ARTH GANGA
PATNA DISTRICT

Submitted By

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Executive Summary

Being the capital of the State of Bihar, Patna is also the largest town and headquarters of Patna district, Patna division and Bihar state. It is located on the south bank of the river Ganga. It is well connected by air, rail and roads. It is mainly an administrative and educational centre of Bihar. It has, however, a few ancient sacred places which interest the tourists most.

Agriculture is the main occupation of the people living in the district. However, due to rapid urbanization, Patna Municipal Corporation is suffering from intense load on its resources which is resulting in very fast change in its land cover/land use pattern. The district plays a very huge role in the production of rice, pulses and vegetables like potato, onion and some green vegetables. The mango and banana production is blessed with deep fertile soil and plenty of water along with a subtropical climate suitable for a wide range of crops. It does, however, lack the necessary infrastructure for storage, packing, transportation and a well-organized marketing system. By improving the storage and transportation facilities and reinforcing the vegetable seed program would help to improve the infrastructure and it will also increase the yield of vegetables. There is a large scope of organic farming in this district. The government is already giving monetary help, but it can be expanded to most of the farmers.

Major sources of electricity generation in Patna are thermal and hydel energy. In recent years, there has been a greater emphasis on the development of renewable energy sources despite that there is power deficit in the district, even for basic demands. Replacing the use of grid power for certain end-uses through low temperature solar thermal, renovation and modernization of existing units to restore original efficiency along with reduced auxiliary power consumption and reduced chimney emissions can be helpful to mitigate power deficit.

The district does not have forest under the category of Very Dense Forest (VDF). Currently, Patna has zero reserved forest area. Thus, there is a desperate need to increase the vegetation of the total geographical area through afforestation and land-use diversification. Establishing a distinct multi-disciplinary facility/wing in the Environment and Forest Department for climate change action plan research and monitoring, as well as inter-departmental coordination is recommended.

There are many wetlands in the region out of which some wetlands are of more significance. The region has a large number of tanks and ponds. The wetlands are habitats for a variety of species. It creates a unique ecosystem that supports many species simultaneously like aquatic, terrestrial, and human beings. It is recommended to rejuvenate and restore the water bodies of the district. This can be done by recharging old ponds, aquifers and lakes present and preserving them.

This leads to the solution of water scarcity, water quality in the region, also, to promote organic farming and a scientific approach near the wetlands to lower the pollution of the wetlands. It is recommended to promote organic farming and a scientific approach near the wetlands to lower the pollution of the wetlands. Also, these practices will help to attract the market and increase the yield of the scheme. The government scheme will give a boost to crops like sugarcane, grains. Steps needed to be taken to promote techniques to increase production in organic farming with less cost in cultivation. The region has many medicinal plants cultivation like lemongrass, fenugreek, suragandha, ashwagandha, etc. Production of these plants can be increased by turning nursery and allocated land, and products like essential oil and ayurvedic medicine can be derived.

This research work gives a strong insight and recommendations to improvise in the fields of agriculture, forestry, energy, tourism, wetlands and biodiversity. It further indicates programs and initiatives that can be taken in the process of overall development of the district.

District Overview

1. Introduction[1]

Patna is the capital of India's most significant state of Bihar. It is located on the southern bank of river Ganga having the highest population out of all the districts in the state. The general information about the district is summarized in Table 1.

Table 1 Brief information about Patna, 2011

Sr. No.	items	Statistics
1	Geographical Area	3202 sq km
2	Forest Area	23. 54 sq km
3	Total population (a) Male (b) Female	5,838,465 3,078,512 2,759,953
4	Population density	1823 persons per sq. km
5	Sex-ratio	857
6	Literacy rate	70.68%

The district is divided into 23 Blocks which contains 1395 villages and 322 panchayats an is spread up to 3202 sq. km in area. (Table 2)

Table 2 District subdivisions and Blocks details

Sr. No.	Sub-Divisions	Blocks
1	Patna Sadar	Patna Sadar, Phulwarisharif, Sampatchak
2	Patna City	Fatuha, Khusrupur, Daniyanvan
3	Danapur	Danapur, Bihta, Maner, Naubatpur
4	Masaurhi	Masaurhi, Dhanarua, Punpun
5	Paliganj	Bikram, Dulhinbazar, Paliganj
6	Barh	Bakhtiarpur, Athamalgola, Belchi, Pandarak, Barh, Mokama, Ghoswari.

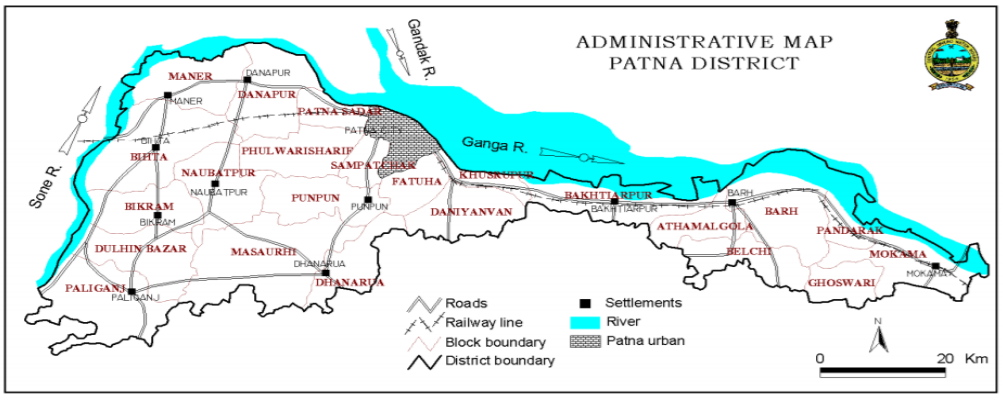


Figure 1 Map of the Patna district

Table 3: Trends in Gross District Domestic product in Patna at Constant Prices

[1] https://patna.nic.in/

(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	TOTAL GDDP
2007	11859	25264	83386	120508				
	(9.84)	(20.96)	(69.20)	(100)				
2008	12711	29064	92372	134148	7.18	15.04	10.78	11.32
	(9.48)	(21.67)	(68.86)	(100)				
2009	10181	32060	101038	143279	-19.90	10.31	9.38	6.81
	(7.11)	(22.38)	(70.52)	(100)				
2010	12459	39881	108049	160389	22.38	24.39	6.94	11.94
	(7.77)	(24.87)	(67.37)	(100)				
2011	13996	50594	115918	180508	12.34	26.86	7.28	12.54
	(7.75)	(28.03)	(64.22)	(100)				
2012	15247	59459	132804	207510	8.94	17.52	14.57	14.96
	(7.35)	(28.65)	(64.00)	(100)				
2013	14968	67036	145252	227255	-1.83	12.74	9.37	9.52
	(6.59)	(29.50)	(63.92)	(100)				
Average Growth Rate					4.85	17.81	9.72	11.18
Source: http://data.icrisat.org/district-level-data/ Note: Figure in Parenthesis are percentage share in total GDDP								

2. Land use pattern in Patna

The district can be divided into two natural divisions comprising (i) a narrow strip of somewhat high land about 8 Kms. in width along the southern bank of the Ganges having very fertile soil and (ii) alluvial fertile plains in the remaining portions (District Census Handbook, 2011).

Urbanization in Patna Municipal Corporation is characterized by unplanned and uncontrolled growth leading to urban sprawl. Land use planning and the pattern of development, relationship between residential areas and industrial, commercial and office complexes have a considerable impact on the environment (Singh & Steinberg, 1996). Most of all, appropriate infrastructure provision has not kept pace with economic growth.

Table 4 Land use pattern of the Patna District

Land Use Types	Patna (in Ha) 2018	Patna (in Ha) 2013-14
Geographical area	3,17,236	3,17,236
Barren and unculturable land	12369	12369
Total area put to non-agriculture use Land Area	67872	67420

Total area put to non-agriculture use Water Area: Perennial / Temporary	10332 / 2029	10332 / 2386
Culturable Waste land	707	754
Permanent Pasture and grazing land	99	106
Land Under misc. Tree, Crop and Groves not included in net area Sown	1042	1025
Other Fallow land	1515	1540
Current Fallow land	45502	71075
Net area Sown	175713	150173
Gross crop Area	218925	Total Cropped Area: 194925
Area Sown More Than Once	43212	44752
Crop Intensity	1.25	-

Quantitative Data Analysis

1. Agriculture

Patna District is an important part of the state of Bihar for the production of rice, pulses and vegetables like potato, onion and often green vegetables. *Kewal soil* of this region has favoured the production of rice, pulses and potato. Onion has remained an important crop in this region, because people of Bangladesh prefer the onion of this region more than the onion of other areas. In Patna, the production of cereals, green vegetables and seasonal fruit has been considerably affected by the importance of market-oriented crops and urban demand (Kumari, 2020).

Patna is one of the few districts of state which have had a network of irrigation canals since the British days. A number of Medium Irrigation schemes, Minor Irrigation schemes, Open borings, irrigation wells and tube wells have been introduced in the district during the different plan periods. The government has tried to create irrigation facilities through state tube wells and lift irrigation schemes. Besides the various irrigation projects executed in the district, tube-wells under the Patna-Barh-Ekangarsarai Bihta Emergency River Pump and Technical Cooperation Administration Schemes were installed in the district and some *Pynes* were also renovated (District Census handbook, 2011) so availability of irrigation facilities is not a point of concern for the district.

Table 4 Area covered under the H.Y.V. crops (Unit-In 000' Ha)

Sr. No.	Crops	Area	
		2016-17	2015-16
1	Rice	33	34
2	Wheat	28	26
3	Maize	1	1

Source: Bihar Statistical Handbook

Table 5: Trends in Area under Principal Crops in Patna District (in 1000 Ha)

Crop/Year	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Rice	60.11	59.84	56.73	63.66	63.68	61.36	72.1
Wheat	60.26	59.31	60.66	60.6	60.07	60.44	68.18
Maize	8.07	6.43	5.51	6.78	6.73	6.34	5.56
Barley	0.15	0.22	0.15	0.18	0.19	0.17	0.1
Chickpea	6.53	5.77	6.45	6.34	6.18	6.32	8.74
Rapeseed and Mustard	2.48	3.78	3.03	3.14	3.32	3.16	3.81
Linseed	0.24	0.3	0.24	0.25	0.26	0.25	0.11
Sunflower	0	0.04	0.02	0.02	0.02	0.02	0.03
Sugarcane	0	0.12	0.13	0.11	0.12	0.12	0.11

Source: http://data.icrisat.org/district-level-data/

Table 6: Trends in Production of Principal Crops in Patna District (in 1000 Tons)							
Crop/Year	**2011-12**	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**
Rice	167.32	191.98	137.47	163.12	192.85	184.61	216.66
Wheat	220.39	211.57	170.66	170.08	143.99	200.79	246.7
Maize	17.97	18.76	22.14	21.91	16.4	13.91	24.58
Barley	0.26	0.37	0.22	0.18	0.26	0.29	0.18
Chickpea	12.34	10.58	9.3	10.03	5.42	8.19	10.42
Rapeseed and Mustard	4.18	7.68	7.19	6.22	3.32	4.42	4.42
Linseed	0.21	0.26	0.2	0.22	0.23	0.21	0.1
Sunflower	0	0.06	0.02	0.03	0.04	0.03	0.04
Sugarcane	0	0.64	0.73	0.65	0.58	0.67	0.67
Source: http://data.icrisat.org/district-level-data/							

Table 5: Variability in Area, Production and Yield of Principal Crops (2010-11 to 2017-18)									
	Area (1000 Ha)			**Production (1000 Ha)**			**Yield (Kg/Ha)**		
Crop/Year	**Average**	**SD**	**COV**	**Average**	**SD**	**COV**	**Average**	**SD**	**COV**
Rice	62.50	4.87	7.79	179.14	25.57	14.27	2859.86	282.28	9.87
Wheat	61.36	3.04	4.96	194.88	35.22	18.07	3168.71	495.87	15.65
Maize	6.49	0.87	13.33	19.38	3.70	19.10	3063.43	879.73	28.72
Barley	0.17	0.04	22.81	0.25	0.07	26.62	1521.00	269.29	17.70
Chickpea	6.62	0.97	14.62	9.47	2.19	23.12	1444.71	359.80	24.90
Rapeseed and Mustard	3.25	0.46	14.12	5.35	1.67	31.29	1661.29	500.70	30.14
Linseed	0.24	0.06	25.08	0.20	0.05	24.45	861.57	21.38	2.48
Sunflower	0.03	0.01	33.47	0.04	0.01	37.26	1491.33	316.94	21.25
Sugarcane	0.12	0.01	6.36	0.66	0.05	7.44	5613.00	364.17	6.49
Source: http://data.icrisat.org/district-level-data/									

2. Horticulture

With 11 percent and 9 percent of national production, Bihar is one of India's leading producers of vegetables and fruits. It ranks third and sixth in the production of vegetables and fruits, respectively, among other states. Patna's fruit area is around 9815 hectares, or around 12 percent of the state's total fruit area (Table 5). Patna's fruit and vegetable yield rates are often lower than those of other districts. However, for mango and banana, they are among the highest.

Patna produces around 1.04 lakh M.T. of fresh fruits each year. In addition, vegetables are cultivated on around 54 thousand hectares, yielding 9.05 lakh metric tonnes of vegetables (Table 2). Aside from that, potato production covers about 17 thousand hectares, yielding 5.12 lakh M.T. of potato.

Table 5 Area and Production of Fruits in 2017-18

Sr no.	Name of the Fruits	Area (Hectares)	Production (Tonnes)
1	Aonla	-	320
2	Banana	720	31165
3	Guava	1230	10063
4	Lemons	665	4765
5	Mango	4500	52915
6	Muskmelon	980	1306
7	Papaya	120	3000
8	Other Citrus	1600	1600
	Total	**9815**	**104814**

Source: Directorate of Horticulture, Govt of Bihar

Table 6 Area and Production of Fruits in 2017-18

Sr no.	Name of the Vegetables	Area (Hectares)	Production (Tonnes)
1	Potato	17800	512394
2	Onion	2980	72207
3	Brinjal	2150	55185
4	Tomato	2250	51157
5	Okra	3450	47150
6	Cabbage	3305	44066
7	Green Chilly	2960	42755
8	Bottle Gourd	10650	24154
9	Radish	990	15950
10	Peas	600	4320
11	Beans	430	3870
12	Carrot	340	3626
13	Bitter Gourd	335	2791
14	Cucumber	120	1560
15	Cauliflower	4480	1532
16	Pumpkin	30	870
17	Other Vegetables	1400	21430
	Total	**54270**	**905017**

Source: Directorate of Horticulture, Govt of Bihar

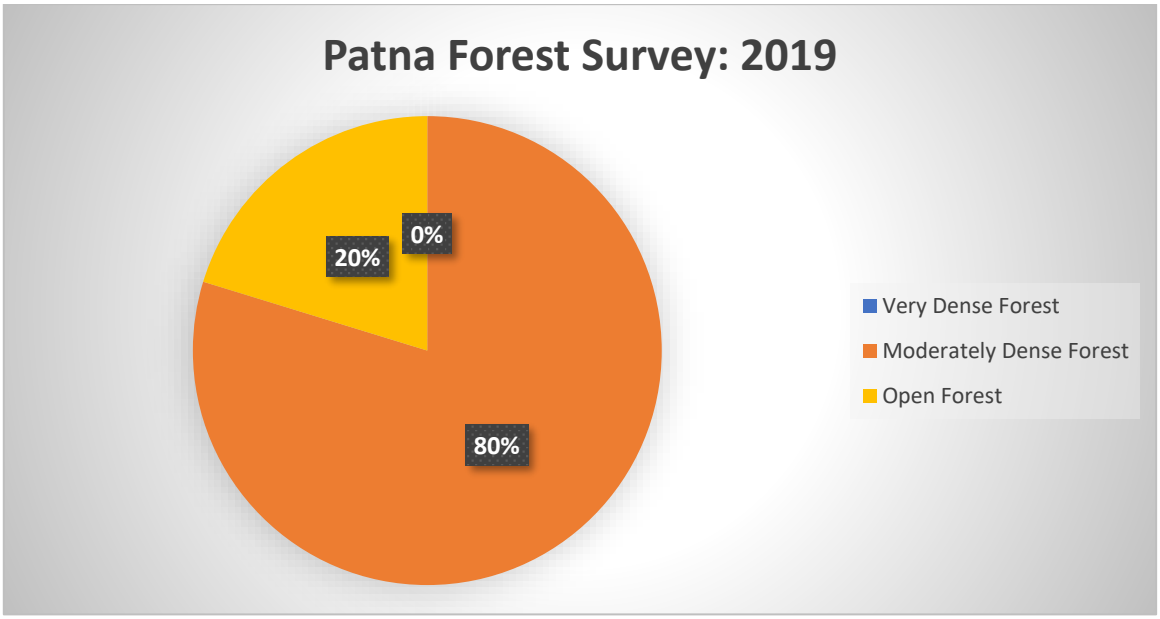
3. Fisheries

The extensive bed of the river Ganges in Patna and other places in the district offers one of the best fishing grounds. The spawn of rehu, Katla and hilsa is also collected from the river Ganges. There are a large number of rivers, streams, ponds and low-lying fields in the district where water accumulates in the rainy season and these have considerable potential for development of fishery. Fishing practically begins in October and the peak season is December, January and February when a variety of fish can be seen in the fish market. The district's overall fish output is at 50 thousand tonnes, with an average yield of roughly 0.5 tonnes per hectare per year. It accounts for roughly 0.8 percent of Bihar's G.D.P. (District Census handbook, 2011).

3. Forestry

District of Patna has 3202 Km^2 total geographic area. Forest cover area as per 2019 forest survey assessment is 23.54 Km^2. This is 0.7351% of the total area which makes district forest deficient. The state has a total 7305.99 Km^2 forest area which is 7.75% of the total geographic area of the state.

Patna district does not have forest under the category of Very Dense Forest (VDF), 18.78 Km^2 of area comes under the category of Moderately Dense Forest (MDF) and 4.76 Km^2 is open forest (OF) as per 2019 assessment.



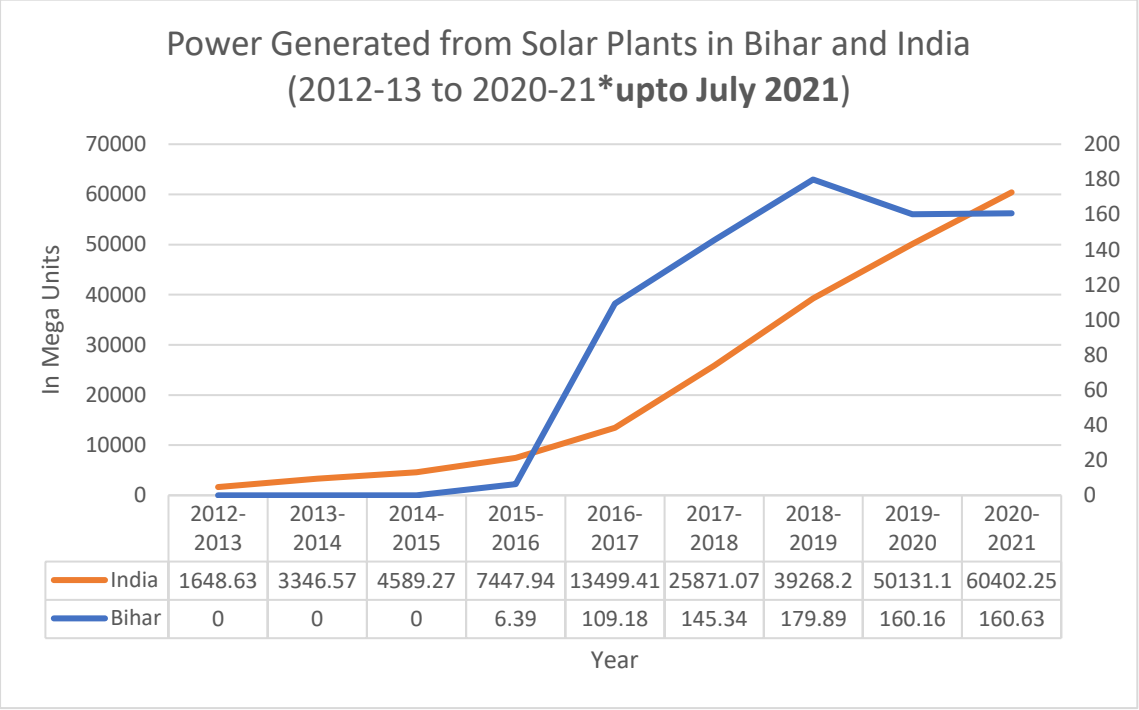
Forest Survey of India 2019 Bihar State vs Patna Comparative Assessment						
Area	Geographical Area	Very Dense Forest	Moderately Dense Forest	Open Forest	Total	%of Geographical Area
Patna	3202	0	18.78	4.76	23.54	0.74
Bihar	94163	333.13	3280.32	3692.54	7305.99	7.76

At present Patna has zero reserved forest area. 139 Km^2 area was recorded under afforestation and reforestation schemes during 2020-21 assessment. Total 97,100 plants are planted in FY 2020-21 under various schemes like Namami Gange Yojana, Campa Yojana, Path Tat Yojana.

4. Energy

4.1. Solar

According to The Times of India in January 2015, Patna can generate 277 MW of solar energy by 2025. Patna can start producing solar energy up to 35MW in the initial phase by using the roofs on government and industrial buildings. This can bridge the ever-increasing gap between demand and supply of energy, as per a report of the Centre for Environment and Energy Development (CEED) titled "Rooftop Revolution: Uncovering Patna's Solar Potential". Co-authored with Bridge to India, the report says that solar energy can also save us from dirty, unsustainable, uncertain and costly electricity from conventional sources like coal and diesel. The Bihar Electrical Regulatory Commission (BERC) increased distribution licensees' renewable electricity purchase obligation from 2.5 per cent in 2011-12 to 5 per cent in 2014-15. In 2011-12, this obligation included a minimum of 0.5 per cent solar electricity.



	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021
India	1648.63	3346.57	4589.27	7447.94	13499.41	25871.07	39268.2	50131.1	60402.25
Bihar	0	0	0	6.39	109.18	145.34	179.89	160.16	160.63

The contribution of share of energy from solar energy has increased over the years for Bihar as well as for India.

According to the data provided by the district administration of Patna , a total of 4.585 MW of solar plants at 397 locations are installed. The total solar power generation capacity is 10676 KWh.

There are 180 grid connected solar plants, with the capacity of 3802 kWp, while total 217 off-grid connected solar plants, with the capacity of 783.4 kWp.

In the urban areas, 1,21,69,615 rooftop solar panels were installed. Net power generation through solar energy in the urban areas is 93945 Kwh.

i) Cost of solar cells/plants for both domestic as well as commercial sectors-

Project	**Cost/KWp in ₹**			**Project**	**Cost in ₹**	
	Category A (01 – 10 KWp)	**Category B (11 – 100 KWp)**	**Category C (101KWp & above)**		**2 HP**	**3 HP**
Residential	56800	51940		**Solar Water Pumps**	205800	269850
40 MW	58796	52000	48000			
JJH	50650	37500	35500			

Source: Data provided by District Administration, Patna

ii) Central and state government subsidies related to solar energy -

S. No.	**Project**	**Subsidies**	
		Central	**State**
1.	**Residential**	30%	25%
2.	**Pumps**	25%	50%
3.	**40 MW**	-	75%
4.	**JJH (Jal Jeevan Hariyali)**	-	100%[2]

Source: Data provided by District Administration, Patna

Number of Solar Pumps Sanctioned and Funds Released under Saur Sujala Yojana in Bihar (As on 01.04.2014 to 30.06.2017)		
State	**No. of Pumps Sanctioned**	**Fund Released (Rs. in Crore)**
Bihar	2000	17.67
India	**128898**	**1007.61**

[2] Data provided by District Administration, Patna, Bihar.

Source : Lok Sabha Unstarred Question No.3117.

The total 2000 solar pumps sanctioned and ₹ 17.67 Crore released under Saur Sujala Yojana in Bihar between 01/04/2014 – 30/06/2017.

Number of Solar Pumps Sanctioned for Irrigation and Drinking Water Purposes in Bihar (2017-2018)	
Bihar	3300

Source: Lok Sabha Unstarred Question No. 1512, dated on 26.07.2018.

In the financial year 2017-2018, a total 3300 solar pumps were sanctioned for irrigation and drinking water purposes in Bihar.

Physical Progress of Suryamitra Training in Bihar (2015-2019 and 2019-2020)				
State	**Targets of Suryamitras to be trained (March, 2020)**	**No. of Suryamitras Trained (2015-2019)**	**No. of Suryamitras Training Allocated in (2019-2020)**	**Total No. of Suryamitras**
Bihar	2500	1139	150	1289
India	**50270**	**31092**	**5700**	**36792**

Source: Ministry of New and Renewable Energy, Govt. of India. (ON2016)

'Suryamitra' training program to train the ITI/diploma holders as a skilled workforce/field technician for installation, commissioning, operation and maintenance of solar technology to execute the National Solar Mission (NSM) programme across the country. In Bihar, this training program is running at a slow pace, the targeted no. of suryamitras to be trained is 2500, but only 1139 surmitras were trained between 2015-2019.

Physical Progress of Varunmitra (Solar Water Pumping) Training in Bihar		
(2018-2019)		
State	**Targets of Varunmitras to be Trained**	**No. of Varunmitras Trained**
Bihar	20	20
India	**400**	**425**

Source : Ministry of New and Renewable Energy, Govt. of India. (ON2016)

The MNRE sponsored three weeks 'Varunmitra' Training Programme with an objective to develop a skilled workforce for solar water pumping system design, installation and commissioning has been designed by and implemented by NISE. In Bihar, in the financial year 2018-19, training target of training 20 varunmitras is achieved within the stipulated period of time.

4.2. Biogas

Biogas plants data is unavailable for the district; however, biogas potential can be calculated by knowing the livestock population in the district.

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)
Cattle	Manure	3,05,971	10	1,11,67,94,150	837595612.5	167519122.5	25	6700764.9
Buffalo	Manure	2,92,689	15	1,60,24,72,275	1201854206	240370841.3	25	9614833.65
Sheep	Manure	13,193	1	48,15,445	3611583.75	722316.75	25	28892.67
Goat	Manure	1,78,937	1	6,53,12,005	48984003.75	9796800.75	25	391872.03
Pig	Manure	38,570	2.5	3,51,95,125	26396343.75	5279268.75	25	211170.75
Poultry	manure	5,34,458	0.1	1,95,07,717	14630787.75	2926157.55	25	117046.302

Assumption: manure availability=everyday, moisture content= 80%

Source: ***https://vikaspedia.in/energy/energy-production/bio-energy/biogas***

Table 10 Biogas potential from agricultural waste.

Crop	residue type	Total crop production (tons) (2017-18)	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)
Maize	straw	54070	1.5	81105	56773.5	15	48257.475	800	38605980
Wheat	straw	500150	1.5	750225	525157.5	30	367610.25	800	294088200
Sugar cane	Bagasse	1420	0.33	468.6	328.02	80	65.604	750	49203

4.3. Hydropower

Koshi Hydel Power Station, which has 19.2 MW (4x4.8), was handed over to Bihar State Hydel Power Corporation on 11 November 2003. As per the MNRE data, a new small hydropower plant site in Patna has been investigated, and details of the project are as follows:

S.NO.	Name of project	Category of project	Name of river/canal	Capacity in kW	Head in m	Discharge in m^3/sec
1	Mahabalipur	Canal	Patna BC	500	2	23

4.4. Biomass Energy

The district Patna depends on agriculture and has some industries as well. Paddy is the main crop in the district with a total productivity of 2856 q/ha followed by 23400q/ha. The district also produces oil seeds such as sunflower, mustard and linseed with a total productivity of 1110q/ha,

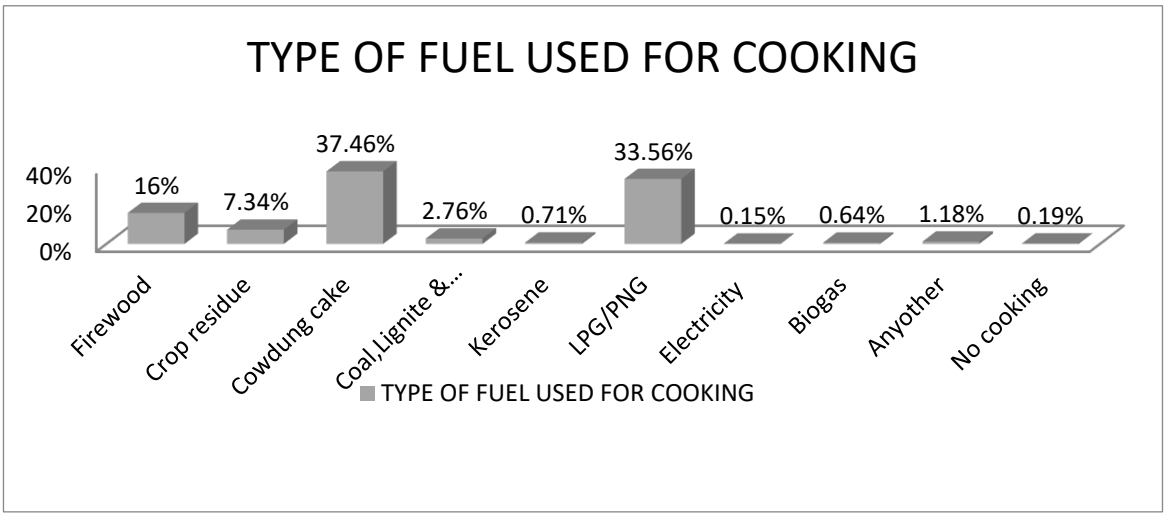


Fig. 2

790 q/ha and 640 q/ha respectively. Wheat and maize are also cultivated in the district. Out of the 225800 ha of total cultivable land 11100 ha land is cultivable waste land. 2000 ha of land out of the total land is fallow.

According to the 2011 census data available, fuels used for cooking are mainly LPG/PNG and cow dung cakes. Firewood and crop residue are also used by good number of people as depicted in the graph above. Husk Power System, Pataliputra, Patna actively sells its proprietary gasification plants and maintenance services to agro-processing units like rice mills to help them reduce diesel consumption by up to 60%.

5. Livestock

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

Category	2003	2007	2012	2019
CATTLE TOTAL	310.58	282.72	305.97	453
CATTLE ADULT MALE	62.31	33.21	13.15	2.77
CATTLE ADULT FEMALE	144.2	148.48	189.4	259.87
CATTLE YOUNG TOTAL	104.07	101.03	103.42	190.35
CATTLE SHARE IN LARGE RUMINANT (Percent)	53.89	50.76	51.11	58.16

BUFFALO TOTAL	265.78	274.27	292.69	325.83
BUFFALO ADULT MALE	4.17	2.23	4.92	5.7
BUFFALO ADULT FEMALE	155.66	165.01	181.55	175.3
BUFFALO YOUNG TOTAL	105.95	107.04	106.22	144.83
BUFFALO SHARE IN LARGE RUMINANT (Percent)	46.11	49.24	48.89	41.84
SHEEP TOTAL	17.48	5.65	13.19	9.84
SHEEP SHARE IN SMALL RUMINANT (Percent)	8.17	3.39	6.87	4.89
GOATS TOTAL	196.57	160.9	178.94	191.31
GOATS SHARE IN SMALL RUMINANT (Percent)	91.83	96.61	93.13	95.11
PIGS TOTAL	51	25.4	38.57	22
LIVESTOCK TOTAL	841.75	751.61	830.85	1001.98
POULTRY TOTAL	383.66	597.47	401.27	-
Source: http://data.icrisat.org/district-level-data/				

5. Tourism

The below-given data presents the number of visitors reaching Patna and total visitors in Bihar in 2011. The data shows the trend of visitors in Bihar and Patna in different months. This data can be utilized to treat the industry for maximum output and impact. The number of visitors in a particular month denotes the trend of interest of visitors. From this, it can be evaluated which kind of tourism visitors are more interested in, such as cultural tourism, heritage tourism, or Mahotsav/festivals. Based on this, sectoral development can take place. For example, if tourists are more interested in heritage tourism, investment and beautification projects can be diverted towards that route.

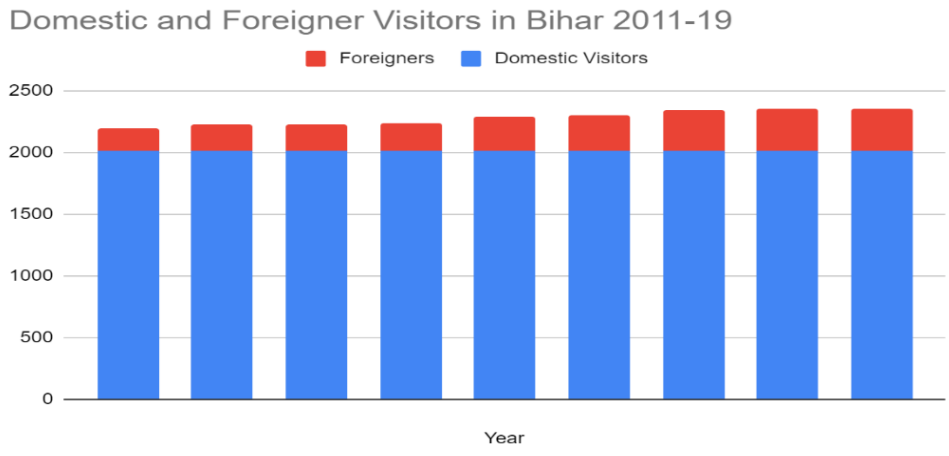
Table 12: Number of Visitors Reaching Patna and Total Visitors in Bihar 2011

	Months	Domestic Visitors in Patna	Foreigner Visitors	Total in Bihar	% in Patna
	January	571557	432	1448567	39.45
	February	502502	902	1173372	42.82
	March	587300	145	1158791	50.68
	April	392107	272	758936	51.66
	May	374432	279	640747	58.43
	June	355751	190	610620	58.26
	July	388898	231	3035306	12.81
	August	524402	228	2174451	24.11
	Septembe r	476898	218	3073254	15.51
	October	559031	830	1409264	39.66
	November	511430	589	2276934	22.46
	December	534035	6064	1609735	33.11
	Total	**5778343**	**10380**	**19369977**	29.83

The table 12 shows that the number of tourists coming from other nations is almost homogeneous throughout the year. But December notes the drastic increase that is 6065 visits from 589 in November. On analysis, it can be concluded that December is the month where weather is quite pleasant for foreigners. In this case, more facilities are needed to be developed to assist foreign visits.

The below-given data table presents the total number of visitors in Bihar from 2011 to 2019. The data is also divided to inspect the number of Domestic visitors and Foreigner visits in Bihar. The data will help to know the year when the number of visitors drops and the year the number increased. Aligning the data with various tourist offers will assist in knowing which scheme worked effectively and which failed. Impact assessment tools will help to know the reason for failure and success, and later it can be used while working on projects and policies related to tourism in Bihar

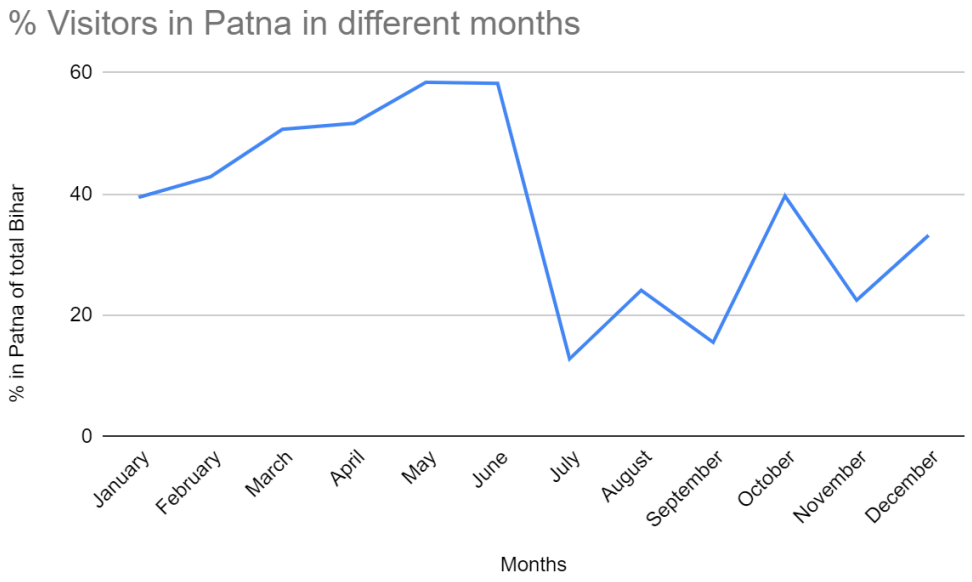
Year	Number of Tourists in Lakh in Bihar		
	Domestic	Foreigner	Total
2011	183.9	9.7	193.6
2012	214.5	10.9	225.4
2013	215.9	7.7	223.6
2014	225.4	8.3	233.7
2015	280.3	9.2	289.5
2016	285.2	10.1	295.3
2017	324.1	10.8	334.9
2018	336.2	10.9	347.1
2019	339.9	10.9	350.8



From the above-given data table and bar graph, it can be assumed that the number of domestic visitors in Bihar are constantly rising. This is a good sign for domestic

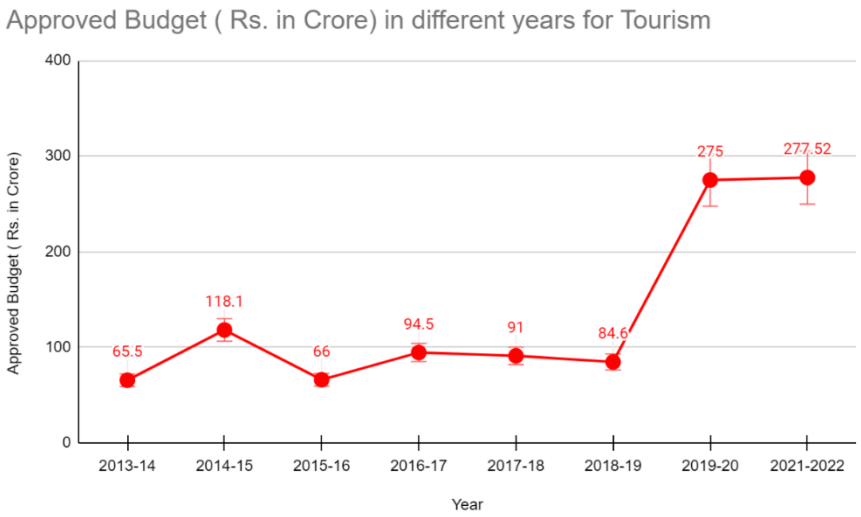
tourism. It can also be seen as Bihar tourism is attracting more domestic tourists and probably is more suitable for them.

On reading the data of foreign visitors, the data is quite curvy. In the year 2012, it increased to 10.9 from 9.7 lakh in 2011. Whereas in the year 2013 the number went down to 7.7 lakh. The reasons can be scrutinized from the other secondary data to understand why foreign visits to Bihar were affected. This will help to understand what are the factors affecting tourism. Factors can be a natural disaster, economic or political instability, elections, among many others. Knowing the reason is essential to implement tactics while making policies and allocating resources.



If we take the scenario of Domestic visits in Patna, it is evident that the number of visits is relatively high in January, February, March, April, May and June. In other months the percent of people visiting Patna with respect to total visits in Bihar is less. This data can be used to design Mahotsav/festivals and fairs in those months where we see minimum tourist arrival. This can be beneficial in two ways; one, it will homogenize the visits in the different months and eventually reduce seasonal unemployment for those associated with the tourism sector. Second, it will be helpful to manage the crowd visiting Patna. If these big Mahotsavs are placed in months like January, February, March, April, May and June, that will cause a shortage of resources and eventually chaos.

The below-given graph presents the Approved Budget for the Tourism department in Bihar by the Government of Bihar.



The recent years have been good for the Tourism Department of Bihar as it receives a relatively handsome amount of funds for development and Tourism promotion. In 2019-20, the Budget experienced a 225% increase in allocation of funds compared to 2018-19.

Expenditure of Department of Tourism (2013-14 to 2019-20)				
Year	**Approved Budget (Rs. in Crore)**	**Expenditure**	**Expenditure as % of Budget**	**% increase in Budget**
2013-14	65.5	59.4	90.68	
2014-15	118.1	87.4	74.00	80.30
2015-16	66	65.4	99.09	-44.11
2016-17	94.5	86.4	91.42	43.18
2017-18	91	76.7	84.28	-3.70
2018-19	84.6	47.2	55.79	-7.03
2019-20	275	82.8	30.10	225.05
2021-2022	277.52	-	-	0.91

The above-given data table shows the Approved Budget for the tourism department of Bihar. It also shows the percent of expenditure from the allotted Budget (in the second) column. The last column shows the percent increase in the allocated Budget compared to the previous year for the Department of Tourism Govt of Bihar.

From this data table, it can be evaluated that in none of the above given years, hundred per cent of the Budget is utilized. Which also denotes some kind of inactiveness of the department. Allocated Budget must be used to build capital for the tourism department to generate maximum revenue in coming years.

In 2017-18 and 2018-19, the budget allocation faced a negative growth that should ideally not occur. However, in the subsequent year, 2019-20 and 2021-2022, budget allocation was increased. The budget allocation also depends on the utilization of the previous year's allocated fund expenditure; hence the department can focus on maximizing the use of allocated resources and funds.

The total allocation in the 2021-22 budget seems not sufficient. 0.12% of total expenditure on tourism is a negligible amount. The government can see this allocation as an investment in the capital which indeed brings a return. However, this may be due to the changed priorities after the Covid-19 pandemic. Because the tourism sector faced the harshest effects of the pandemic, hence there is a great need to pump the tourism economy through fund inputs.

Now people are more concerned about hygiene friendly tourism and social distancing after Covid; hence policies can be directed in that direction to build tour packages suitable to protocols and guidelines. To develop new normal tourism packages, the requirement of finances should not be a constraint. If the sector is not immediately provided with the support and investment, it can easily be a sick industry after the pandemic.

6. Wetlands

There are many wetlands in the region, but some important wetlands are like Maner Talav and Begumpur Pokhra. The region has a large number of tanks and ponds. The data in Table 5 represent the number of wetlands and their area representation in the district. There are around 63 wetlands sized greater than 2.25 Ha and 164 less than 2.25 Ha areas. The region consists of small wetlands, generally less than 50 Ha in the area, but there is 1 wetland with an area of more than 50 Ha.

Table 13: Wetland Data of Patna District

Wetland Types	**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	1	1	0	0	0	1	0	0	0	0	0	0	1
Ox-bow lakes/cut off meanders	8	11	3	0	1	1	3	2	1	0	0	0	4
High altitude Wetlands	0	0	0	0	0	0	0	0	0	0	0	0	0
Riverine Wetlands	2	2	0	0	0	0	2	0	0	0	0	0	2
Waterlogged	10	10	0	0	4	3	2	1	0	0	0	0	8
River/Stream	0	22	22	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	0	0	0	0	0	0	0	0	0	0	0	0	0
Tanks/pond	13	13	0	0	8	1	4	0	0	0	0	0	8
Waterlogged	4	4	0	0	0	1	1	2	0	0	0	0	0
Salt pans	0	0	0	0	0	0	0	0	0	0	0	0	0
Total (227)	**38**	**63**	**25**	**164**	**13**	**7**	**12**	**5**	**1**	**0**	**0**	**0**	**23**

Source: NRCD (National River Conservation Directorate)-NWIA Inventory Data 2007, NWIA Wetland Atlas report

- The district comprises 227 wetlands; most of them are waterlogged, meanders and tanks. The meander wetland type with a large wetland size of more than 50 Ha is found in the region.
- The wetland size is small in general
- The number of natural wetlands is more than man-made.
- Many natural wetlands have aquatic vegetation also.

Qualitative data

1. Geography

Patna is the capital city of Bihar State situated 15 km along the confluence of the River Ganges. It is an entirely land–locked state and lies midway between the humid West Bengal in the east and the sub-humid Uttar Pradesh in the west which provides it with a transitional position in respect of climate, economy and culture.

The city has a very long river line surrounded on three sides by rivers – The Ganga, Sone, and Punpun. The river Gandak flows into the river Ganga making it a unique place having four largest rivers in its vicinity to the north of Patna. The bridge over the river Ganges named Mahatma Gandhi Setu is 5575m long connecting Patna in the south to Hajipur in the north of Bihar and is the longest river bridge in India.

2. Agriculture

Bihar is considered destination for second Green Revolution in the country. Several reports including the National Farmers Commission have emphasized the need for accelerated development of agriculture in the state for securing food security of the country. The state is endowed with deep fertile soil, plenty of water, both surface and underground, and a subtropical climate suitable for a wide range of crops. The farmers are very hard working. There is a conducive policy environment. The first Green Revolution experienced in the mid-sixties has been the success of dwarf high yielding varieties of Rice & Wheat. These varieties are responsive to high fertilizers doses mainly under irrigated ecology. This success largely remained confined to north western parts of the country. Bihar mostly remained bereft of the benefits of the first green revolution. Now, Bihar is piloting Rainbow Revolution in the country. The Rainbow Revolution would be achieved through sustainable farming technologies. With launch of Agriculture Road Map in 2008, the state took a major step forward for the holistic development of agriculture in the state. Plan outlay for agriculture has increased more than 100 times, from Rs. 20.43 crore in 2005-06 to Rs. 2161.74 crore during 2013-14. Major achievements have been recorded in increasing Seed Replacement Rate of Rice and Wheat. S.R.R. for rice increased to 40.77 percent during kharif 2013 and 35.73 percent for Wheat during 2012-13 from around 10 percent in 2005-06. The first Agriculture Road Map was coterminous with the 11th plan. The initiatives started in the 11th five-year plan has started yielding results. All time high food grain production at 178 lakhs has been recorded during 2012-13. Record Rice, Wheat and Maize production was achieved in one year. The productivity of Rice and Wheat has gone above the national average for the first time in recent years. Bihar has received Krishi Karman Award for outstanding achievement in Rice production.

3. Horticulture

Fruits, vegetables, spices and aromatic plants occupy around 9 percent of land area in the district, although horticulture generates far more revenue. The district has a monopoly on mango and banana production, and continues to cultivate a variety of fruits, vegetables, and spices. Floriculture is gaining popularity in the district and state. The agro-climatic conditions are ideal for a wide range of vegetables, as well as a variety of roots and tubers crops, perennial fruit crops such as mango, guava, and limes, annual fruit crops such as banana, pineapple, and papaya, and spices such as ginger, turmeric, and chilli.

A. Fruits

Mango, Guava, Pineapple, Citrus, Banana and Papaya are among the district's most popular fruits. Mangoes are farmed in Patna, Muzaffarpur, Vaishali, Bhagalpur, Darbhanga, Madhubani, Sitamarhi, and West Champaran, among other places. Pineapple is grown in the state's north-eastern regions, notably in the districts of Kishanganj, Purnea, Araria, Katihar, and Saharsa.

B. Vegetables

Bihar ranks 3rd in vegetable production in the country and produces a variety of traditional and non-traditional vegetables. The district's climate and soil characteristics are favourable for the production of a variety of vegetables. It does, however, lack the necessary infrastructure for storage, packing, transportation, a well-organized marketing system, and post-harvest management. Seed is the most important factor affecting the yield of vegetable crops. Only if the seed production programme is reinforced can the vegetable production programme be improved. As a result, the seed production programme should be bolstered in order to enhance vegetable output.

4. Forestry

Forests have an important function as carbon sinks and are hence essential for climate mitigation. It also recognizes the importance of forests in sustaining the favourable and stable conditions required for long-term agricultural productivity by contributing to soil fertility, structure, and water storage capacity. Forests are also important for maintaining the hydrological cycle, regulating water flows and sub-soil water regimes, recharging aquifers, and maintaining the flow of water in rivers and rivulets, as well as the fact that forested watersheds have better water availability and quality than watersheds with alternative land uses.

According to the Indian Forest Policy of 1988, woods should cover 30 percent of the land area for environmental balance. It is difficult to increase the area under forest cover in a heavily populated region like Patna. However, it can be compensated by creating alternate agreements and utilizing all of the district's

vacant lands. The Kishore Chetna Vriksh Yojna, which was previously begun, aims to raise environmental awareness, particularly about trees, among school children and secure their involvement in afforestation projects.
For the conservation of wildlife, various acts and rules have been implemented. This involves Gangetic dolphin conservation, Bihar sawmill regulation act 1990, Bihar sawmill regulation rules 1993, Bihar sawmill regulation amendment act 2002, biological diversity act 2002, Indian forest act 1992, Environment protection act 1986, wildlife protection act 1972, and wildlife protection amendment act 1991. Bihar shares the national vision of sustainable forest management to meet the needs of current and future generations. The state-specific vision includes the following goals.

- ✓ Increasing vegetation (forest and tree) cover 17% of the state's total geographical area by 2022 through afforestation and land-use diversification.
- ✓ Natural forest management and the construction of rainwater harvesting structures

Natural forest rehabilitation with a focus on local species.

Forest Survey 2019 assessment reported a variety of native trees in rural and urban areas across the state. These common species are Mangifera indica, Bombax ceiba, Psidium guyava, Dalbergia sissoo (FSI, 2019). Currently, the State government forest department runs 'Krishi Vaniki Yojana', a scheme which primarily focuses on motivating farmers to plant trees and other crops on a large scale along with traditional crops on their land. This scheme is aimed to improve the income of farmers in the event of crop loss and to contribute towards agricultural produce by growing poplar trees such as Heesham, Guava, Gambhar, Amla, Mahogany, Teak, Peepal, Jamun, Kachnar, Gulmohar, Mango, Eucalyptus, Neem, Kadam, Bahera, Palas, etc. Farmers are provided seedlings of the trees in government nurseries at the rate of Rs 10 / seedling. If farmers maintain 50 percent of the plants purchased from the forest department in their lands for 3 years, then for this, the farmers will be given an incentive of Rs 60 per plant. Moreover, the Rs 10 they spent for purchasing the seedling is also given back to the farmers (Krishi Yojana).

5. Energy

Patna has chosen a combination of thermal and hydel energy sources. The district presently has just 100 MW of installed power production capacity, with thermal plants accounting for roughly 70 percent of total installed power generation capacity and hydel plants accounting for the remaining 30 percent. In recent years, there has been a greater emphasis on the development of non-conventional energy sources, such as solar, wind, and biomass energy. Despite the fact that Patna has the lowest yearly per capita electricity consumption in the State, due to

the state's inadequate generation capacity, there is a severe power deficit in the state, not just for peak demand but also for base demand.

Peak demand is expected to be roughly 65 percent lower in 2012, according to the Central Electricity Authority (C.E.A.). While this scenario is bleak in terms of energy supply, it also offers enormous potential for comprehensive and planned approaches to the energy industry, including the integration of multiple climate problems.

Bihar has taken a long-term approach to the energy sector in order to achieve its vision of providing "Har Ghar Bijli," as outlined in 7 Nischay. The vision roadmap advocates for a low-carbon path to economic growth. The vision focuses on increasing the number of state-owned power generation plants with a greater share of renewable energy, a separate feeder for agricultural purposes, demand-side management by improving overall distribution system efficiency, and distribution company strengthening. This aligns with the SDG vision of "ensuring access to affordable, reliable, sustainable, and modern energy for all. Bihar has RE potential of more than 12.559 GW (solar: 11.2 GW, biomass gasifier/cogeneration: 619 MW, bagasse cogeneration: 300 MW, wind power: 144 MW, waste to energy: 73 MW etc.), which is yet to be harnessed. The state realizes the importance of electricity on the overall economic growth and has initiated steps to address this gap by implementing large power projects which are primarily based on conventional sources and are in various stages of implementation. These large power projects have a long gestation period while the demand continues to rise; therefore, the state has a unique opportunity to meet this requirement through the rapid deployment of modular RE systems.

Sectors	Investment Opportunities
Biomass	Biomass and Biogas projects, Biomass Hybrid Systems and biomass applications in Domestic and Industrial Sector.
Hydel Power	Small Hydropower projects (up to 25 MW)
Others	Cogeneration in sugar and other industries, Waste to Energy projects including municipal solid waste, industrial waste etc. based energy projects, Wind power projects. RE modular product manufacturing.

Biomass Energy

According to The Telegraph, The Bihar Renewable Energy Development Agency (BREDA) has formulated an energy conservation building code (ECBC). The adoption of the ECBC will help reduce commercial buildings' energy consumption and promote low-carbon growth. The ECBC sets parameters for builders, designers and architects towards energy efficient buildings and also to integrate renewable energy sources in building design. Also, the government has policies for mini grid projects with capacity size of up to 500 kW, and powered by solar, biomass, wind, or hybrid. According to Bihar Policy for Promotion of Bihar New and Renewable Energy Sources 2017, for any project having a capacity of 5 MW or more, BREDA (Nodal Agency)/SIPB (State Investment Promotion Board) shall not approve any other biomass-based project within a radial distance of 25 km from approved project. Government from its side has provisions for encouraging biomass energy production. The lack is in knowledge of people which needs to be developed.

According to one of the articles of MERCOM INDIA Bihar Electricity Regulatory Commission has released draft tariff regulations for renewable energy projects. These regulations will be valid for the control period of the financial year (FY) 2020-21 to FY 2022-23. A useful life period of 25 years will apply to wind power projects, biomass projects with Rankine cycle technology. Similarly, the useful life period of municipal solid waste-based projects, biomass gasifier-based projects will also be 25 years.

By using SRI (System of Rice Intensification) method, the government has formulated the Sividhi scheme and has increased the cultivation of rice to many fold and so has the crop residue but no proper provisions are there to utilize this crop residue.

The need is for an integrated system which looks after and manages the biomass energy production in a centralized manner with its bodies established at various local levels.

6. Tourism

1.1. Historical Places

A. Golghar

Located 8 kilometres away from Patna railway station, west of the Gandhi Maidan in Patna, capital of Bihar state, India. This striking beehive-shaped dome is unquestionably Patna's most recognizable landmark, topping the city's list of things to see and do. Golghar, a distinctive whitewashed dome with a spiral stairway, was erected in 1786 as a granary for the British troops garrisoned in the city by Captain *John Garstin*. The most astonishing aspect of this construction is

that the massive dome, which stands 29 metres tall and has a diameter of 125 metres, is supported by no pillars. Golghar was supposed to be the first chain of such buildings built to guard against the region's periodic famines after 1770 famines which gulped 10 million people from Bihar and Bengal. The beehive-like *Stupa* (hemispherical dome-like shape) architecture of Golghar is spectacular and has no pillars to support it, but the 3.6 meters wall at the base; 145 spirally arranged stairs let you see the panoramic view of the Ganga river from the top of the dome. Laser light shows have always attracted tourists in the evening.

B. Ruins of Patliputra (Kumhrar)

The remains of Pataliputra, Patna's precursor, may be found 5 km east of Patna railway station. The city, once governed by three famous kings – Ajatshatru, Chandragupta, and Ashoka – is now little more than a heap of debris, sandstone pillars, wood platforms that may have supported a stairway Buddhist monastery foundation brick, and carved stone fragments. This has always been an archaeological space and a site of Mauryan ruins. The most notable findings during excavation are of 80-pillared-hall and Panini's Arogyashala. The 80-pillared-hall has been referred to as Ashoka's palace, audience hall, etc. The excavated structure consists of rooms measuring approximately 3.20 m x 3.10 m and 6.50 m x 3.10 m. Arogyashala, confirmed with the terracotta seal, was a hospital-cum-monastery managed by Dhanvantari, an ayurvedic physician.

C. Nalanda Mahavihara

About 95 km from Patna, this glorious scholastic and monastic institution today tells its stories through its ruins of stupas, shrines and viharas. A UNESCO World Heritage Site, the attraction also features a fascinating archaeological museum next to the ruins. Displays include the Nalanda University seal, bronze and stone sculptures.

Nalanda, a famous seat of study in ancient India Magadh (present Patna), was one of the country's first colleges, with students hailing from India, Tibet, China, Korea, and Central Asia. Between 685 and 762 AD, eminent Chinese scholar and traveller Hsuan-tsang studied Buddhist theology, the Vedas, logic, and metaphysics at the institution. Nalanda thrived from the 5th century A.D. until 1200 AD and was well-supported by the *Gupta monarchs*. Nalanda, one of the most prominent centres of learning, is said to contain three massive libraries that burned for six months when Islamist invading forces besieged the monastery in 1193. The Nalanda circuit in Bihar consists of historical places such as Ancient Nalanda University's Ruins, Nalanda Sangrahalya(library), Black Buddha, Hiuen Tsang Memorial, Pushpkarni Talab (Sanskriti Gram), Badgaon Surya Mandir, Badgaon Sun Pond, Kundalpur, Nav Nalanda Mahavira, Rukmani Sthan, Juaferdih Stupa, Chandimau, Silao

D. Patna Museum

Around 2.5 kilometres from Patna railway junction, this Mughal and Rajput architecture is also known as *Jadu Ghar*. The Patna Museum is housed in a beautiful edifice that was built specifically for the museum created by Sir Edward Gait, the then Lieutenant Governor of Bihar, in 1917. It began to display significant historical and archaeological findings unearthed in and around the city, and it now houses over 20,000 items. Focus on the Dadoxylon fossil, a 200-

million-year-old tree, the Buddha Relic Casket – a soapstone casket said to contain Mahatma Buddha's ashes, the 2300-year-old Didarganj Yakshi, an ancient sculpture, and the museum's various galleries, such as the Natural History Gallery. embraced

E. Gandhi Ghat

Located 5.5 kilometres east of the Patna Junction, the bank of the holy river Ganga in Patna is also known as Gandhi Ghat because the ashes of Mahatma Gandhi were immersed here. Also famous for Ganga aarti, this place embraces thousands of devotees during the Navdurga festival and Chhath puja. The river cruise ships and the floating restaurants amidst the lukewarm blueish waters of the Ganges have always been an attraction point of tourist for its photogenic panorama. The kite festival is also a massive celebration here and is celebrated on the occasion of Makar Sankranti in January.

F. Gandhi Sangrahalaya

4.2 Kilometres away from Patna Junction, near the Gandhi Maidan, the Gandhi Sangrahalaya is a museum displaying the life events of Mahatma Gandhi. This museum serves as a knowledge reservoir for Mahatma Gandhi; it delineates his role in Bihar during the freedom struggle.

Glimpses of Mahatma's visual biography can be contemplated here structured with the help of images, sculptures, paintings, available scripts and many of his quotes. The most lionized attraction is the central hall, a clone of Mahatma's actual room, which embodies chronological events from birth to the crematorium of Mahatma.

The museum has an extensive collection of books, magazines, and various documents such as recordings, newspapers, idols sharing messages of Mahatam and videos. The Gandhi Sangrahalaya is set in a serene environment in the vicinity of the heart of Patna. Visitors can also enjoy their time at the adjoining

park. Recently a bronze statue of Gandhi exhibiting his arrival to Patna was installed inside the Sangrahalaya

G. Rajgir

Located 100 kilometres from Patna railway station and 15 kilometres from Nalanda. Nalanda in ancient times was a prosperous village with major trade routes and a business hub that ran through the nearby city of Rajagriha (modern Rajgir), which was then the capital of the Magadha kingdom during the Mauryan empire. Rajagriha means House of the Kings. This place is notable in Jainism and Buddhism because it was the birthplace of the 20th Jain Tirthankar Munisuvrata and is closely affiliated with the Arihant Mahavira and Gautama Buddha. The warm water ponds here are believed to possess some medicinal property that cures some skin illness. The Shanti Stupa and Monasteries built by the Japanese Devotees on top of the Ratnagiri hills have always enticed travellers and tourists. The Rajgir circuit has much more for tourists to explore, such as Japani Mandir, Rajgir International Convention Centre, Virayatana, Thai Temple, Gram Kund (Tapodarama), Makhdoom Kund, Vaitarni Ghat, Gurunanak Kund, Maniyar Math, Mrigya Vihar, Sonbhandar Caves, Jarasandhaka Akhara, Bimbisar Ka Karagar, Rath Chakka And Shankh Lipi, Jivak Ka Amra Udyana, Akashiya Rajju Marg (Rope-Way), Vishwa Shanti Stupa, Griddhakut Parwat, Cyclopiyan Diwar, Saptarni Gufa (Cave), Sri Digambar Jain Temple, Burmese Mandir, Sir Jain Shwetambar Mandir (Naulakha Mandir) amongst many other.

H. Khuda Baksh Oriental Public Library

The captivating Khuda Baksh Oriental Public Library is located on the banks of River Ganges, 4 kilometres from the Patna railway station, next to the bustling Ashok Rajpath. It is a national library that has been operational since 1891. The library is a repository of about 21000 Oriental manuscripts and 2.5 lakh printed books.

Apart from a vast collection of Urdu literature, the library contains rare Arabic and Persian manuscripts, Rajput artworks and texts, Mughal paintings, miniature form of holy Quran inscribed on a book merely 25 mm wide, and some Spanish stuff. Books associated with the Mughal period have handmade portraits showcasing the life and culture of those times that can be witnessed here. Manuscripts are showcasing excellent calligraphy skills written on palm leaves. Many of these volumes are unique to this library and cannot be found elsewhere in the world. The Khuda Baksh Oriental Library was declared an Institution of National Importance by an act of Parliament in 1969. Currently, the library is funded by the Ministry of Culture, Government of India.

2.1. Religious Places

A. Mahavir Mandir

Patna's Mahavir Temple, one of the most remarkable temples devoted to Lord Hanuman, is a peaceful oasis in a busy urban jungle, located not far than one kilometre from the Patna Railway junction. Sankat Mochan's idol (synonym for Lord Hanuman) is enshrined there. The temple, which was most likely erected in the 17th century, gained prominence following India's partition in 1947 when lakhs of Hindu refugees from the newly formed Pakistan began to settle in the city. The temple also has a 'floating stone' from the fabled Ram Setu, in addition to Lord Hanuman's magnificent statue.

The temple is an explicit example of Modernization for a reason it offers online services such as Divya Darshan, Bhajan, Spiritual offerings, Live Darshan/Booking, Anushthan and accepts online donations. The trust of this temple also runs a spiritual publication and a hospital-cum-research centre for heart diseases, cancer and eye illness. The temple turned its spaces for covid patients during the Covid pandemic.

B. Takht Sri Patna Sahib

Located 13 kilometres northeast of the Patna railway station, Takht Sri Patna Sahib, also known as Harmandir Sahib, is a Gurdwara. The holy shrine is situated in the ancient parts of Patna city, in the Kucha Farrukh Khan neighbourhood, and is visited by devotees worldwide. Sikh religion holds Patna in high regard since it is the birthplace of Guru Gobind Singhji, the 10th Sikh Guru. Guru Gobind Singhji was born on 22 December 1666 in Patna, Bihar. Maharaja Ranjit Singh constructed Takht Sri Patna Sahib to commemorate the incident. The shrine

houses relics of the 10th Guru, including four iron arrows, weapons, a pair of his sandals, and a cradle with gold-plated supports.

Action plan development

1. Establishing Institutional Linkages

It is important to build institutional linkages with h Indian Council on Agricultural Research (ICAR) and its participating organizations including Central Research Institute for Dryland Agriculture (CRIDA), Indian Agricultural Research Institute (IARI), Indian Institute of Horticultural Research (IIHR), Central Institute of Agricultural Engineering (CIAE), National Dairy Research Institute (NDRI), Central Marine Fisheries Research Institute (CMFRI), Central University of Bihar (C.U.B.) and other collaborating centres for technical advice, capacity building, and research support including State and sector specific vulnerability analyses.

2. Sustainable Agriculture Development Project

Efforts should be made to encourage sustainable agriculture development; it can be achieved by reducing production fluctuations and uncertainty caused by floods, droughts, and water logging, as well as promoting environmentally friendly techniques such as organic farming, soil health improvement, and waste and by-product reuse. Developing strategic plans at the agro-climatic zone level so that action plans in the areas of research and development, technology and practises, infrastructure, and capacity building are contextualized to regional sizes.

3. Building Long Term Warehousing Facilities

For farm expansion and food security, a significant increase in warehouse and storage capacity should be implemented. Multiple agencies should be involved, and institutional frameworks should be innovated, to boost the marketing of

agricultural products. With the proper implementation of the project the higher agricultural productions can be achieved.

4. Plantation of Forests in Non-Forestlands

To encourage farmers to grow trees on their fields, a strong social forestry programme should be planned. A pilot project can be introduced in the district and the project will cost around ₹20 crore. To attain a 12 percent forest/tree cover, social forestry and agroforestry, as well as MNREGA programmes, must be implemented vigorously and widely. Farm nurseries in the private sector must be fostered and supported since the Environment and Forest Department cannot meet the State's demands alone.

5. Afforestation Project

The identification and mapping of all types of land accessible for afforestation and tree planting, as well as the computerized compilation of land records data by state governments and union territories administrations, becomes critical. It is also critical for state governments to plan a good long-term land use strategy. The purpose of the State Forest Policy is to provide for afforestation and tree planting on specified areas outside of the Recorded Forest Area, as well as the maintenance of existing natural forest cover, and to guarantee that the policy is implemented effectively.

Forestry

District of Patna is extremely deficient in forest area. The major occupation in the district is agriculture. That is why the Government of Bihar had drafted Agroforestry policy in 2018. The district lies under the agriculture category III. This categorisation had been developed on the basis of climatic condition, geography of the region, soil condition and water availability. Major crops in the district are Rice, Wheat, Lentils, and Gram pulse. The study has suggested a variety of trees in this zone. Eucalyptus, Arjun, Jamun, Kadam, Semal etc are the suggested tree species in the flood prone zone; whereas Shisham, Gamhar, Melia, Teak etc for the non-flood zone. Litchi, Mango, Jamun, Kathal, Guava can be most profitable, yielding trees as part of agro-horticulture. Medicinal plants like Kalmegh, Aswagandha, Sarpgandh, Satawar, Lemon grass, Safedmusli etc are the viable options in agroforestry (Govt of Bihar, 2018).

Below are the important species which can be included under agroforestry:

Fruits	Vegetables	Spices	Flowers	Aromatic Plants
Mango, Guava, Litchi, Banana, Pineapple	Solanaceous, Cucurbits, Onion, Okra, Beans	Turmeric, Ginger, Garlic, Coriander	Marigold, Rose, Tuberose, Gladiolus, Jasmin	Japanese Mint, Lemongrass, Pamaroja, Citronella

Afforestation on the riverbanks and open public spaces is another option that suits Patna district. Miyawaki afforestation method has been adopted by many urban authorities in the world. This technique helps to build dense, native forests. This method ensures that plant growth is 10 times faster and the resulting plantation is 30 times denser than usual. It involves planting native species in the available area and becomes maintenance-free after the first three years. The most important aspect of this method is it requires as minimum as 20 square feet area. This can enable the native citizens of Patna to grow the profitable fruit plants in the community. The combination of small forest and home garden is known as homestead forest. With the combination of Miyawaki method of afforestation and trading platform for these products, this combination can be beneficial for the local economy (Miyawaki Afforestation, 2019). Some of the major Indian cities like Mumbai, Chennai have also adopted this technique for the afforestation (Indian Express, 2021). Afforestt is the firm which works in the development of Miyawaki Forest.

6. Afforestation

The Ministry of Environment, Forest, and Climate Change (MoEFCC) implements plantation/afforestation schemes in the forest areas with a participatory approach. The plantation species under the schemes is selected by the implementing agencies/the members of Joint Forest Management Committees (JFMC) based on their needs, ecological conditions, and other local factors in consultation with the Forest Department. The native forest species are encouraged for plantation in the forest areas giving importance to trees with multiple uses.

The conservation and development of forests primarily involve three strategies – afforestation through natural/artificial regeneration, protection, and management.

The ministry is implementing three major schemes for the development of forest areas, *i.e.*, the National Afforestation Programme (NAP) scheme, the National Mission for a Green India (GIM), and the Forest Fire Prevention & Management Scheme (FFPM). While NAP is being implemented for afforestation of degraded forest lands, GIM aims to improve the quality of the forest and increase forest cover besides cross-sectoral activities on a landscape basis.

7. Pollution control

The major sources of air pollution in Patna are road dust, vehicular emission, domestic fuel burning, open waste burning, construction activities, industrial emissions etc. Bihar State Pollution Control regularly monitors the ambient air quality at Patna through Continuous Ambient Air Quality Monitoring Station (CAAQMS) installed at Indira Gandhi Science Complex, Planetarium premises, and Beltron Bhawan Shastrinagar & Gandhi Maidan, Bankipur Bus Depot under NAMP. A multifaceted awareness campaign is scheduled to create sensitization and create some agents of change among all sections of society. According to the Hindustan Times newspaper, the Bihar government is gearing up to prepare a comprehensive action plan to mitigate the impact of the climate crisis on different sectors.

8. Hydropower Project

The district needs to develop small hydropower plants to fulfil the energy requirement. The district can install about 40 M.W. electricity through the small hydropower plants. Bihar has large hydropower generation potential in Dagmara by way of 125 MW in the Kosi, and 450 MW at Indrapuri, besides five pumped storage projects, prefeasibility for which has been established by the BSHPC.

Biogas and hydropower

- ✓ Bihar has considerable potential for New and Renewable Energy sources, which is yet to be harnessed; the Government of Bihar resolved to issue a revised policy to promote power generation from various sources of New and Renewable Energy.
- ✓ This policy will apply to all New and Renewable Energy projects. The policy shall be applicable for any industry, institution Private Agency, partnership firm, consortia, Panchayat Raj institutions, Urban Local bodies, co-operative or registered society desirous of installing and generating electricity from New and Renewable Energy Sources.
- ✓ BREDA/BSHPC will provide necessary information and assistance regarding the identification and selection of feasible sites.
- ✓ The electricity generated from the New and Renewable Energy projects shall be exempted from tax and electricity duty.
- ✓ In case of power generation from mini/micro/small hydel schemes, the project developer shall be allowed to use canal waterfall or river water flow subsequent to the approval and agreement with the Water Resources

Department, the Government of Bihar. However, the water will be released based on irrigation demand. Bihar Renewable Energy Development Agency (BREDA) will be the key agency for all renewable projects, except for small/ micro/ mini-hydro projects, for which Bihar State Hydroelectric Power Corporation Limited (BSHPCL) shall be the nodal agency. Its objective is To target installed capacity of 2969 MW solar, 244 MW Biomass & Bagasse cogeneration, and 220 MW, small hydropower by 2022 in the state with an objective, to meet the growing demand for power in an environmentally sustainable manner.

- ✓ The state has significant Hydro potential that includes sites for developing Micro (up to 100 kW), Mini (101 kW-2 MW) & Small (2.001-25 MW) Hydropower projects. RE policy envisages a cumulative target of 220 MW from Micro/Mini/Small Hydro projects in Bihar.
- ✓ The policy envisages that Biomass and Bagasse based cogeneration projects will contribute a cumulative target of 244 MW by 2022. 2. For any project with a capacity of 5 MW or more, BREDA (Nodal Agency)/SIPB (State Investment Promotion Board) shall not approve any other biomass-based project within a radial distance of 25 km from the approved project. However, BREDA/SIPB reserves the right to reduce or increase the above area while considering the availability of biomass in that area.
- ✓ Mini-grid projects with a capacity size of up to 500 kW powered by solar, biomass, wind, or hybrid can be installed. 2. The Bihar government targets to achieve deployment around 100 MW of capacity equivalent to mini-grids.
- ✓ Additionally, with approval from BERC, a renewable energy development cess of 10 paise/unit will be charged for each unit of power sold by state DISCOMs for all consumers except BPL & agriculture consumers and deposited against the fund. 3. BREDA shall charge a service charge of 7% for execution of RE projects which will contribute towards the Bihar renewable energy development fund.

8. Biomass Energy

The district practices agriculture on a large scale, the waste produced are- wastes from fields and wastes from processing. Field wastes are produced after harvesting crops and include stems, leaves, and stalks, and waste after processing crops includes seeds, peels, husks, etc. The biomass wastes normally do not receive treatment and are disposed of, which can contaminate the environment and cause environmental load. The government can encourage the youth to set up start-ups which solely work on developing technologies and convert these bio-wastes into useful resources according to the needs of the district. This way the burden will be shared where both the agriculture produce as well as agricultural waste will get utilized.

The government should formulate such policies which include people on a small scale. This way energy production will become easily manageable. A lot of people use firewood and cow dung cakes as cooking fuel. Such provisions can be made that the firewood and cow dung collected by the people should be provided to the biomass energy producing centers, this way Biomass Cogeneration projects can be set up. These projects could be run by small start-ups. These could also collect industrial wastes from the local cottage industries. The district has about 2000 ha of fallow land which can be utilized in setting up these power plants

9. Renewable Energy Projects

In Bihar, renewable energy-based generation, particularly in the biomass and small hydro subsectors, plays a considerable role. Such sources are expected to be self-sustaining and economically sustainable, given the economy's primarily rural basis. Furthermore, the plateau and hilly parts of Bihar, as well as the riverine belts, are predicted to have significant wind speeds for wind power generation. As a result, wind energy potential development should be taken up in the district for assessment soon, with the Ministry of New and Renewable Energy's approval.

The policy should be made for renewable energy projects, as well as adequate budgetary allocations in plan funds to supplement Central support, to encourage local private sector participation in renewable energy power generation projects, such as solid waste and sewerage gas based projects or decentralized distributed generation (D.D.G.).

10. Ecotourism Projects

Travelling to places where flora, wildlife, and cultural legacy are the main attractions is known as ecotourism. Ecotourism aims to provide visitors with a better understanding of how humans affect the environment and create a greater appreciation for our natural ecosystems. There is a huge opportunity to develop ecotourism projects in the Patna district. The project will not only minimize the negative aspects of conventional tourism on the environment but also enhance the cultural integrity of local people. Also, this project will boost the tourist inflow in the district.

11. Sustainable Tourism

It is a type of tourism in which all the needs and desires of a tourist/ and other stakeholders of the tourism industry are fulfilled without compromising the ability of the future generation to utilize the tourism. Several goals of Sustainable Developments Goals are also seen associated with sustainable tourism. Life below water and life on land are impacted by human activities if the tourism place is a water body or forest area, hence it is the duty of all of us to take care of the

sustainability aspect in tourism. Sustainability for local/natives can be provided by including them in trade and business activities.

There is a sense of responsibility of different stakeholders associated with tourism to develop sustainable tourism. In which each stakeholder takes care of other stakeholder and biotic and abiotic factors. For example, reducing the Carbon footprint produced by per visitor, using eco-friendly vehicles to roam around, supporting local businesses.

One example of sustainable tourism is promoting tourists to travel off-season. It will reduce the impact of seasonal unemployment on the marginal traders and other workers in the tourism sector.

Offering eco-friendly services is another example of sustainable tourism. Providing tourists with cycles to roam around nearby places will help in reducing carbon footprint and it is economical.

Wetlands

The district comprises some of the healthy and wealthy wetland ecosystems. They directly or indirectly support millions of people and provide goods and services to them. They support all life forms through extensive food webs. They are a habitat to aquatic flora and fauna and numerous species of birds, including migratory species. They mitigate floods and recharge the groundwater. They need to be taken care of and action on different fronts needs to be taken. The action plan below gives a glimpse of the action and development required to protect, conserve, rejuvenate the wetlands existing and extinct.

1. Identification and Inventory
    - The Space Application Centre of ISRO has already made identification of wetlands on the scale of 1:50,000. They need to re-collect the information on the scale of 1:25,000 to gather precise data of small wetlands. Also, they need to re-collect the data on the scale of 1:50,000 to understand the present scenario and compare it with past wetland data.
    - Creating an open-source inventory database. Introducing the data with the total number of wetlands on the area basis.
    - Marking of the name of wetland, altitude, type on the district-wise maps.
    - Criteria for identification of wetlands as those prescribed under the Ramsar convention (9 criteria)
    - Produce regional and national wetland inventories, baseline assessments and monitoring programs.
    - Data collection of pre and post-monsoon changes in the size of the wetlands
2. Condition
    - Quantification of woods, fish, species (especially endangered species) and valuable goods provided by the wetland ecosystem.

- Measurement of the condition of the wetland like water quality, air quality, soil quality and other parameters.
- Assessment of the impact of wetland degradation on public health, food and productive security, and poverty prevention.
- Assessment of pre and post-monsoon conditions.
- Assessment of the recent and past condition of wetlands

3. Research
   - To improve the health of the wetland, both central and state must fund schemes and research
   - Research of sustainable (environmental, economical, social) development of significant wetlands.
   - Research on rejuvenation and restoration of wetlands.
   - Scientific research and assessment on the vulnerability of wetlands to climate and other factors
   - Conduct research on the economic value of wetland ecosystems
4. Reviving Plan
   - Conduct extensive study before applying any reviving plan, as many species depend on wetlands.
   - Making local stakeholders significant advisors. To document, highlight, apply traditional knowledge to wetland conservation
   - Formation of the steering committee of the technical experts of the different domains to assess the reviving/rejuvenation plan.
   - Monitoring of plan execution with regular interval data collection.
   - Marking of the wetlands based on wetland quality index.
5. Policies
   - National Plan for Wetland Development (NPWD)
   - Integrated wetland sustainable management policies
   - Wetland protection act following the pattern of Ramsar wetlands.
   - Providing some wetland of national importance
   - Establishment of an institution/centre to study the importance of wetlands against climate change/global warming.

Integrated Framework

Patna is highly urbanised with less agriculture share. Thus, there is a need to find ways to exploit high Economic values while innovatively reducing the negative impacts. Activities like agriculture and horticulture figure here.

- Organic forms of agriculture. The economic value and livelihood value of this is much higher than chemical farming while reducing negative impacts. Mechanization and reductionist approaches have caused us to move away from this. Better marketing and supporting activities (collection, grading, segregation etc.) are needed here.
- Horticulture farming makes the idea of food processing and more livelihood more attractive in the district. Land laws and laws against felling

of trees are an impediment here. A need for a case-based mechanism of approvals here with supportive state machinery.
- Poly House based cultivation in very high altitudes. Since people living there also need important crops that don't grow there, controlled temperature cultivation is the way to go.

2. Projects which fare high on conservation and livelihood, need maximum resource provisioning. Livelihood providing activities like wetlands conservation and rejuvenation, agro-forestry have several positive externalities. It helps tackle climate change all while providing livelihood.

- Agroforestry. Covering the mountains and hills and allowing for a future timber industry to develop
- Rejuvenation of wetlands, digging up ponds in certain regions etc. which can hold rainwater.
- Livestock, promoting wool, silk, dairy, fisheries in sustainable fashion, provisioning areas as pastures with indigenous grasses for sustaining livestock. More livestock can help soil
  carbon increase while creating future (supply led) demands for wool etc.
- Increasing herbal gardens in the district. These help in educating people about herbs and also provide a future possibility of economic use.
- Making available SBLP (SHG Bank linkage Program) through NABARD etc. by organizing women into SHGs since most work here is female labor based.

Given the impact on nature and high livelihood possibility, we need maximum resource provisioning in these projects. This can be done through the route of MNREGA and other schemes. With support from the state, these activities can then become self-sustaining or evolve alternate usages.

3. Finally, the activities that are low in economic value, livelihood, but high conservation. Like energy and biodiversity management. All investments made here will yield a bounty for future economic activities.

- Energy is a basic requirement and with proper supply in the hills other development projects can fly. Emphasis must be on decentralized models. These can prove resilient to outages in some places and also have lower environmental damage. High Temperature Proton Exchange Membrane based fuels cells for clean electricity from biogas, Micro hydro energy projects can power both fisheries and factories near them
- If conservation works are done well, then eco-tourism and medicinal plants availability will be more profitable. Biodiversity management hence must be done in a scientific manner. Managing keystone species etc. is a technical work with low economic returns.

Recommendations

1. Agriculture

- The agriculture of this area is vegetable-based. Major vegetables of this area are onion, potato, Pointed Gourd, Bottle Gourd, Cauliflower, Okra, cabbage. But the storage facility is lacking, especially for onions. Storage and transportation facilities should be improved.
- The vegetable seed program should be reinforced. It will also increase the yield of vegetables.
- Most of the Farmers are already following KVK Patna.
- There is a large scope of organic farming in this district. The government is already giving monetary help, but it can be expanded to most of the farmers.
- The irrigation is done by only flooded irrigation. Drip and Sprinkler irrigation should be introduced in the area to increase the water use efficiency and crop yield.
- In Diara (Lowland area) area, Wheat is cultivated in the Rabi season and summer Watermelon, Pointed Gourd, Kakri, but this area suffers from flooding.
- The farmers have small landholding, and there is a need for mechanized plantation, especially for vegetables. This can also increase the yield and time of farmers.
- Bihar state vegetable processing and marketing co-operative Federation Limited introduced Tarakri express service to deliver vegetables to the Patna residents at their doorstep at half the market prices. The vegetables obtained directly from the farmer's fields will reach all the neighborhoods of Patna within a span of a few hours on e-rickshaws. This type of scheme should be increased.
- Kishan chupal was introduced on April 28, 2012, but due to COVID, its operation is affected. In Kishan chaupal, Every Saturday, scientists from KVK visit new villages to train the farmers. The chaupal has enabled the farmers to directly interact with expert scientists to get the solution to their agricultural problems, thereby strengthening the farmer's scientist’s relation.
- Polyhouse is very few Polyhouses in this area which should be increased.
- Strawberry, Mushroom, Capsicum, these high revenue generated crops, are cultivated by few farmers, which shows a large profit. More farmers should be encouraged.
- The farmers have small landholdings. Group farming may be more profitable.

2. Horticulture

- After thorough study and analyses of location-specific agricultural methods and agro-climatic variables, a cluster-based approach to creating fruit and vegetable belts in each block was adopted.
- Low grown fruits and vegetable varieties, like muskmelons, lemons and other citrus fruits should be given prominence, so that the district could provide a wide range of fruits and vegetables to the state and country.
- The emphasis should be laid out on production of off-season/exotic crops and flowers.
- The administration should try to provide a market intervention system to farmers for the highly grownup fruits, like mango, banana and guava. Similarly, a safety net could also be provided to farmers by a way of crop insurance for these fruits.

3. Forestry

- More nurseries for the production of high-quality agroforestry and farm forestry planting supplies are needed.
- Park development and management, as well as road greening in urban and semi-urban regions.
- Establishing a distinct multi-disciplinary facility/wing in the Environment and Forest Department for climate change action plan research and monitoring, as well as inter-departmental coordination.
- Encourage the growth and promotion of agroforestry through active campaigning and extension services.
- To strengthen the capacity to withstand climate change-related stress, protect and enhance forest cover and proactive N.G.O.s.
- As new trees grow fast and fallen leaves accumulate on the forest floor, planting trees on marginal agricultural land improves carbon sequestration at a rapid pace. Reforestation of depleted forest stands can also help remaining forests sequester more carbon.
- Patna being an agriculture-based economy with a very arid climate; Agroforestry and homestead forest are the suitable options for increasing forest cover. This way the citizens can earn extra income through these forest products such as fruits, flowers, and beekeeping.
- Agroforestry information centres and forest product processing clusters can be established. The government scheme ‘Krishi Kalyan Yojana’ should not be

only limited to the farmers but to the citizens who can grow mini forests in their space.

- Being a Historic place, Patna district can have Miyawaki Forests with native plants at every open space possible and these forests can be utilised as heritage and ecotourism places. These forests can be tourist attractions. Native Fruit bearing trees can be planted in these forests and the processing can be done on a public private partnership basis. This can provide aesthetics to the geography and income to the locals.

4. Energy

- Renovation and modernization of existing units to restore original efficiency along with reduced auxiliary power consumption and reduced chimney emissions.
- Feasibility of gas based and nuclear (including thorium-based) power plants should be explored.
- Replacing the use of grid power for certain end-uses through low temperature solar thermal – e.g. water heating.
- Adoption of supercritical technology for all future coal-fired power plants in order to improve efficiency and minimize emissions.
- Implementation of a small hydro project in the district Patna.
- Use existing infrastructure like a canal for hydro projects.
- Use of local people for project construction or installation work.
- Educate local citizens about renewable energy, its necessity, employment, and energy from hydro projects.
- Implementation of various biogas generation schemes such as National biogas fertilizer management program, biogas-based power generation program, bagasse-based cogeneration projects in sugar mills power projects based on other biomass, biomass-based gasifier power projects, Industrial waste-based power projects, biomass-based cogeneration power projects for increase generation of biogas and solid waste management.
- Increasing awareness to the farmers and local citizens about the environment and indoor pollution, its effect on the human body, biogas potential, necessity of solid waste management, efficient use of agriculture and animal waste to produce biogas and fertilizer.
- Providing subsidies or incentives for promoting biogas plants (high upfront cost) for the village and industrial level.
- Strict policy measures are required to increase biogas production from municipal and industrial wastes.

5. Tourism

- The district administration needs to develop efficient connectivity between the tourist places.
- Campaigns such as Saher-Darshan, a theme-based tourists circuit scheme, should be launched to lift the district's tourism potential.
- There is a need to reduce the G.S.T. from homestays. Higher G.S.T. hampers the homestay business and discourages domestic tourists from accessing it. Currently, homestays across the country are subject to an 18 percent G.S.T. on hotel rooms with rentals above ₹1,000. Before the G.S.T., homestays were subject to an 8% service tax. A lower tax slab will not only boost the homestay industries but will also promote the local economy[3].
- Private players should be encouraged to invest in unserved/underserved tourist initiatives by the administration. The incentive structure might be more appealing to attract more creative tourist initiatives.
- Administration can promote tourism startups. New generation entrepreneurs have shown the power of frugal innovation and lean startups in revolutionizing the travel industry. Online aggregators and travel tech startups are changing supply chain paradigms and putting customers in control.
- To boost the local economy, a due attentiveness favouring native artisans who produce genuine Madhubani paintings and handicrafts can work as a panacea and reduce industry sickness. Also, local season markets/melas, which allow natives to sell/purchase local goods, are a source of tourism that can be modernized and marketed well for enhanced tourism activities.
- Tourists are a source of income for the natives; developing local marketplaces such as specialized malls for locally made handicrafts can give a place to sellers and buyers simultaneously. Usually, local markets (selling original articles) are scattered throughout the city; a specialized marketplace will help the sellers showcase their product at excellent places, and buyers can find a wide variety of ranges at the same site.
- Local producers can be trained to market their products using the internet and social media. Lessons of Digital marketing can be helpful to the native producers of various articles such as metal crafts, tukuli painting, manjush painting.
- Terra cotta has been in the history of Bihar since 8th A.D.; the form of art is used to make a variety of articles. Terra cotta is still relevant and can be upgraded and standardized to fit modern use. Terra cotta articles are widely

[3] Homestays in a dilemma over GST, The Hindu
https://timesofindia.indiatimes.com/city/mangaluru/18-gst-on-homestays-hurts-districts-tourism-prospects/articleshow/61598629.cms

used as decorative pieces. This can be targeted to benefit particular demography of artisans in Bihar.

- Madhubani or Mithila painting of Bihar is very famous, however, there is still scope for scalability. Other similar forms of paintings such as Tikuli Painting, Sikki Craft, Manjush Painting, and Sujani Craft are limited to very small demographics. Artisans related to this art are precarious labourers. Easy loan, training sessions (Through Kaushal Vikas Kendra/skill development centres) and marketing skills for native artisans can be helpful.
- Regular maintenance of tourist spots and the different roads connecting it with the city's centre is necessary to provide tourists with an enjoyable experience. Information and contact details of authentic tourist guides on the government tourism website may be helpful for tourists and encourage them to visit more places and eventually more business. Acquiring a license by local tourist guides from government bodies is generally seen as a complex process that discourages genuine candidates from getting the license. Easy to apply and get the license can benefit tourism.
- Also training sessions for guides can be beneficial for individual guides and help them earn livelihood and the tourism sector to embrace more tourism. These training sessions can also help know the actual number of available tourist guides in the city. And the same information can be uploaded on the website for customer support.
- Supporting tourism can also help flourish other sectors such as local handicrafts, restaurants and eateries, travel agencies, local vendors and many more as all of these are in a symbiotic relationship.
- Local foods can be promoted with tourism for an authentic tourism experience. Bihar is very famous for Litti Chokah, Makhana Kheer, Tilkut and Anarsa, Malpua etc.
- Letting tourists know about community-based initiatives such as women-led Self Help Groups and Social Enterprises will support the tourism and initiatives. As it can bring business to initiatives.
- Development of COVID 19 protocol friendly tourism packages to boost the tourism sector economy after the pandemic.
- Patna is the capital of Bihar; hence it can be developed for heritage tourism as it has been associated with Gandhiji and the freedom struggle.
- Ghats can be developed on the verge of international standards to attract more and more foreign tourists.
- Patna is the centre of Bhojpuri film industry, connecting it with tourism can bring profit to the industry. Developing spots for tourists to witness the shooting and film scenes can increase the revenue.

6. Wetlands

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 recommendations 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 rejuvenate and restore the water bodies of the district. This can be done by recharging old ponds, aquifers and lakes present and preserving them. This leads to the solution of water scarcity, water quality in the region. The government needs to take steps like water quality testing and quantification of water bodies at regular intervals and promote MNREGA schemes to rejuvenate extinct water bodies and promote rainwater harvesting.
- It is recommended to promote organic farming and a scientific approach near the wetlands to lower the pollution of the wetlands. Also, these practices help attract the market and increase the yield of sesame. The government scheme will give a boost to crops like sugarcane, grains. Steps needed to be taken to promote techniques to increase production in organic farming with less cost in cultivation.
- It is recommended to promote animal husbandry, the fishing industry in the area. This provides a boost to the economic growth of the local people. Sustainable development of industries will lead to minor exploitation of the wetlands as these are water-intensive industries. Awareness about the water utilities needs to be promoted between the local people to lower the water crisis.
- It is recommended to promote eco-tourism in the region. The wetlands must be allowed for a limited number of visitors. The economy generated by eco-tourism must be utilized in the maintenance of the hotspot. The awareness campaign like say no to plastics, let us make hills plastic-free must be organized. Strict action for littering, no plastic zone like action must be taken to conserve.
- The region has many medicinal plants cultivation like lemongrass, fenugreek, suragandha, ashwagandha, etc. Production of these plants can be increased by turning nursery and allocated land, and products like essential oil and ayurvedic medicine can be derived
- It is recommended to increase waste management practices in the region by promoting plastic waste management, sewage disposal management, encouragement of the use of toilets by local stakeholders and increasing the number of bio-toilets in the region for public use. This also helps in maintaining the health of the riverine and groundwater

7. Biodiversity

- Provide Wildlife Corridors and Connections Between Green Spaces.
- Planting or seeding with native trees, flowers, fruits, vegetables and shrub species.
- Reduce the use of pesticides and fertilizers in an agricultural field.
- Reduce, reuse, and recycle to minimize our demand for resources.
- Use environmentally friendly products for cleaning, clothing, packaging.
- Aim for energy conservation in home, office, university, everywhere.
- Reduce single-person and short-distance car use.
- Incorporate renewable energy and/or energy efficiency into your home.
- Demand and encourage sustainable products

Discussion during the Report Presentation

- NYKS volunteers are very active in Patna
- Natural Farming is being promoted among the farmers. Namami Gange will be contacted for the required training.
- Vaishali has a great historical heritage which has a great opportunity to attract tourism.
- Arth Ganga Trails will be explored.
- The suggestions by the Advisor, NMCG were noted
- Officials assured that the reports of the IIM-IIT consortium will be discussed in future DGC meetings.
- Regular Aarti at the Ganga Ghaats will be planned. 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.

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