous festivals which people celebrate in

Munger is Chatth puja, Maghi Purnima, Shivaratri etc. besides many other pujas and worship held every year.

- At Sitakund in every year a big mela is held on the occasion of Maghi Purnima. It is started that it is held since the days of Ram. This fair is famous for the sale of wooden furniture of all varieties at affordable prices. Traders from Katihar, Purnia and Saharsa in Bihar, Uttar Pradesh and Assam participate in the fair along with their products.
- At Rishikund at Kharagpur every year in the Malmas, a big mela is held which has a religious sanctity.
- At Deogarh in Kharagpur there is a hill. On the top of the hill is Shiv Mandir. A big mela is held in Fagun on Shivaratri day and it continues for three days.
- At Rangnath in Kharagpur also a big mela is held at Shivaratri day for two days, At Rangnath in Tarapur a big mela is held on Shivaratri day and it continues for five days. This village is situated on the road to Bhagalpur.
- In Munger town Dashara Mela is held on a gigantic scale and about a lakh of people congregate here on the occasion from different parts of the district.
- At Kastaharinighat in Munger town on Maghi Purnima day a big mela is held.

TOURISM POTENTIAL OF MUNGER DISTRICT

Munger district has a unique historical background. The areas falling under this district are considered a part of the first Aryan settlers' midland. It has been identified with Modagiri, a place mentioned in the epic Mahabharat. It was the capital of a kingdom in eastern India near Bhanga and Tamralipta.

Heritage Tourism: Munger district has immense potential for Religious, Adventure and Archaeological tourism. There are number of heritage structures, Adventure and Ghat sites present in the district. These structures include buildings, temples, shrines, Khanquah, Mosque, Tomb, Waterfalls, Lakes, Ghats etc. Some of the major tourist spots in the district are: Kashtaharni Ghat, Meer Kasim Tunnel, Jail Ghat, Babua Ghat, Sojhi Ghat, Kankad Ghat, Machhli Talab, Karnchaura/ Yoga Ashram, Chandi Sthan, etc.

Presently, (*Final CDP Munger*, n.d.)

Nature Tourism: The district being surrounded by rivers, hills, lakes and Waterfall etc. Nature Tourism can be promoted as one of the tourism circuit for the district. Some of the identified sites for nature-based tourism are: Bheemband Sanctuary, Kharagpur and Jamalpur Lake, Jamalpur Waterfall, Sita and Rishi Kund, Dolphin Eco Park, Mirchi Talab, Kali Pahari and Company Garden etc.

Health Tourism: Munger being the center of attraction for its International Yoga Institute can well be developed and promoted as Health Tourism and its surrounding area. Simultala which is already a popular destination for health resort can be connected with Munger and developed as a health tourism circuit.

Religious Tourism: The district is dotted with a number of places that hold many religious significance. The religious tourism can also be promoted and developed as one of the tourism circuit for the district. Munger can also act as the focal point in attracting the important Hindu, Islam, Jain Christian & Sikh religious destinations, some of them are: Chandi Asthan, Goenka Shivalaya, Shahi Masjid, Peer Pahar, Khanquah Rehmania, Peer Shah Nafa Shah, Munger Church and Gurudwara Sangat.

Table: 1 Tourism Potential Destinations of Munger District

Religious and Spiritual Tourism	★ Chandi Asthan ★ Goenka Shivalaya ★ Ucheswar Nath Temple ★ Sita Charan ★ Munger Church ★ Peer Shah Nafah Shrine ★ Tomb of Mullah Muhammad Said ★ Dargah Shah Mubarak Hussain ★ Dargah Gorho Sharif ★ Astana Shah Chandan Aaliya ★ Pir Pahad ★ Jama Masjid Muzaffarganj ★ Shahi Masjid ★ Masjid Lakhanpur ★ Gorho Sharif Masjid ★ Jama Masjid Mirzapur ★ Masjid Ali Shujapur ★ Khanquah Rahmania ★ Eidgah Mirzapur Bardah
Archaeological and Historical Tourism	★ Munger Fort ★ Mir Qasim Tunnel ★ Munger Museum

Adventure, Nature and Eco Tourism	★ Sita Kund ★ Rameshwar Kund ★ Rishi Kund ★ Bhurka Khund ★ Bhimband Kund ★ Kharagpur Lake ★ Jamalpur Lake ★ Jalkund or Heart Lake ★ Mirchi Talab ★ Golkund Talab ★ Jalkund Waterfall ★ Jamalpur Waterfall
	★ Daman Koh Waterfall ★ Bhusi Hill ★ Chill Hill ★ Aama Hill ★ Chandanpur Mountain ★ Dolphin Eco Park ★ Company Garden ★ Sri Krishna Vatika ★ International Yoga University ★ Paduka Darshan Yoga ★ Bhimband Wildlife Sanctuary ★ Gangta Forest ★ Herudiyara

Ghat Tourism	★ Kastaharni Ghat ★ Dumantha Ghat ★ Babua Ghat ★ Kankar Ghat ★ Shoji Ghat ★ Belwa Ghat ★ Godhi Tola Ghat ★ Shamshan Ghat ★ Mirzapur Ghat ★ Karballa Ghat ★ Herudiyara Ghat

3.4. WELANDS:

The wetlands create a unique ecosystem that supports many species simultaneously like aquatic, terrestrial, and human beings. Local stakeholders directly or indirectly depend on the wetland for their income and small-scale business. The district has a close connection with Hindu devotees, and the district is also known for Mithila paintings and the Maithili language. The data collected and analyzed shows the region's production and possible product that can be derived from the raw product. The list of sources and the possible products are mentioned below:

- Rice, wheat, maize and pigeon pea crops are the main crops grown in the region.
- Fruits like mango, guava and banana are grown in the district.

3 ACTION PLAN DEVELOPMENT

4.1 FORESTRY

The district should practice agroforestry and people should be made aware in accordance with the State's Agroforestry Policy, 2018. It is recommended that for agro-silviculture in non-flood affected areas Poplar, Shisham, Gamhar, Melia, Chah, Eucalyptus, Kadam, Semal, Ulmus, Sagwan, Toon, Bamboo, Casurina etc. and in the flood affected areas Eucaluptus, Kadam, Semal, Chah, Arjun, Salix, Jamun etc. can be grown. If farmers want to take up agro-horticulture then Mango, Litchi, Jamun, Kathal, Barhar, Guava, Bel, Ber etc. is recommended. Apart from major fruit crops like Mango, Guava, Litchi, Banana etc., Makhana, Pineapple, Betelvine can also be included under agroforestry systems.

Medicinal plants like Kalmegh, Aswagandha, Sarpgandh, Satawar, Lemon grass, Safedmusli etc. can be grown along with tree component. The aromatic plants like Japanese Mint, Lemongrass, Pamaroja, citronella etc. may also be included.

One thing which is very important is making people aware about the need of forests and trees. Educating them about the policies and how planting trees can be beneficial in both the ways, i.e. environmentally as well as economically.

4.1.1 Biodiversity –

- Under the Namami Gange project, a sewage treatment facility will be built in this ancient city so that polluted water does not enter the Ganges River.

4.2TOURISM

- Religious tourism, Adventure and Wildlife Sanctuary are the mainstream activities in Munger. The natural resources in the district of like Lake, rivers scenic beauty and Bhimband wildlife sanctuary has not received enough attention and did not grow to its fullest potential.
- To strengthen the tourism and attract large number of tourists, Tourism Product Diversification/Improvement is needed like, Promotion and packaging of tourist resources, Upgradation of identified tourist spots, Quality accommodations, Information Centre, Road and public transportation and Road furniture and signages etc.
- Provide adequate Park and Open Spaces/ Recreational Facilities and attract all type of tourism.
- New projects to diversify the tourist inflow apart from the pilgrimage/ religious tourism, emphasis on other tourism places for promotion of more tourism activities like, arts & crafts, urban haat, fair & festivals, waterfront development, health tourism etc.
- The development of regional tourist circuit and inter-State tourism circuit is required to prevent the diversion of tourist flow.
- Establish Tourist Information Centre in the District Headquarters. Tourist information centres will be equipped with the modern information and communication technology devices.
- Development of tourist facilities and overall improvement of infrastructure facilities for tourists in places of tourist attractions.
- Riverfront development, Eco Park, Water Park, Water Sport etc. around the tourism sites and along Ganga ghats.
- The strategy for heritage and tourism should be formulated to protect, conserve and maintain the heritage buildings and promote tourism in the district.
- Explore private sector participation for tourism promotion such as weekend tourism, wildlife tourism, aqua tourism and Heath tourism.
- Development of boating facility in existing Ghats across the fort.
- The Department of tourism would identify potential tourist destination where religious fairs and festivals are an integral part of culture and would promote such destinations.
- The condition of ferry booking centre is also miserable. Few temporary shops are there to serve the requirements of people travelling across the river Ganga. It is presumed that after the construction of rail-cum-road bridge over Ganga, the traffic load on ferry will decrease

drastically. The same system should be upgraded for tourism purpose to connect Sita Charan with Kashtaharni Ghat.

- Facilities for tourists like cloth change rooms, public toilets, rest rooms, water stand posts etc. should be provided at Kashtaharni Ghat and other ghats as well.
- District's image and aesthetic look should be improved to boost tourism. Construction of trees along with greenery on the banks of river Ganga, Benches will be set up for the people who come to visit here, Lights will be installed on the side of the parking track and Laser and water screen show will be held to promote tourism etc.
- Project like Riverfront development scheme, Project Dolphin will help the Gangetic dolphins, particularly those found in Munger district.

SWOT ANALYSIS

STRENGTHS

★ Munger's natural features (Rivers & Hills dominate the landscape) and unique ecosystems are valuable scenic and recreational resources and can contribute to environmental services.
★ Financial institutions / willingness to invest in the district.
★ Great Religious, Adventure and Eco tourism potential in the district.
★ Presence of arts / culture venues and religious structures.
★ Residents who are passionate and involved.
★ Engaged leadership.
★ Cohesive Community.

WEAKNESS

★ Poor maintenance of heritage structures and lack of awareness among local population about their heritage value.
★ Railway divides the district capital into two parts. The core area of the city is also identified as the sensitive zone since these areas are an old area and highly congested and prone to various environmental issues.
★ Lack of high-class tourism supporting infrastructure like star hotels.
★ Lack of high-class tourism supporting infrastructure like quality accommodations & resting places.
★ Lack of desire of skilled work force to stay in the district, lack of accountability of service delivery, Lack of Leaders and Entrepreneurs in the community and Lack of developable land in and around the district.
★ Terrible condition of the tourist information centre, thus provide inadequate infrastructure facilities to the tourists.
★ No maintenance of natural heritage leading to loss of valuable recreational space that can act as tourist destinations.

OPPORTUNITIES

★ Ongoing, committed and proposed development projects.

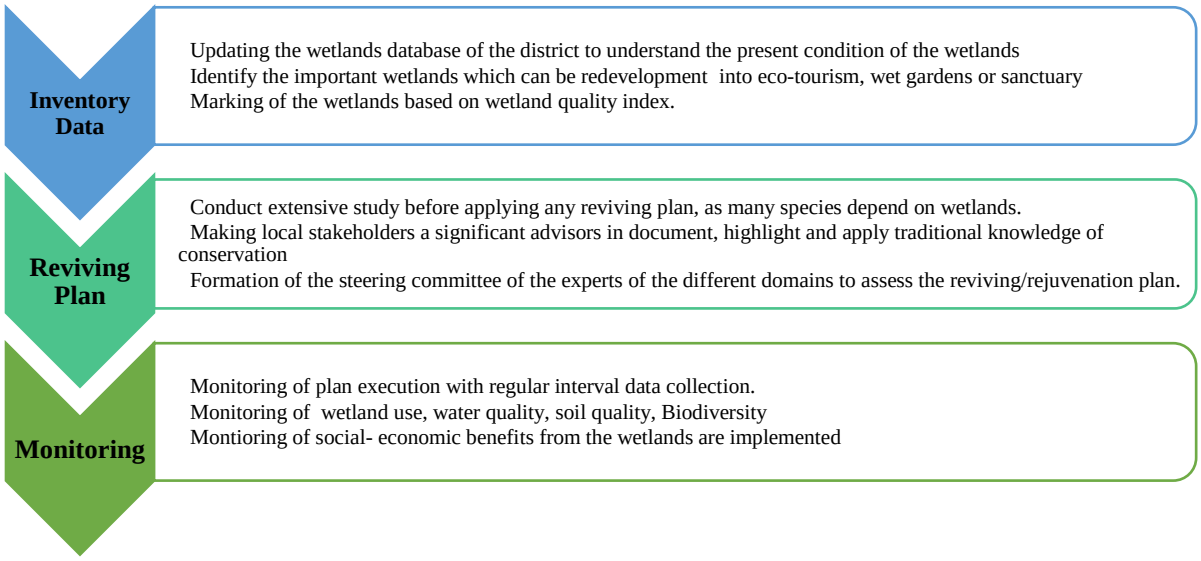
★ The holy river Ganga will attract a large volume of religious tourists.
★ The district can be promoted as the major health tourism destination.
★ A wide scope for river front development along Ganga.
★ Development of local resources into tourist destinations.
★ Potential for growth in arts / culture like Fairs & Festivals.
★ Reuse of vacant lands into economically productive use.
★ Obtaining grants for provision of infrastructure and housing.
★ Attract industries for processing of local agricultural produce.
★ After the construction of rail-cum-road bridge the connectivity of the district will increase many folds.

THREATS

★ Political stability, Naxalism and Corruption.
★ Munger comes under the zone of Environmental threats: Wind and cyclone high risk zone, Earthquake high zone and Flood prone area.
★ Competing districts for external investments in the vicinity.
★ Too much dependence on single economic sector.
★ Poor Infrastructure facilities for tourists in Munger.
★ There are chances of epidemic due to lack of sewage and solid waste disposal system for the city area particularly in slums. These increase losses during disasters. Thus, a disaster mitigation plan should be prepared for the city and whole district.
★ The dynamics of change in urban settlements due to large-scale population has led to the evolution of mixed land use, growth of industries, high population density, increasing poverty and lack in urban basic amenities.

3.3 WETLANDS

Some of the known wetlands in the district need to be taken care and action on different fronts must be taken. The action plan below gives a glimpse of the action and development required to protect, conserve, and rejuvenate the wetlands existing and extinct.



4.4. ENERGY

4.4.1. Solar

There are 861 villages in the district, out these, 534 villages are electrified. There is a scope for electrification of 322 villages. Here, solar energy could be utilised to provide lightning. According to the Census 2011, 7753.2 hectares of land is barren and uncultivable land. Here, component A of PM-KUSUM scheme can be implemented, which involves installation of ground-mounted renewable energy plants like installing the solar plants on the barren lands.

To improve the irrigation in the district component B of PM-KUSUM scheme could be implemented with sufficient government support in terms of finances and credit. Moreover, training and awareness programs could help in increasing the uptake of solar energy in the district. Rooftop solar panels should also be made mandated to be installed on government and private buildings and institutions.

PROJECTION AND MONITORING MATRIX

Firstly, awareness in the district about solar energy is required, as it has a huge scope in the district.

Secondly, solarisation of feeders could be made available.

Thirdly, component A and component B of PM-KUSUM scheme needs to be implemented properly in the state.

Fourthly, government should provide proper subidies and support farmers to adopt solar energy.

Lastly, solar panels should be made compulsory in the big institutions and organisations in the district.

The implementation of solar energy in the district would result in better irrigation systems, electrification of rural areas through green energy, which would help in sustainable development of the district.

4.4.2. Biomass

It is apparent that the awareness level is low in the district, as not much work has been done in the district to generate renewable energy through biomass plants. There is also a requirement of short-term training courses by government to the rural people so that they could take care of the biomass plants. The government also need to financially support the biomass plant owners in setting up their plants and also guide them to work efficiently. The district has a huge forest cover and also engages in agriculture sector, so from both the biomass raw materials could come, and help in generation of biomass energy. There is also management of biomass raw materials is needed, so that the raw materials don't get tarnished or spoiled. These would require human resources as well, in transportation, maintenance of the biomass plants, and security for storage facilities, all these would also create opportunities for income generation in the district.

PROJECTION AND MONITORING

Firstly, it is essential to have awareness in the district regarding biomass energy.

Secondly, technical support is required to maintain the biomass plants.

Thirdly, government subsidies or access to financial credit would help in setting up of the new biomass plants in the district.

Fourthly, storage facilities for biomass plants are needed.

The biomass generation in the district would help in achieving the renewable goals of the state.

4.4.3. Biogas:

The district has a huge potential to generate biogas from agricultural and livestock waste. However, no biogas plants are present in the district or city. The government should conduct a program to encourage or educate people to install at the household level; all the incentives or subsidy schemes should be told to local people and make them aware of the benefit of installing the biogas plant.

4.4.4. Hydropower:

The state plans to establish huge hydropower projects and pumped storage systems with the help of bilateral and international finance agencies, joint partnerships with government entities like the National Hydro Power Corporation (NHPC), and even private sector participation.

5 RECOMMENDATIONS

5.1 AGRICULTURE AND ALLIED SECTORS

1. Groundwater share increased from 38.38% of NIA in 2011-12 to 38.78% of NIA in 2019-20. The Central Groundwater Board (CGWB) 2020 reports that all nine blocks of Munger fall under the safe category. However, if high dependence on groundwater continues, soon, some blocks will fall under the semi-critical category. Therefore, Drip and Sprinkler irrigation systems should be encouraged, especially for vegetable and fruit cultivations.

2. As per the CGWB, 2013, the groundwater recharge of the district is 41336.22 ham, whereas the annual groundwater withdrawal (for irrigation, domestic and industrial water supply purposes) is 12105.32 ham. The stage of groundwater development is only 32.40% which should be increased further by the government by taking some crucial steps under Jal Shakti Abhiyan (2019).

3. The area under trees and gardens remained constant at 0.43% between 2011-12 and 2019-20, which should be increased to achieve sustainable development goals. Forest area can be increased if the activities involving cutting down the trees be compensated by reforestation and afforestation. It may help to ensure better air quality and a constant supply of forest products.

4. The share of barren and uncultivable land remained constant (8.15%) over the years. The fallow land significantly increased from 15.59% in 2011-12 to 18.38% in 2019-20, a matter of concern for the district economy. Moreover, the NSA decreased from 31.90% in 2011-12 to 29.40% in 2019-20., which is not a good sign for the district economy, as an increase in fallow land implies a decrease in NSA, which in turn will lead to decrease the total output in the district. Hence necessary steps should be taken by the government.

5. Food grains comprised 93.97% of GCA, focussing more on the cultivation of staple crops like Rice, Wheat, and lentils. However, this monoculture (Rice-Wheat cropping system) needs to be changed toward high-value cash crops such as horticulture. The government can promote micro and small units for horticulture product processing.

6. Per hectare yield of total cereals decreased from 25.54 qtls in 2013-14 to 23.35 qtls in 2019-20, majorly due to a significant decrease in the yield of Rice. Per hectare yield of total pulses decreased from 11.43 qtls in 2013-14 to 8.75 qtls in 2019-20. The yield of total oilseeds also decreased from 13.33 qtls in 2013-14 to 10.00 qtls in 2019-20. Thus, all crop yields went down in the latter years of the study, which is a serious issue and must be addressed. Fall in yield can be due to several reasons like temperature fluctuations, non-availability of hybrid seeds, variations in seasonal rainfall, etc.

7. The livestock subsector witnessed significant growth during the study period. Female Cattle increased by 72.80% in 2019 compared to 2003. Thus, dairy farming needs to be promoted by creating an efficient marketing network, adopting cross-breed, and setting up dairy and dairy-based processing units. Goats, Sheep, and poultry farming can be promoted to improve local livelihood.

8. Munger has 74 organic groups in five development blocks, divided into Bariyarpur (33), Munger Sadar (24), Jamalpur (8), Dharhara (8), and Asarganj (7). However, 50 out of 74 groups are formulated under the Namami Gange scheme, and there are only 24 groups present under the PKVY. Hence, the government must encourage more groups under the PKVY. Organic farming could be an economically viable option if the government builds strong marketing networks linking farmers, processors, and distributors with the easy certification process and minimizes farmers' risk by protecting their farm income through payments of ecosystem services. A long-term system of incentives and regulation needs to be evolved to retain the existing farmers and motivate others to move toward a sustainable farming system.

9. Training to prepare vermicomposting and green manuring should be organized for the farmers.

10. About 97% of farmers in the district are small and marginal, with landholdings less than two hectares. They can contribute substantially to livestock, vegetables, and other labour-intensive allied farm activities. There is a need for the adoption of a group farming model by these farmers to get the benefit of economies of scale in production, transport, and marketing and to improve their bargaining power. Qualitative vegetable seed production should be encouraged. An integrated farming system (IFS) should be adopted to generate more income from small land.

11. The farmers should adopt improved crop varieties and technologies for Wheat, Paddy, Pigeon pea, Rapeseed and Mustard, Moong, and vegetable cultivation.

12. The district has scope for cultivating spices such as methi and coriander, which should be encouraged.

13. Mushroom farming could become a source of income for low-income landowners.

14. Marketing and processing infrastructure facilities (Oil extraction units) should be build-up to promote Japanese mint cultivation.

15. Low-cost poly houses and shed net houses should be promoted for seedling raising and the growth of high-value orchids (gerbera).

16. Mango, guava, and banana are the major fruits of the district; there is a need for proper marketing and processing units for the surplus production. Training should be made available for the rejuvenation of old mango orchards.

17. Beekeeping should be introduced in the district.

18. Farm mechanization (Thresher, combine, power tiller, trans-planter) and resource conservation technologies (zero till, mulching, happy seeder) must be promoted.

19. Low land areas can be efficiently used for fish culture and cultivation of Singhara and makhana.

5.2 FORESTRY

People should be made aware of the importance of forests. The large chunks of fallow land should be planted with trees under the National Forest Mission and properly monitored and taken care. Agro-forestry is highly recommended for the district. Administration should act in accordance with the State's Agroforestry Policy, 2018.

5.2.1 Biodiversity

- Strict action must be taken against the mafia and the forest department because the stone mafia is unlawfully digging stones on the hills of Rishikund every day with the help of the forest department.
- It is recommended to conduct afforestation program as data shows decrement in forest area.

5.3 WETLAND

The wetlands need to be intact, but at the same time, they need to be planned wisely to support the district economically, socially and environmentally, which will lead to indirectly relieving of stress from the Ganga River to a large extent. It will also lower the local people's dependence on the Ganga River for their small-scale industry or basic daily needs. The following recommendation and interventions are required to get valuable products and solve the issues/ challenges faced by the local people of that region.

- It is recommended to introduce improved cultivars and production technologies for fruits.
- It is recommended to focus on aromatic crops like Japanese mint to increase their production.
- Small-scale industries like boat making and net making should be promoted under the schemes by the Ministry of Micro, Small & Medium Enterprises.
- It is recommended to create awareness about the Fisheries and Aquaculture Infrastructure Development Fund (FIDF) scheme and Pradhan Mantri Matsya Sampada Yojana (PMMSY).

5.4 ENERGY

5.4.1. Solar

- ❖ Awareness should be made in the district about solar and green energy.
- ❖ Solar energy for commercial purposes need to be strengthened.
- ❖ Solarisation of feeders is economical in the district.
- ❖ Focus on PM-KUSUM scheme needs to be there to improve irrigation in the district.

5.4.2. Biomass

- ❖ Technical support needs to be increased.
- ❖ Financial support system needs to be enhanced.
- ❖ The prices of biomass raw materials should be set up by the government in advance for the betterment of both sellers and buyers.
- ❖ Biomass gasifier and Co-generation projects need to be established in the district, as the district is abundant with biomass raw materials.

5.4.3. Biogas

- A centralized biogas plant for the district should be constructed for the treatment of organic fraction of municipal solid waste.

5.4.4. Hydropower

- It is recommended to construct ganga canal near Bariapur and investigate sites for hydropower generation.

5.5. TOURISM

- ★ Upgradation / beautification of areas around tourist spots (parking, shed, cafeteria, drinking water facility, toilet (male & female) and washroom, etc.) Kashtaharni Ghat, Pir Snah Nafah Shrine, Babua Ghat, Sojhi Ghat, Belua Ghat, Kankad Ghat, Chandi Sthan, Sita Kund, Sita Charan, Provision of net-railing by the sides of Outfall nallah (from Riverbed upto property line).

- ★ Development of Peer Pahad as Adventure and Knowledge Tourist site, Construction of a Resort near Sita Kund and Chandi Sthan and Development and beautification of adventure tourism along the Kali hill and Water-front development near Kali Pahadi Lake.
- ★ Development/ Re-establishment of Tourist Information Centres in all important places of Munger.
- ★ Development of Boating facility in existing moat along the fort area and around existing Ghats.
- ★ Development of Ferry booking centre Provision of at least 10 Glow shine boards showing tourist spots; at various locations in Munger Boards on all the sites to be read as nonspitting area, waste to be dropped in provided bins only, no entry zone (wherever applicable), etc.
- ★ Establishment of intra-city tourist van/taxi service system.
- ★ Upgradation/ construction of road along Ganga covering several tourist spots Provision of cheaper facilities for low-income tourists Construction of Dharmshalas Mobile toilet facility specially in Mela time at Sita Kund.
- ★ Construction of gateway, Drinking water points, public toilets Avenue and ornamental plantation (1.5 km)
- ★ Munger city does not have any organized sewerage system. Sanitation in the city is therefore poor.
- ★ Project to conserve and promote the heritage for tourism promotion.
- ★ Cleaning and maintenance of water bodies and green areas.
- ★ Appropriate and standardized tourism planning, and policies must be drafted and applied, ecofriendly infrastructural developments, popularizing the concept of eco-tourism among tourists and locals are the crucial requirements of the time.
- ★ Empowering and Sensitizing Ganga Ghats to make tourism compatible, environmentally friendly and sustainable.
- ★ Stakeholder consultation & Participatory management and involvement of Municipality, Disaster management authority and local communities from Ganga villages and tour operators to build ecotourism options and choosing adventure and religious tourism sites.

- ★ Developing Tourism circuits through the Integration of Archealogical, Religious, Nature and Adventure Tourism by Development of capacity building, engagements with local stakeholders.
- ★ Development of town park (Area .5 Hac) Development of green belts along major roads and along revived major drains Landscaping and flood protection along Ganga River front Meditaion park (2 acr) Millenium Park Beautification of various tourism attraction sites.
- ★ Tourism carrying capacity at individual sites and caping the number tourists must be estimated through specific research and development projects.
- ★ Development of combined projects involving Tourism department/ Ministry, Disaster management department and Environment, forest and climate change section/Ministry.

CHALLENGES AND THREATS

★ Lack of awareness on the importance of maintaining areas of natural beauty like wildlife, Lakes, Waterfall, Hills and cultural heritage of the district has led to a decline in tourism in the district. Thus, Tourism industry is underdeveloped.

★ The district is prone to different kinds of disasters, which include floods, earthquakes, cyclones etc. Incorporating disaster mitigation measures within the infrastructure planning process.

★ Inadequate infrastructure facilities and information centres for tourists. The tourist information centre is in its most appalling condition. The dilapidated building should be either repaired or reconstructed.

★ There are important traditional and living heritage practices which are critical to economic, urban image and social development of Munger. The process is to be set in view of developing a system for care of heritage and tourism assets and bring out economic regeneration in the city on these grounds.

★ Prevent of naxalism, poverty, snatching, robbery etc. Tourist security should be increased.

★ Tourist infrastructure not able to support sudden swell of pilgrims and sudden influx of tourists leads to degradation of urban environment. Must look at the tourism carrying capacity of the district at different site-specific destinations of the district.

★ District lacks in adequate accommodation and restaurant facilities for tourists. The other major issues with respect to tourism include excessive commercialization, encroachment on streets by hawkers and vehicles, inadequate parking facility and lack of tourist guides.

★ Lack of appropriate tourism promotion strategies.

★ The problems being faced by pilgrims while taking dip during the ongoing festivals like:

★ Chath Puja is a matter for serious concern.

6 Discussion during the Report Presentation

- The Tussar silk and Bhagalpuri silk is famous and can be associated with Jalaj Model.
- Jalaj team is very active and has a production unit and production unit.
- Namami Gnage has provided Vikramshila Gangetic Sanctury which attracts a good footfall of tourists.
- There is a turtle-Rehab centre in Bhagalpur.
- Officials ensured that the submitted report will be reviewed and will be taken up for suggestions for implementation of interventions in the districts.
- The IIML Report for Arth Ganga should be a regular Agenda item for next 6-8 DGC meetings.
- Hon'ble PM during the post-Budget webinar on Tourism had spoken about market potential of destination weddings. It was suggested that suitable Ashrams in Ganga Basin may be identified for such purpose to promote blissful experience, cost reduction, livelihood opportunities and better upkeep.
- Allocate separate space for Namami Gange Awareness and Jalaj Marketing kiosk in Melas/Congregatios/Fairs for providing better marketing opportunities to the Jalaj products.
- As Dilli Haat Centre – Namami Gange Awareness and Marketing Centre – is being launched soon, it was requested that every district to identify niche products with a creative story and link it with Jalaj in their area.
- To identify Arth Ganga Tourist Trails and organize Ganga Guide training
- Promotion of Natural Farming in Ganga Basin and training workshops should be organized on a regular basis. NMCG is supporting this initiative in coordination with MoA& FW and NCOF.
- Make plans for reuse of treated waste water for agriculture, industrial etc. purpose and also the sludge.
- Training of volunteers for Ganga awareness & Aarti workshops to promote regular aartis on Ghats.

7 REFERENCES

https://censusindia.gov.in/census.website/data/census-tables

http://www.nicra-icar.in/nicrarevised/images/statewiseplans/Bihar/BR25_Munger_28.12.2013.pdf

https://www.researchgate.net/publication/295863538_Replication_and_scaling-up_of_isolated_mini-grid_type_of_off-grid_interventions_in_India

https://documents1.worldbank.org/curated/en/198631468269101355/pdf/E46730V30P132600Box385371B00PUBLIC0.pdf

https://www.breda.bih.nic.in/

https://www.thermaxglobal.com/case_studies/test/

https://www.udyogmitrabihar.in/docs/dp/munger.pdf

http://www.bihar.com/dist_munger.aspx

https://munger.nic.in/district-profile/

http://www.bihar.com/dist_munger.aspx

https://inputsurvey.dacnet.nic.in/RSL/districtsummarysizeclass1a.aspx

file:///C:/Users/AAYUSHI%20SHARMA/Downloads/DH_2011_1024_PART_A_DCHB_MUNGER.pdf

https://portal.ceew.in/datastory/munger-bihar/

- https://fsi.nic.in/isfr-2021/chapter-13.pdf
- https://censusindia.gov.in/nada/index.php/catalog/288
- http://www.nicra-icar.in/nicrarevised/images/statewiseplans/Bihar/BR25_Munger_28.12.2013.pdf
- https://dokumen.tips/documents/agroforestry-policy-2018-government-of-bihar-need-for-dedicated-agroforestry-policy.html?page=12

6 APPENDICES

Table 1 Biogas potential from animal waste.

Livestock	Residue type	Total population as of 2012	Manure yield * (kg/day)	Total manure generation annually (kg)	Average collection (75%)	Dry manure after removing Moisture content	Manure required for biogas* (kg/m^3)	Biogas potential (m^3/yr)	m3/day	Dry matter per day
Cattle	Manure	166614	10	60,81,41,100	456105825	91221165	25	3648846.6	9996.84	249921
Buffalo	Manure	52350	15	28,66,16,250	214962187.5	42992437.5	25	1719697.5	4711.5	117788
Sheep	Manure	279	1	1,01,835	76376.25	15275.25	25	611.01	1.674	41.85
Goat	Manure	169079	1	6,17,13,835	4628537 6.25	9257075.25	25	370283.01	1014.474	25362
Pig	Manure	7845	2.5	71,58,563	5368921.875	1073784.375	25	42951.375	117.675	2941.9
Poultry	manure	91,575	0.1	33,42,488	2506865.625	501373.125	25	20054.925	54.945	1373.6
Total		**4,87,742**						**5802444.42**		

Table 2 Biogas potential from agricultural waste.

Crop	residue type	Total crop production (tons) (2006-07)	Residue production ratio	Residue amount (tons)	Average collection (70%)	Moisture content	Residue amount after removing moisture (tons)	Biogas potential [m3/(tons of dry matter)]	Overall biogas potential (m3)
Rice	husk	59693	0.28	16714.04	11699.828	30	8189.8796	800	6551903.68

Wheat	straw	33736	1.5	50604	35422.8	80	7084.56	750	5313420
Total		**93429**							**11865323.68**