Arth Ganga Project: District Hardoi

Submitted to:

National Mission for Clean Ganga (NMCG)

Submitted by:

IIM Lucknow

IIT Roorkee

JUNE-2022

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Hardoi, a district in the state of Uttar Pradesh is bestowed with nature's aesthetics and biodiversity along with religious and spiritual diversity. The city is traversed by the rivers Gomti, Ram Ganga, and Sai River.

The total geographical area of the district is 5989 km^2. The primary sector showed the average annual growth rate from 2011-12 to 2018-19 is only 1.82% with its share decreasing from 35.54% to 28.02. The tertiary sector occupies, on average, a 50.90% share of the district economy with an average annual growth rate of 7.31%, with its share increasing from 47.79% in 2011-12 to 55.34% in 2018-19. Overall, the district economy grew with an average annual growth rate of 5.11%

Agriculture with the horticulture sector grew at an average annual growth rate of 2.40% from 2011-12 to 2018-19. However, its share increased from 81.08% in 2011-12 to 84.23% in 2018-19

In 2017-18, the net sown area and the gross irrigated area represents 421693 ha and 553776 ha. The cropping intensity of the district is 156.15%. The total irrigated area is 375345 ha. Major crop types are wheat, rice, maize, barley, tide, millet, pulses like a variety of black pulses, pigeon pea, pea, lahi mustard, etc. along with sugarcane, potato, mole, groundnut, etc. The total food grains along with pulses account for the production of 1664713 MT. The livestock consists of cattle (indigenous and crossbred), buffalos (indigenous and crossbred), pigs (indigenous and crossbred), sheep; along with poultry.

The net sown decreased from 71.48% in 2010-11 to 70.41% in 2017-18. The area for non-agricultural use increased steadily over the period from 8.98% to 9.36%. The district's percentage of the net and gross irrigated areas have increased over the years with an average of 90.08% and 82.78%, respectively.In 2017-18, however, the nitrogen share decreased to 71.50%, while the phosphorus share increased to 26.39%, and the potassium share decreased to 2.11%. The use of nitrogen is more than the recommended ratio, while the Phosphorous and potassium ratio is less than the recommended ratio. The overall use of chemical fertilizers increased in the district from 166.43 kg/ ha GSA in 2010-11 to 196.42 kg/ ha GSA in 2017-18.

The share of the livestock decreased from 13.28% to 5.91% in the same period as it grew with a negative average annual growth rate of 2.42%. The fishery and aquaculture subsector share is around 3.65% in 2018-19, but it grew with an average annual growth rate of 77.57% from 2011-12 to 2018-19. Mines and quarrying also recorded a remarkable average annual growth rate of 19.34%.

The total forest cover of the district is 143.85 km^2 which represents 2.05% of the total reported area. There is no major forest cover in the district. Out of total forest cover, the maximum area is covered by Open Forest (126.87 km^2) followed by Moderately dense forest (16.98 km^2). The district's forest cover decreased from 2001(81 km^2) to 2013 then increased to 143.85 km^2 which is reflected by the figures for forest cover and very dense forest covering 70 km^2 which has been reduced to moderately dense forest and open forest.The share of forestry and logging in the total agriculture and allied sector is small, around 6.22% in 2018-19 with an average annual growth rate of 8.76%. The share of area under trees and gardens slightly reduced from 1.81% in 2010-11 to 1.72% in 2017-18.

Hardoi is known for its varied religious destinations and ecological attractions. The district is not connected well through roads or airways but the railway network is developed better. In the year 2019, the district received a total of 18358 tourists out of which 18276 were domestic visitors, the numbers have been increasing since 2016 but decreased drastically in 2020 due to COVID-19. There are a variety of places to visit in the district such as Jama Masjid Shahabad, Hardoi Baba Temple, and Mangala Devi Temple. For nature lovers is the Sandi Bird Sanctuary, Naimisha Forest, etc.

In the district, kerosene is the main source of lightning used by 84.79% of households, followed by 13.48% using electricity and only, 1.15% using solar energy. The district has not witnessed many solar energy unit installations. In the district, 52% of households use firewood for cooking followed by 32% of them using cow dung cake, 8 % crop residue, and 8 % LPG/PNG. The district has two industrial waste-based biomass plants by the name Baghauli Distillery and Saif Yeast Bakers, of 2 MW each. Electricity consumption in agriculture has increased significantly from 71.02 KWH in 2014-15 to 156.48 KWH in 2019-20, a net increase of approximately 120.33%. The percentage share of the agriculture sector in the total electricity is around 18.72%. The total number of wetlands existing in the district is 4076 consisting of both Man-made and Natural. Most of them are small or medium-sized and tanks/lakes/ponds and waterlogged. The district's biodiversity data includes various crop production, livestock population, bird species, and forest cover with 362 bird species and 5 threatened/rare species of bird in the district. Biogas potential from animal waste is calculated as three crores m^3/year and eighty-three crores m^3/year. For a small hydro project, two sites have been identified/investigated and for one another site pre-feasibility report has been prepared.

The government should put efforts to increase forest cover and reduce overexploitation of resources. The implementation of various schemes, promoting local participation, taking measures for utilization of timber products and cultivating medicinal plants, increasing irrigation, improving storage and transportation, horticulture, agroforestry, Mayawaki plantation, organic farming, etc. can aid the overall development of the district. Measures such as eco-tourism should be taken to improve tourism and enhance the use of renewable energy especially by creating awareness. Use of high-yielding seeds, ferti-seed drill, micro-irrigation, constructing and maintaining harvesting structures, resource conservation technologies like zero tillage, adopting greenhouse farming with organic farming, and encouraging farmers for adapting different crop cultivation and various irrigation methods. Along with focusing on agriculture practices Bee culture, dairy, poultry, fisheries, etc. needs encouragement as they have high economic potential. Promoting a system of rice intensification, cultivating oilseeds like sunflower, til, mustard cultivation, spices such as garlic and turmeric, pulses, etc. Practices like green manuring, vermicomposting/FYM, and bio-fertilizer along with storage facilities, processing, and marketing can be developed.

1. DISTRICT OVERVIEW

1.1 INTRODUCTION

Hardoi district is a district situated in the center of Uttar Pradesh, India. The district headquarters is in the city of Hardoi. Hardoi is the third largest district of Uttar Pradesh. It falls under Lucknow division in the history region of Awadh. The district lies between Latitude 260 53' north and 270 47' north and Longitude 790 41' and 800 49' East. The rivers of the district have played an important role in the topography fashion-in-style of district. The district is situated between Ganga and Gomti rivers.

As of the 2011 census, the total population of Hardoi district is 4,092,845 people, in 730,442 households. It is the 13th-most populous district in Uttar Pradesh. There are five tahsils in the district namely Shahabad, Sawayajpur, Hardoi, Bilgram and Sandila. The most populous tahsil is Hardoi followed by Sandila, Sawayajpur,is least populated tahsil. The urban population in the district is 13.2 per cent. The sex-ratio in the district at 868 is way behind 912 at the State level. In the total population of the district of 40,92,845 as much as 32.23 per cent are workers and rest of 67.77 per cent are non-worker. Among workers 23.70 per cent are main workers and rest of 8.53 per cent are marginal workers of total population. The extent of workers in rural areas and non-workers in urban areas is higher. In the district, among workers about 45.25 per cent are cultivators and 19.38 per cent other workers. Over 29.23 per cent of female workers are engaged as cultivators.

The economy of the district pivots around agriculture, nearly 83.37 percent of the workers are engaged in agriculture related work. This clearly shows that majority of the population are dependent on agriculture. There are three harvests called by the usual names, Rabi, Kharif and Zaid. The Zaid are intermediate harvest is of little importance in the district. The district kharif crop is comprised of four main produce like Jawar, Millet, Arhar, Maize and Paddy and under the Rabi wheat, gram, barley, pea, mustard, cultivation of potato is done. There is fairly good production of sugarcane in the district. The percentage of cultivable area to total area is 75.18 percent. Cultivation of sugarcane, potato, wheat, gram, arhar and paddy is gaining. The cash crop is sugarcane along with potato. Double cropping was done to obtain more yield in the district.

In 2006 the Ministry of Panchayati Raj named Hardoi one of the country's 250 most backward districts (out of a total of 640).[4] It is one of the 34 districts in Awadh, Uttar Pradesh currently receiving funds from the Backward Regions Grant Fund Programme (BRGF).

Hardoi is located in UP. It is a city with a rich historical past and is home to a population that is a milange of different religions. The Hardoi District is bifurcated into five tehsils. Hardoi city comprises a great part of the Hardoi district. The Hardoi District is characterised by thick forests spread to approximately 5kms and is also a recipient of the entire massive body of Ganga river and its tributaries, flowing on the south of the district. Hardoi's tourist places include something for everybody; for those who are religiously inclined, there's Jama Masjid Shahabad, Hardoi Baba Temple, and the Mangala Devi Temple. For nature

lovers is the Sandi Bird Sanctuary, which is around 20 km from Hardoi. The migratory birds arrive here in the winter, and the sight of them would take anyone's breath away. The Naimisha Forest is another Hardoi tourist place for nature lovers and history lovers as it is believed to be an ancient forest mentioned in the Ramayana. The combination of nature's beauty and beautiful religious shrines and temples make Hardoi a tourist place for the entire family. Its north border touches Shahjahanpur & Lakhimpur Kheri Districts. Lucknow and Unnao are Situated at south border, West Borders touches Kanpur & Farrukhabad and on eastern border Gomti river separates the district from Sitapur. District Hardoi comprises of 5 tehsils (Hardoi, Shahabad, Bilgram, Sandila & Sawayajpur), 19 blocks, 191 Nyay, Panchayat, 1101 Gram Sabha & 1901 habited revenue villages.It also has 7 Nagar Palika Parishads & 6 Nagar Panchayats. Geographical area is 5947 sq. km. As per census 2011, Population of the district is 4091380, out of which Female are 1887116 & Male are 2204264. Paddy - wheat, Maize - Wheat, Maize-potato, rice - mustard, Maize-potato-vegetable, groundnut-barley- vegetable are major cropping sequence in the district.

Sandi Bird Sanctuary is a freshwater marsh in Uttar Pradesh's Hardoi district. The wetland is characteristic of the Indo-Gangetic lowlands, and monsoon rains provide the majority of its water. With over 40,000 ducks reported in 2018, the Site, which is rich in aquatic vegetation, provides a good habitat for waterfowl. The sanctuary lies in the Hardoi district of Uttar Pradesh, India, in the Bilgram tehsil. It is only 1 km from Sandi town and 19 km from Hardoi city.

The tomb of Diler Khan, a governor during the reigns of Shah Jahan and Aurangzeb, as well as the Jama-Masjid, Sankta Devi temple, Balaji temple, and Baram Baba temple are all located here. According to legend, this is also the location of the ancient settlement of Angadpur.

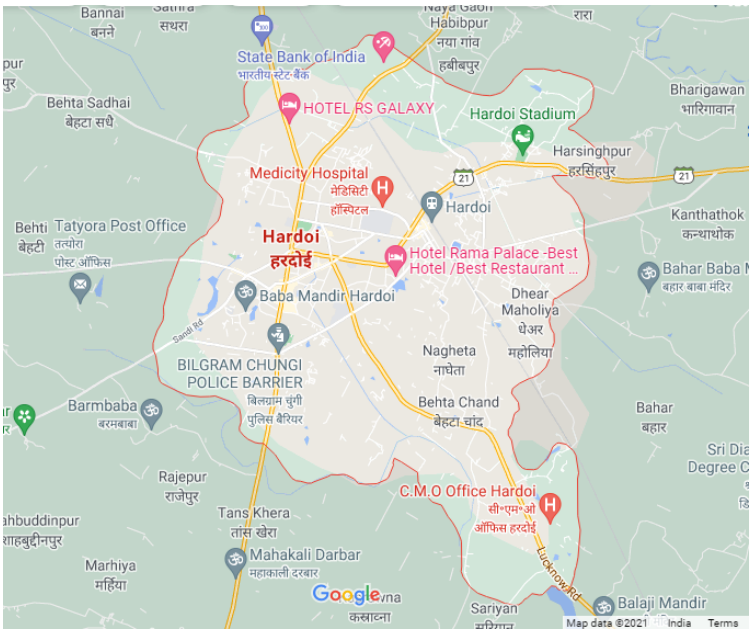


Figure 1 Map of the district

1.2 DEMOGRAPHIC PROFILE OF HARDOI

1. Economy and Livelihoods

- Geographical Area: 5989 Sq. Km.
- Administrative Divisions:

  District Headquarters: Hardoi

  No of Municipalities: 13

  No of Tehsil: 5

  No of Blocks: 19

  No of Gram panchayats: 1306

  No. Of Villages: 2072

- Demographic and socio-economic indicators:

  Population: 40,92,845 (Census 2011)

  Population density (Total persons per sq. km): 684

  Sex ratio: 868

  Literacy: 64.6%

- Occupation/ other Livelihood source: Agriculture
- Major Rivers: Gomti, Ram Ganga, Sai River
- Forest Area: 143.85 Sq. Km. (ISFR 2019)

1.3 ECONOMIC PROFILE OF HARDOI

The District Economy

The primary sector has a significant impact on the district economy because it contributes, on average, 32.27% share in the district GDP. However, the average annual growth rate in this sector from 2011-12 to 2018-19 is only 1.82%. Thus, its share decreased from 35.54% in 2011-12 to 28.02% in 2018-19. The share of the secondary sector remains constant (average, 16.82%) over the years, despite growing with a significant average annual growth rate of 6.21%. The tertiary sector occupies, on average, 50.90% share of the district economy. Moreover, the sector grew with a remarkable average annual growth rate of 7.31%, with its share increasing from 47.79% in 2011-12 to 55.34% in 2018-19. Overall, the district economy grew with an average annual growth rate of 5.11%. The growth in the primary sector is less than in the other two sectors. Steps should be taken to increase the productivity of the primary sector so that it can grow at a higher rate. It will improve the overall district economy's growth, as the primary sector has a decent contribution to the district GDP. The secondary and tertiary sectors have performed well during the period of the study.

Table 1: Trends in Gross District Domestic product in Hardoi at Constant Prices (base 2011-12) in Rs Crore

Year	Sector-wise GDDP (Rs, Crore)				Annual Growth Rates			
	Primary	Secondary	Tertiary	Total GDDP	Primary	Secondary	Tertiary	Total
2011-12	3343.77	1567.97	4495.86	9407.61	-	-	-	-
	(35.54)	(16.67)	(47.79)	(100)				
2012-13	3337.11	1747.54	4636.28	9720.93	-0.20	11.45	3.12	3.33
	(34.33)	(17.98)	(47.69)	(100)				
2013-14	3514.43	1859.16	5120.95	10494.54	5.31	6.39	10.45	7.96
	(33.49)	(17.72)	(48.80)	(100)				
2014-15	3205.70	1830.83	5440.23	10476.75	-8.78	-1.52	6.23	-0.17
	(30.60)	(17.48)	(51.93)	(100)				
2015-16	3544.16	2076.97	5982.10	11603.24	10.56	13.44	9.96	10.75
	(30.54)	(17.90)	(51.56)	(100)				
2016-17	3883.91	1593.40	6136.15	11613.45	9.59	-23.28	2.58	0.09
	(33.44)	(13.72)	(52.84)	(100)				
2017-18	4111.98	2100.90	6534.67	12747.55	5.87	31.85	6.49	9.77
	(32.26)	(16.48)	(51.26)	(100)				
2018-19	3717.25	2208.24	7341.35	13266.84	-9.60	5.11	12.34	4.07
	(28.02)	(16.64)	(55.34)	(100)				
Average Growth Rate					1.82	6.21	7.31	5.11

Source: UPDES
Note: Figures in Parentheses are percentage share in the total GDDP

We further break down the primary sector GDP to determine which sub-sectors are driving the primary sector growth. Table 2 shows that agriculture, including the horticulture sector, grew at a low average annual growth rate of 2.40% from 2011-12 to 2018-19. However, its share increased from 81.08% in 2011-12 to 84.23% in 2018-19. On the other hand, the share of the livestock subsector decreased from 13.28% to 5.91% in the same period as it grew with a negative average annual growth rate of 2.42%. The share of forestry and logging in the total agriculture and allied sector is small, around 6.22% in 2018-19, despite growing at a remarkable average annual growth rate of 8.76%. The fishery and aquaculture subsector share is very minimal, around 3.65% in 2018-19, but it grew with a magnificent average annual growth rate of 77.57% from 2011-12 to 2018-19. Mines and quarrying also recorded a remarkable average annual growth rate of 19.34%. This high growth in this subsector can have serious environmental issues like deforestation, soil erosion, etc., with long-term effects on the health of local citizens. Overall, the primary sector performed below expectations during the period of the study as the majority of the subsectors have not done well. More work can be done on improving the agriculture (including horticulture) and livestock sub-sectors as they have the most significant impact on the primary sector.

Table 2: Trends in Gross District Domestic product from Agriculture and allied activities in Hardoi at Constant Prices (base 2011-12) in Rs. Crore

Year	Agriculture	Livestock	Forestry and Logging	Fishery and Aquaculture	Total Agriculture and allied	Mining and Quarrying	PRIMARY SECTOR
2011-12	2669.46	437.08	170.46	15.34	3292.34	51.43	3343.77
	(81.08)	(13.28)	(5.18)	(0.47)	(100)		
	-	-	-	-	-	-	-
2012-13	2509.07	461.13	313.46	16.07	3299.73	37.37	3337.11
	(76.04)	(13.97)	(9.50)	(0.49)	(100)		
	[-6.01]	[5.50]	[83.89]	[4.76]	[0.22]	[-27.34]	[-0.20]
2013-14	2667.96	498.12	279.37	16.57	3462.01	52.42	3514.43
	(77.06)	(14.39)	(8.07)	(0.48)	(100)		
	[6.33]	[8.02]	[-10.88]	[3.09]	[4.92]	[40.28]	[5.31]
2014-15	2252.43	520.37	342.59	17.71	3133.10	72.59	3205.70
	(71.89)	(16.61)	(10.93)	(0.57)	(100)		
	[-15.57]	[4.47]	[22.63]	[6.93]	[-9.50]	[38.48]	[-8.78]
2015-16	2530.98	628.42	241.71	18.08	3419.20	124.97	3544.16
	(74.02)	(18.38)	(7.07)	(0.53)	(100)		
	[12.37]	[20.76]	[-29.45]	[2.09]	[9.13]	[72.15]	[10.56]
2016-17	2772.17	691.86	268.20	22.14	3754.36	129.54	3883.91
	(73.84)	(18.43)	(7.14)	(0.59)	(100)		
	[9.53]	[10.10]	[10.96]	[22.40]	[9.80]	[3.66]	[9.59]
2017-18	2919.33	722.88	226.75	21.95	3890.91	221.07	4111.98
	(75.03)	(18.58)	(5.83)	(0.56)	(100)		

	[5.31]	[4.48]	[-15.45]	[-0.84]	[3.64]	[70.66]	[5.87]
2018-19	3061.08	214.68	225.89	132.71	3634.35	82.90	3717.25
	(84.23)	(5.91)	(6.22)	(3.65)	(100)		
	[4.86]	[-70.30]	[-0.38]	[504.57]	[-6.59]	[-62.50]	[-9.60]
Average Growth Rate	2.40	-2.42	8.76	77.57	1.66	19.34	1.82

Source: Compile from UPDES
Note: 1. Figures in () are percentage share in the total agriculture & allied GDDP
2. Figures in [] are annual growth rates.

Table 3 shows the percentage share of subsectors in secondary and tertiary sectors. Within the secondary sector, the manufacturing sector had a share of approximately 35.46% in 2018-19. The share has decreased over the years despite the sub-sector growing at an average annual growth rate of 10.09%. The share of the electricity, gas, and water supplies subsector has increased from 6.02% in 2011-12 to 9.49% in 2018-19. Moreover, this subsector grew with a remarkable average annual growth rate of 12.43%. The share of the construction sub-sector increased from 52.95% to 55.05% in the same period, and the average annual growth rate is significant (5.68%). It indicates that the secondary sector in Hardoi is heavily dependent on the manufacturing and construction sub-sector, and the electricity subsector is also growing at a faster rate.

Within the tertiary sector, the Real estate subsector made up the highest share (29.57%) in 2018-19, followed by Trade and Hotel (18.68%), public administration (15.03%), and transport, storage, and communication (14.89%). Average annual growth is observed highest in Public Administration (20.59%), followed by transport, storage and communication (15.18%), financial services (7.29%), real estate subsector (4.15%) and lastly lowest in trade & hotel (3.54%). All the subsectors in the tertiary sector have performed well during the period of the study. More work needs to be done to improve construction and trade & hotel subsectors. Public Administration, Transport and Communication and Financial services sub-sectors are the major contributors to the Tertiary sector's growth.

Table 3: Trends in percentage share of non-agriculture sub-sectors in DGDP in Hardoi at Constant Prices (base 2011-12) in Rs Crore

Year	Manufacturing	Electricity, Gas, Water Supply	Construction	SECONDARY SECTOR	Transport, Storage & Communication	Trade and Hotel & Restaurant	Financial Services	Real Estate and Professional Services	Public Administration	Other Services	TERTIARY SECTOR

2011-12	41.03	6.02	52.95	100	9.39	24.14	7.75	36.37	8.13	14.22	100
2012-13	45.27	6.08	48.65	100	9.92	23.75	8.72	37.58	6.71	13.32	100
2013-14	47.37	6.42	46.21	100	10.54	24.24	8.52	35.43	8.10	13.16	100
2014-15	42.39	6.81	50.79	100	12.32	23.22	9.07	34.84	6.67	13.88	100
2015-16	46.50	6.26	47.24	100	15.70	23.32	8.77	32.04	6.26	13.91	100
2016-17	27.55	10.15	62.30	100	15.69	21.67	8.54	31.95	7.06	15.09	100
2017-18	37.25	9.77	52.98	100	15.65	20.53	7.17	31.88	10.71	14.07	100
2018-19	35.46	9.49	55.05	100	14.89	18.68	7.55	29.57	15.03	14.28	100
Average Growth Rate	10.09	12.43	5.68	6.21	15.18	3.54	7.29	4.15	20.59	7.51	7.31
Source: Compiled from District Statistical Handbooks											

2. Quantitative Data Analysis

2.1 Agriculture and Allied Activities

2.1.1 Trend in Land Use Pattern

The total declared area of the district is 1142.76 sq. km². The share of Forest area in the total reported area has decreased from 2.52% in 2010-11 to 0.74% in 2017-18. The share of cultivable wasteland decreased slightly from 0.78% in 2011-12 to 0.75% in 2017-18, which is a good development indicator. Barren and uncultivable land share decreased from 2.27% in 2010-11 to 1.30% in 2017-18. The share of area under trees and gardens decreased from 0.20% in 2010-11 to 0.07% in 2017-18. The current fallow land has also decreased over the years, which is good for the district economy. The net sown area (NSA) increased over the years, from 73.69% in 2010-11 to 76.58% in 2017-18. The area for non-agricultural use increased over the period from 13.02% to 16.76% (Table 4). Overall, the land use pattern shows that the fallow and uncultivable land area has decreased while the NSA increased over the years.

Table 4: Trends in Land-use Pattern in Hapur (as % of the total reported area)

Year	Total Reported Area (ha)	Area under forest	Cultivable waste land	Current Fallow	Other Fallow	Barren and uncultivable land	Land other than agriculture	Pasture land	Area under trees and gardens	Net Sown Area
1	2	3	4	5	6	7	8	9	10	11
2010-11	118722	2.52	0.08	7.46	0.71	2.27	13.02	0.05	0.20	73.69
2011-12	114276	1.43	0.78	3.98	1.95	1.48	13.97	0.07	0.19	76.16
2012-13	114276	0.74	0.77	3.84	1.53	1.46	15.29	0.06	0.19	76.12
2013-14	114276	0.74	0.85	3.38	1.61	1.45	15.62	0.06	0.16	76.13
2014-15	114276	0.74	0.85	3.28	1.60	1.41	15.88	0.05	0.15	76.04
2015-16	114276	0.74	0.84	2.86	1.60	1.35	15.88	0.05	0.14	76.03
2016-17	114276	0.74	0.78	2.93	1.39	1.30	16.60	0.05	0.07	76.14
2017-18	114276	0.74	0.75	2.29	1.45	1.30	16.76	0.06	0.07	76.58
Source: Compiled from http://updes.up.nic.in/spiderreports/intialisePage.action										

2.1.2 Trends in Operational Land Holdings

In Hapur district, the total number of operational farms increased from 105 thousand in 2010-11 to 107 thousand in 2015-16, a net increase of 1.90%. While in the state, their numbers increased from 23,325 thousand in 2010-11 to 23822 thousand in 2015-16, a net increase of 2.13%. Most land positions in the district are marginal and small. These two size categories represented around 91.51% in the district in 2015-16, while the corresponding proportion in the state was 92.81% (Table 5). The two agricultural censuses of 2010-11 and 2015-16 report no significant change in the percentage share across the various categories of landholdings. Marginal land holdings increased in 2015-16.

Table 5: Distribution of Operational Holdings by Size-categories of farms (in %) in Hapur

	Agri, Census	Marginal Holdings (0-1 ha)	Small Holdings (1-2 ha)	Semi-Medium Holdings (2-4 ha)	Medium Holdings (4-10 ha)	Large Holdings (10 & above, ha)	Total Holdings ('000 No.)

Hapur	2010-11	75.32	15.94	7.10	1.60	0.04	105
	2015-16	75.92	15.59	6.98	1.47	0.04	107
							[1.90]
Uttar Pradesh	2010-11	79.45	13.01	5.72	1.71	0.11	23325
	2015-16	80.18	12.63	5.51	1.58	0.1	23822
							[2.13]
Source: Compiled from Statistical Diary 2018-19, UPDES. Figures in [] are percentage increase/decrease in 2015-16 over 2010-11.							

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

2.1.3.1 The Trend in Cropping Patterns

Rice, Wheat and Sugarcane dominate the agriculture of the district. Table 6 shows the area under various crops over the last eight years. In 2017-18, Wheat made up the highest share of GCA (30.12%), followed by Rice (14.40%). These two crops together constitute around 44.52% of the GCA. The area shared by the total cereals has decreased from 47.61% in 2010-11 to 45.28% in 2017-18. The main pulses produced are Urad and Arhar, while the rest of the pulses are not significantly produced. The total pulse acreage has decreased from 1.61% in 2010-11 to 1.53% in 2017-18. Thus, the food grains cover a majority (average, 47.48%) of the GCA.

Mustard is the only major oilseeds crop produced, and the total oilseed acreage has increased from 1.20% in 2010-11 to 1.36% in 2017-18. The area under Sugarcane and Potato has increased over the years. Moreover, it is very important for the welfare of farmers to further increase the area under them as both of them are high-value crops. In general, there has not been any significant change in the cropping pattern during the study period. However, the NSA increased over the years, from 60.42% in 2010-11 to 61.21% in 2017-18. The average cropping intensity is 164.85.

Table 6: Trends in Cropping Pattern (as % GSA) and Cropping Intensity

Crop/Year	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Rice	14.44	14.91	14.63	14.79	14.45	14.15	14.22	14.40
Wheat	32.03	31.43	30.26	29.76	30.24	29.60	29.75	30.12
Maize	0.80	0.89	0.93	0.62	0.52	0.51	0.51	0.52
Other Cereals	0.34	0.25	0.30	0.26	0.24	0.23	0.24	0.24
Total Cereals	47.61	47.49	46.13	45.44	45.45	44.50	44.72	45.28
Urad	0.38	0.70	0.77	0.72	0.54	0.53	0.53	0.54
Arhar	0.95	0.75	0.76	0.71	0.60	0.58	0.59	0.59
Other Pulses	0.27	0.37	0.42	0.39	0.40	0.39	0.39	0.39
Total Pulses	1.61	1.82	1.95	1.82	1.53	1.50	1.51	1.53
Total Foodgrains	49.21	49.31	48.07	47.26	46.98	46.00	46.23	46.81
Mustard	1.19	1.16	1.50	1.51	1.37	1.34	1.35	1.36
Total Oilseeds	1.20	1.16	1.50	1.51	1.37	1.34	1.35	1.36
Sugarcane	23.38	24.71	26.08	26.25	25.54	25.01	25.13	25.44

Potato	2.13	2.63	2.38	2.49	2.39	2.34	2.35	2.38
Net Sown Area	60.42	60.62	60.54	61.68	61.01	59.73	60.12	61.21
Gross Sown Area (in 1000 Ha)	144.78	143.56	143.69	141.06	142.42	145.46	144.73	142.96
Cropping Intensity	165.50	164.95	165.18	162.14	163.90	167.42	166.33	163.37
Source: http://updes.up.nic.in/spiderreports/intialisePage.action								

2.1.3.2 Trends in per hectare yield of principal crops

Table 7 shows that the yield per hectare of most crops varies from year to year. However, it increased in the latter years of the study. This can be due to improved irrigation facilities and the availability of better infrastructure. Wheat and Rice are the major crops in the district, and their per hectare yield (41.16 qtls and 28.07 qtls respectively, in 2017-18) are also high. Per hectare yield of total cereals has decreased from 38.93 qtls in 2010-11 to 36.87 qtls in 2017-18.

On the other hand, per hectare yield of total pulses increased from 6.99 qtls in 2010-11 to 10.95 qtls in 2017-18. However, the yield of pulses is less than that of cereals. The yield of total oilseeds has increased from 12.49 qtls in 2010-11 to 13.97 qtls in 2017-18. This can be due to the availability of hybrid seeds in the district. However, the rise in the yield of most crops is not uniform. In some years, it has decreased, but on average, the yield increased in the latter years of the study. The per hectare yield of Sugarcane increased in the recent years, while yield of Potato shows much ups and downs across years. Since Sugarcane and Potato are high-value crops, they can help double farmers' income if proper marketing and infrastructure support are provided. In summary, all crop yields show year-over-year fluctuations. The lack of homogeneity of yields makes farmers' income riskier and more unstable, requiring a solid insurance protection measure.

Table 7: Trends in Per Hectare Yield of Principal Crops in Hapur District (Qtls)

Crop/Year	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Rice	24.86	27.74	29.61	29.24	32.31	29.20	26.19	28.07
Wheat	45.72	44.66	45.97	45.15	30.61	37.34	43.43	41.16
Maize	26.26	20.67	23.05	23.15	22.90	8.87	29.62	29.93
Total Cereal	38.93	38.86	40.19	39.61	31.06	34.37	37.89	36.87
Urad	7.22	6.72	6.66	4.53	5.36	3.98	9.99	7.59
Arhar	7.07	7.11	9.56	7.80	7.56	6.34	17.06	16.54
Total Pulses	6.99	7.10	8.14	6.19	6.49	5.47	12.23	10.95
Total Food Grains	37.89	37.68	38.89	38.33	30.26	33.43	37.06	36.03
Mustard	12.46	11.94	12.77	15.69	12.14	14.67	14.89	13.97
Total Oilseeds	12.49	11.93	12.77	15.69	12.14	14.68	14.89	13.97

Sugarcane	578.96	635.00	625.00	651.84	703.28	664.41	785.45	910.99
Potato	246.78	253.57	245.14	216.34	247.30	327.01	273.56	249.25
Source: http://updes.up.nic.in/spiderreports/intialisePage.action								

2.1.3.3 Trends in Production of Principal Crops

Table 8 shows the trends in the production of the main crops over the years. Rice, Wheat, Sugarcane, and Potato dominate the production. In 2017-18, Rice (57.78 thousand tons) and Wheat (177.25 thousand tons) formed a major part of the total cereal production (238.67 thousand tons). Coming to pulses, Urad and Arhar occupied the highest production. Urad had a production of 0.59 thousand tons, and Arhar had a production of 1.40 thousand tons in 2017-18. Although there has been a significant variation in the production of these pulses over the years, they still represent around 83% of the total pulse production.

Mustard production was 2.72 thousand tons, which represented around 100% of the total oilseed production in 2017-18. Sugarcane is another important crop whose production has been significant in the district (3313.65 thousand tons in 2017-18). Potato production has also been significant over the years (84.82 thousand tons in 2017-18). Looking at the annual production data of various crops, we find that their production has increased, on average, during the period, but at the same time fluctuates year to year, partly due to weather changes and partly due to market conditions. Proper insurance arrangements are the need of the hour to get assured income and take more risk and diversify their production.

Table 8: Trends in Production of Principal Crops in Hapur District (in 1000 Tons)

Crop/Year	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Rice	51.95	59.38	62.25	61.03	66.52	60.10	53.92	57.78
Wheat	211.99	201.51	199.92	189.54	131.83	160.79	187.00	177.25
Maize	3.04	2.65	3.07	2.04	1.70	0.66	2.20	2.22
Other Cereals	1.33	1.35	1.15	1.31	1.02	0.93	2.12	1.43
Total Cereals	268.32	264.88	266.39	253.91	201.07	222.48	245.24	238.67
Urad	0.40	0.68	0.73	0.46	0.41	0.31	0.77	0.59
Arhar	0.98	0.77	1.05	0.78	0.64	0.54	1.45	1.40
Other Pulses	0.25	0.41	0.50	0.35	0.36	0.35	0.45	0.40
Total Pulses	1.63	1.86	2.28	1.59	1.42	1.19	2.67	2.39
Total Foodgrains	269.95	266.74	268.66	255.50	202.48	223.67	248.00	241.06
Mustard	2.14	1.98	2.75	3.35	2.37	2.86	2.90	2.72
Total Oilseeds	2.17	1.98	2.75	3.35	2.37	2.86	2.90	2.72
Sugarcane	1959.71	2252.98	2341.94	2413.50	2558.11	2416.74	2856.98	3313.65
Potato	76.13	95.80	83.89	75.89	84.16	111.28	93.09	84.82
Source: http://updes.up.nic.in/spiderreports/intialisePage.action								

2.1.3.4 Variability assessment in the area, production, and yield

To understand the variability across the years (Table 9), we calculated the mean, standard deviation (SD), and coefficient of variation (COV) of the area, production, and yield of the main crops. Among different crops, the lowest variability in the area is observed in Rice (1.43%), followed by Sugarcane (3.04%) and wheat (3.21%), and the highest in Maize (27.49%). The variability in the area under total pulses (10.30%) is more than the variability in the area under total cereals (2.76%). Since Rice and wheat dominate the production, the variability in the area under total food grains is, therefore, also relatively low (2.81%).

Table 9: Variability in Area, Production, and Yield of Principal Crops (2010-11 to 2017-18)

	Area (1000 Ha)			Production (1000 Ha)			Yield (Qtl./Ha)		
Crop/Year	Average	SD	COV	Average	SD	COV	Average	SD	COV
Rice	20.82	0.30	1.43	59.11	4.62	7.82	28.40	2.27	8.00
Wheat	43.65	1.40	3.21	182.48	25.83	14.16	41.75	5.35	12.81
Maize	0.95	0.26	27.49	2.20	0.79	35.83	23.06	6.63	28.76
Total Cereal	65.80	1.82	2.76	245.12	23.77	9.70	37.22	3.09	8.29
Urad	0.85	0.18	21.14	0.54	0.17	31.67	6.51	1.91	29.32
Arhar	0.99	0.19	19.07	0.95	0.34	35.34	9.88	4.37	44.27
Total Pulses	2.38	0.25	10.30	1.88	0.52	27.59	7.94	2.40	30.21
Total Food Grains	68.18	1.92	2.81	247.01	23.96	9.70	36.20	2.94	8.12
Mustard	1.93	0.17	8.97	2.63	0.45	16.92	13.57	1.42	10.50
Total Oilseeds	1.94	0.17	8.83	2.64	0.44	16.77	13.57	1.42	10.48
Sugarcane	36.17	1.10	3.04	2514.20	411.19	16.35	694.37	106.68	15.36
Potato	3.43	0.19	5.51	88.13	11.70	13.27	257.37	32.16	12.49

Source: http://updes.up.nic.in/spiderreports/intialisePage.action

The variability of production depends on the variability of the cultivated area and the variability of the yield. Therefore, the variability in the production of different crops is greater than in the cultivated area of all crops. The highest variability in production is observed in Maize (35.83%), followed by Arhar (35.34%), Urad (31.67%), mustard (16.92%), and Sugarcane (16.35%). High variation in the production of pulses and oilseeds is partly due to variation in the land area under them and partly due to the high rate of seeds and non-availability of hybrid seeds. Improvement in crop insurance conditions and better market accessibility can lower this variation. Variability is lowest in Rice (7.82%), followed by Potato (13.27%) and wheat (14.16%).

In the case of yield, the greatest variability is estimated in Arhar (44.27%), Urad (29.32%), and Maize (28.76%). Yield variability in total cereals (8.29%) and total food grains (8.12%) is lower as compared to that in total pulses (30.12%). Rice, Mustard, and Potato are the most consistent crops over the years. Several factors, such as climate change, market prices, rainfall patterns, etc., influence the variability in agricultural production.

2.1.4 Trends in Value of production of major crops

Table 10 compares the share of the main crops in the total GCA and their share in the total value of agricultural output (VOP). It is significant to note that total cereals, total foodgrains, and total oilseeds, on average, have a relatively larger share in GCA than their share in VOP. In contrast, Potato and Sugarcane have, on average, a higher share in VOP than GCA. Foodgrains account for around 47.48% of the GCA and 35.46% of the total value of the agricultural output. Wheat, Rice, and Sugarcane together accounted for, on an average, around 70.09% of GCA and 91.56% of the total V.O.P. Overall, the total agricultural GCA has increased in the latter years of the study (average, 143.58 thousand hectares) and the total value of the product has also increased significantly, that is, Rs. 931.87 Cr. in 2010-11 to Rs.1716.37 Cr in 2017-18.

Table 10: Share of Principal crops Total GCA and Total Value of agriculture products in Hapur

Crop	% Share in	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Wheat	GCA	32.03	31.43	30.26	29.76	30.24	29.60	29.75	30.12
	VOP	26.50	22.06	24.11	24.39	14.97	19.14	21.08	18.67
Paddy	GCA	14.44	14.91	14.63	14.79	14.45	14.15	14.22	14.40
	VOP	9.26	9.27	9.48	13.06	17.63	15.91	13.00	12.62
Total Cereals	GCA	47.61	47.49	46.13	45.44	45.45	44.50	44.72	45.28
	VOP	36.62	31.76	34.06	37.83	32.92	35.25	34.58	31.68
Total Pulses	GCA	1.61	1.82	1.95	1.82	1.53	1.50	1.51	1.53
	VOP	0.94	0.91	1.04	1.12	1.17	0.93	1.92	0.95
Total Food Grains	GCA	49.21	49.31	48.07	47.26	46.98	46.00	46.23	46.81
	VOP	37.56	32.66	35.10	38.96	34.09	36.18	36.50	32.62
Total Oilseeds	GCA	1.20	1.16	1.50	1.51	1.37	1.34	1.35	1.36
	VOP	0.67	0.54	0.78	0.94	1.15	1.36	1.24	0.61
Potato	GCA	2.13	2.63	2.38	2.49	2.39	2.34	2.35	2.38
	VOP	3.94	4.34	4.57	3.98	6.88	10.48	7.77	5.76
Sugarcane	GCA	23.38	24.71	26.08	26.25	25.54	25.01	25.13	25.44
	VOP	57.83	62.45	59.55	56.11	57.87	51.97	54.48	61.01
Paddy + wheat + sugarcane	GCA	69.84	71.06	70.97	70.81	70.23	68.76	69.11	69.96
	VOP	93.59	93.78	93.14	93.56	90.47	87.03	88.57	92.30
Total Agriculture	GCA (1000 Ha)	144.78	143.56	143.69	141.06	142.42	145.46	144.73	142.96
	VOP (in Cr Rs)	931.87	1064.18	1160.15	1204.46	1370.22	1371.70	1546.95	1716.37

Source: http://updes.up.nic.in/spiderreports/intialisePage.action

2.1.5 Consumption of Chemical Fertilizers

Table 11 shows the trends in the use of chemical fertilizers in agriculture. The recommended nitrogen to phosphorus and potassium ratio is 4:2:1, which is not maintained in the district. For example, in 2010-11, nitrogen represented 72.84% of the total fertilizers used, while the proportions of phosphorus and potassium were 24.12% and 3.04%, respectively. In 2017-18, however, the nitrogen share increased to 75.09%, while the phosphorus share decreased to 21.08%, and the potassium share increased to 3.82%. The use of nitrogen is more than the recommended ratio, while the Phosphorous and potassium ratio is less than the recommended ratio. The table also shows that fertilizer consumption varies from year to year, which can be due to several factors, including rainfall patterns, cultivation patterns, etc. The overall use of chemical fertilizers has marginally decreased from 297.22 kg/ ha GCA in 2010-11 to 294.37 kg/ ha GCA in 2017-18. The government needs to take steps to reduce their consumption as the chemicalization of agriculture further degrades soils and water resources, requiring the use of organic fertilizers and biofertilizers.

Table 11: Trends in Use of Chemical Fertilizers in Agriculture (Kgs/per ha GSA.)

Fertilizer/Year	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Nitrogen	216.49	178.90	121.07	128.67	113.77	115.53	221.05
Phosphorous	71.69	61.62	32.19	37.51	42.71	45.97	62.07
Potassium	9.03	4.91	4.36	7.77	8.05	9.36	11.25
Total	297.22	245.44	157.61	173.95	164.53	170.85	294.37
Gross Sown Area (Ha)	143558	143694	141055	142416	145460	144730	142959

Source: http://updes.up.nic.in/spiderreports/intialisePage.action

2.1.6 Irrigation Structure and Status

2.1.6.1 Types of Irrigation systems

The types of irrigation systems and the percentage of the net and gross irrigated area to the net and gross cropped area, respectively, are described in Table 12. The length of the canal has remained constant (152 kms) over the years. Ground-level pump sets have also remained constant (8) over the years. Government tube wells increased from 137 in 2011-12 to 154 in 2018-19. Medium and deep tube wells increased by 179.16% and 800%, respectively, in 2018-19 compared to 2011-12. The district's percentage of the net and gross irrigated areas have increased over the years with an average of 99.99% and 99.72%, respectively.

Table 12: Types of Irrigation Systems and percentage of the net and gross Irrigated Area

Name/Year	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Length of Canal (KM.)	152	152	152	152	152	152	152	152

No. of Govt. Tube wells	137	129	130	130	135	133	154	154
No. of Ground-level Pump sets	8	8	8	8	8	8	8	8
Medium Tube wells	48	110	133	153	167	190	126	134
Deep Tube wells	1	1	3	3	6	6	9	9
% Of NIA	99.99	99.97	99.99	100.00	100.00	100.00	100.00	-
% Of GIA	100.00	99.98	99.99	100.00	98.10	100.00	100.00	-
Source: http://updes.up.nic.in/spiderreports/intialisePage.action								

2.1.6.2 Source wise area under irrigation

Canals and groundwater (GW) are the main irrigation sources in the district. The canal's share in the NIA (average, 8.45%) has increased over the years, and the share of wells and tube wells in NIA (average, 91.55%) has decreased slightly over the years. It shows the increased dependency of the district on the groundwater for irrigation purposes, and it can have serious environmental issues if such a pattern continues in the long run.

Table 13: Source-wise Area under Irrigation in Hapur (in %)

Source/Year	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Canal (surface Irri.)	7.24	12.02	10.02	9.22	6.36	6.44	7.88
Wells And Tube-wells (GW Irri.)	92.76	87.98	89.98	90.78	93.64	93.56	92.12
NIA (1000 ha)	87.03	86.97	86.99	86.89	86.88	87.01	87.51
Source: http://updes.up.nic.in/spiderreports/intialisePage.action							

2.1.6.3 Crop wise irrigated area

Table 14 shows that a majority area under Rice (average, 100%), wheat (average, 100%), pulses (average, 100%), oilseeds (average, 100%), Potato (average, 100%), and Sugarcane (average, 100%) is irrigated.

Table 14: Trends in Crop-wise Irrigated Area in Hapur (as % of the cropped area)

Crop/Year	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Rice	100	100	100	100	100	100	100	100
Wheat	100	100	100	100	100	100	100	100
Total Cereal	100	100	100	100	100	100	100	100

Total Pulses	100	100	100	100	100	100	100	100
Total Foodgrains	100	100	100	100	100	100	100	100
Total Oilseeds	100	100	100	100	100	100	100	100
Sugarcane	100	100	100	100	100	100	100	100
Potato	100	100	100	100	100	100	100	100
Source: http://updes.up.nic.in/spiderreports/intialisePage.action								

2.1.7 Electricity Consumption in Agriculture

Electricity is one of the main energy sources used in agriculture. Table 15 shows that per capita electricity consumption in agriculture has increased significantly from 473.22 KWH in 2016-17 to 809.03 KWH in 2019-20, a net increase of approximately 70.96%. It is a cause of concern that results in an increased burden on non-renewable resources and creates waste disposal problems. The percentage share of the agriculture sector (average, 25.81%) in the total electricity consumption in the district is quite significant. It indicates the heavy usage of electricity by agricultural farmers. Since electricity consumption has increased over the years, the authorities need to switch to more sustainable modes of electricity production, such as solar energy.

Table 15: Trends of Electricity consumption in Agriculture

Division/ Year	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Per Capita electricity consumption (KWH.)	-	-	473.22	921.14	854.9	809.03
% Of electricity consumed in Agriculture sector to total consumption	25.83	24.83	27.95	21.74	26.77	27.73
Source: District-wise Development Indicators file.						

2.1.8 Status of Agriculture Market

Table 16 shows the marketing infrastructure in the district. It has one main market and two sub-markets. The number of regulated mandis per lakh hectare of NSA has decreased from 3.45 in 2013-14 to 1.15 in 2017-18, which is a cause of concern as it is very important to increase the number of regulated mandis so that farmers are able to sell their products efficiently.

Table 16: Status of Agriculture Markets in Hapur

Category/Year	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Main Markets (No.)	1	1	1	1	1	1	1
Submarkets (No.)	2	2	2	2	2	2	2
Total Markets (No.)	3	3	3	3	3	3	3

No. of Regulated mandis per lakh Ha. of net area sown	3.45	2.63	-	1.15	1.15	3.45	-
Source: District-wise Development Indicators file.							

2.1.9 Status of Organic Farming

To promote sustainable agricultural practices and improve the farmers' livelihood, the Government of India launched PKVY and Namami Gange schemes. Under these schemes, farmers are incentivized to form groups to do organic farming and sell their products with PGS certification. Under the programme, the beneficiary farmers get Rs.12000, Rs. 10000, and Rs.9000 per hectare, respectively, in the first, second and third years of the conversion period.

The transition period for the full conversion from conventional to organic is considered three years. During this period, crop yield, on average, is expected to decline by 10—15 percent. However, after three years, it may reach its original level. Financial assistance received by the beneficiary farmers seems to be adequate to compensate for the yield losses and motivate them to do organic farming. There is a need to set up an integrated processing unit for organic products. Monitoring of the project should be periodically done through M.I.S., Geo-tagging, and monthly physical and financial reports.

However, the policy-related issue is what would be after the three years? Will the government protect their income? There may be a possibility that the beneficiary farmers may revert to conventional farming in the absence of the regulatory framework. In this context, two things need to be thought of—a well-designed regulatory and monitoring framework and introduction of payments for ecosystem services for the organic farmers after the transition period to carry on the activity on a sustainable basis. Organic and zero-budget farming will provide ecological services in terms of soil health, human and animal health, saving of water, protection bio-diversity, etc. A long-term system of payments for ecological services may be evolved to retain the existing farmers and motivate others to move towards this sustainable farming system to sustain the organic farming initiative. There is no assured market for these products, and farmers do not get premium prices. They sell their products at the same prices their conventional counterparts do. Certification and quality check and monitoring mechanisms are yet to be set up.

Table 17 shows the details of the establishment of organic clusters under the Paramparagat Krishi Vikas Yojana in the district. The district has 50 groups in Garh Mukteshwar development block only. Significantly high variation can be seen in the number of farmers per group in the district. It is reported that the maximum limit of land under a cluster per farmer is 2.00 hectares. Hence, the majority of the beneficiary farmers are small and marginal. No organic cluster under the Namami Gange scheme is reported till date.

Table 17: Status of Organic Farming PGS Groups under PKVY and Namami Gange Schemes in Hapur (as on June 30, 2021)

S. No.	Block	Scheme	No. of groups	No. of farmers in groups			
				Total	Average	Median	SD
1	Garh Mukteshwar	PKVY	50	1811	36.22	34	9.06
2	District Total (Hapur)	PKVY	50	1811	36.22	34	9.06
		Total	50	1811	36.22	34	9.06

Source: https://pgsindia-ncof.gov.in/LGList.aspx

Since per hectare use of chemical fertilizer is quite high in district agriculture, a gradual shift of farmers from conventional to the organic farming system is likely to positively impact water quality and soil health along with farming sustainability. However, being a knowledge-intensive farming system, farmers need proper training to know the practical details of the integrated sustainable farming system. Since economies of scale in both production and marketing matter in organic farming, some institutional framework may be needed in the forms of SHGs/ farm cooperative/P.F.O.s/contract farming, etc. Organic farming could be an economically viable option in the district if the government builds strong marketing networks linking farmers, processors, and distributors with the easy certification process and minimizes farmers' risk by protecting their farm income through payments of ecosystem services. A long-term system of incentive and regulation needs to be evolved to retain the existing farmers and motivate others to move towards the sustainable farming system in the district.

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

1. The major problem of the farmers was poor marketing of the organic products and not being able to fetch a premium.
2. Scaling up the organic production is another problem. The problem of marketing is even more serious in the case of perishable vegetable crops. Contract farming companies and Farmer Producers' companies can be encouraged.
3. To get the scheme's benefit, farmers generally practice organic farming only on a small part of their land (less than one ha).
4. Although organic farming clusters are formed, the farmers allocated a part of their lands to organic farming and practiced conventional farming in the rest of the area, which may contaminate the organic produce and fail the purpose of the cluster approach in organic farming.
5. According to the farmers, implementing policies initiated to promote organic farming in the area is not very efficient as the inspection is not conducted regularly, and the farmers did not receive subsidies in time under the scheme.
6. The knowledge and awareness level regarding practices under organic farming was inadequate among farmers.

2.1.10 Livestock Sector

2.1.10.1 Trends in Livestock Population

Livestock forms an integrated part of the rural economy. From Table 18, we can infer that indigenous male and female cattle decreased considerably from 48587 in 1997 to 3991 in 2019 and from 60739 in 1997 to 28673 in 2019, respectively. The number of exotic male cattle also decreased from 9170 in 1997 to 6818 in 2019, but the number of exotic female cattle increased considerably from 20060 in 1997 to 62633 in 2019. Thus, the total number of cattle decreased only slightly from 138556 in 1997 to 102115 in 2019, thus, a net decrease of 26.30%. Similarly, the number of male and female buffaloes decreased over the years; thus, a net decrease of 69.28% in 2019 compared to that in 1997 is observed in the total population of buffalo. A significant increase in the indigenous sheep population is observed (151.78%) in 2019 compared to that in 1997. During the same period, the population of exotic sheep also increased, thus, indicating an increase in the total sheep population by 153.21%. The total population of goats decreased from 92838 in 1997 to 30690 in 2019, a net decrease of 66.94%. The total pig population decreased considerably from 57896 in 1997 to 4686 in 2019.

Table 18: Trends in Livestock population (in numbers) in Hapur

	Category	1997	2007	2012	2019
Indigenous Cattle	Total Male	48587	11155	5065	3991
	Total Female	60739	15826	11544	28673
	Total	109326	26981	16609	32664
Exotic Cattle	Total Male	9170	9818	14836	6818
	Total Female	20060	17808	41541	62633
	Total	29230	27626	56377	69451
Total Cattle		138556	54607	72986	102115
Buffalo	Total Male	258661	93840	83888	43549
	Total Female	544721	277902	213111	203237
	Total	803382	371742	296999	246786
Sheep	Total Indigenous Sheep	4940	591	1082	12438
	Total Exotic Sheep	0	98	253	71
	Total Sheep	4940	689	1335	12509
Goat	Total	92838	40714	37523	30690
Pig	Total Indigenous Pig	51264	2918	3788	3903
	Total Exotic Pig	6632	993	884	783
	Total Pig	57896	3911	4672	4686
Total Livestock		1136256	473409	416312	-
Total Poultry		272150	22971	38606	-

Source: http://updes.up.nic.in/spiderreports/intialisePage.action
And http://dahd.nic.in/animal-husbandry-statistics

2.1.10.2 Cattle Care Centre

Table 19 shows that the Hapur district has an active network of cattle hospitals and development centres which are very necessary for the livestock sub-sector to grow. The number of cattle hospitals (17) has remained constant over the years. The number of cattle development centres has decreased slightly from 31 in 2010-11 to 28 in 2018-19. The number of man-made reproduction centres increased from 19 in 2010-11 to 49 in 2018-19. There are very few sheep and pig development centres which might be one reason for the declining sheep and pig population in the district.

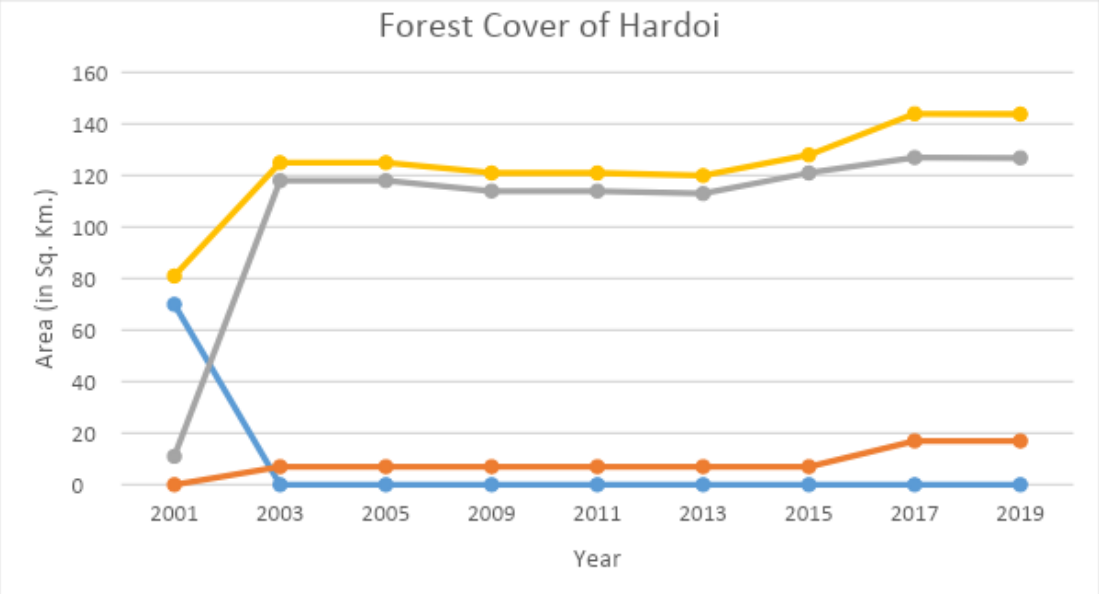
Table 19: Year-wise number of Cattle Hospitals and Development Centers

Category	2010 -11	2011 -12	2012 -13	2013 -14	2014 -15	2015 -16	2016 -17	2017 -18	2018 -19
Cattle Hospital	17	17	17	17	17	17	17	17	17
D- category Cattle Dispensary	4	4	4	4	4	4	4	4	4
Cattle Development Centre	31	31	31	32	28	29	29	28	28
Man-Made Reproduction Centre	19	19	19	17	49	54	54	49	49
Cattle Reproduction Center	1	1	1	1	1	1	1	1	1

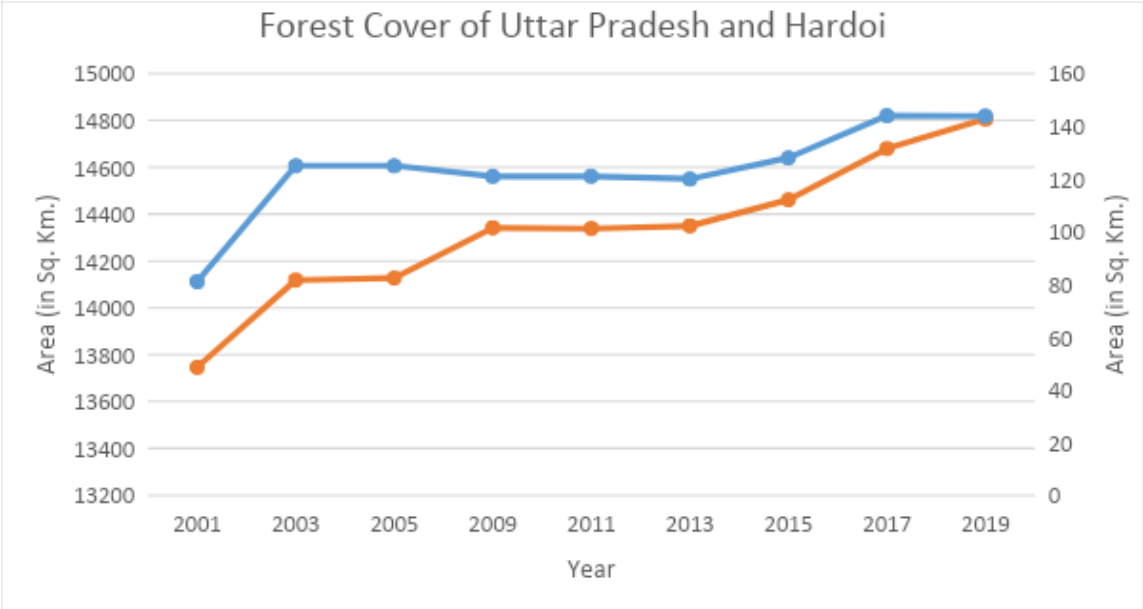
Source: http://updes.up.nic.in/spiderreports/intialisePage.action

2.2 FORESTRY

1. **Baseline Data Analysis/ Quantitative Data Analysis**



According to FSI, the forest cover of Hardoi has increased from 2001, and then it slightly decreased from 2005 to 2013, and it again slightly increased from 2013. Majorly open forest are found in the district followed by medium dense forest.



Uttar Pradesh has shown increasing trend for forest cover from 2001-2019, similarly, Hardoi's forest cover but at a lower pace.

2.2.1 Biodiversity

The district's biodiversity data includes various crop production, livestock population, bird species, and forest cover. The crop production trend shows a reduction in the non-grain crop but increases in all other crops. Forest data shows that forest cover was decreased by 0.15% in 2019. There are 362 bird species and 5 rare species of bird in the district.

Table 1 Bird species recorded in the district.

Number of species	362
Number of rare/accidental species	5

Table 2 Forest cover in square kilometer.

Geographical area	**Very dense forest**	**Mid dense forest**	**Open forest**	**Total**	**% of Geographical area `**	**Change with respect to 2017 assessment**	**Scrub**
5986	0	16.980	126.87	143.85	2.40	-0.15	5.00

Table 3 Biodiversity in Sandi bird sanctuary, Hardoi District.

District	No. of flora species	No. of fauna species	No. of bird
Hardoi	98	209	190
Source: https://rsis.ramsar.org/ris/2409			

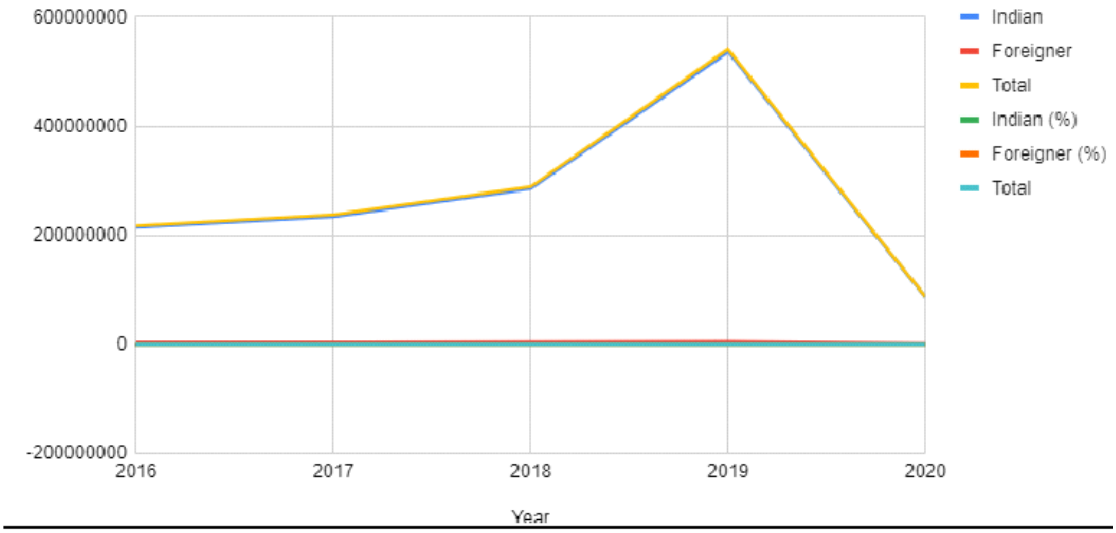
2.3 TOURISM

Baseline data/Quantitative Data
Total number of tourists visiting Ghazipur -(2015-2019)

Domestic and foreign visitors in different years in Uttar Pradesh

The Indian and Foreign Tourist visits in Uttar Pradesh from 2016 to 2020						
				Percentage increase/ reduce in comparison to previous year		
Year	Indian	Foreigner	Total	Indian (%)	Foreigner (%)	Total
2016	213544204	3156812	216701016	3.4	1.69	3.37
2017	233977619	3556204	237533823	9.56	12.65	9.61
2018	285079848	3780752	288860600	21.84	6.31	21.6
2019	535855162	4745181	540600343	87.96	25.5	87.14
2020	86122293	890931	87013224	-83.92	81.92	-83.9

Source: Dept. of Tourism, Uttar Pradesh Government



2.4 WETLANDS

The district is known for the huge number of wetlands, some of them renowned ones. The district consists of lakes and sanctuaries like the Sandi Bird Sanctuary - 353.84 Ha, Baruan Lake - 231.18 Ha, Loni Nala - 66.15 Ha. Table 2 represent the number of wetlands and their area representation in the district. Around 1083 wetlands are sized greater than 2.25 Ha and 2993 less than 2.25 Ha areas. The region consists of small and medium-size wetlands only, generally less than 200 Ha in the area and there is around 8 wetland with a size for than 200 Ha.

Table 2: Wetland Data of Hardoi 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	293	301	8	0	27	42	73	102	46	3	0	0	243
Ox-bow lakes/cut off meanders	70	76	6	0	8	17	8	23	11	3	0	0	42
High altitude Wetlands	0	0	0	0	0	0	0	0	0	0	0	0	0
Riverine Wetlands	62	87	25	0	5	11	8	20	16	2	0	0	24
Waterlogged	144	149	5	0	21	46	32	28	17	0	0	0	90
River/Stream	0	157	157	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	1	1	0	0	0	0	0	0	0	0	0	0
Tanks/ponds	201	201	0	0	84	63	47	7	0	0	0	0	143
Waterlogged	104	111	7	0	17	26	34	22	5	0	0	0	45
Salt pans	0	0	0	0	0	0	0	0	0	0	0	0	0
Total (4076)	**874**	**1083**	**209**	**2993**	**162**	**205**	**202**	**202**	**95**	**8**	**0**	**0**	**587**

Source: (National River Conservation Directorate, 2008), (Space Application Centre-ISRO, 2007)

- The district comprises 4076 wetlands; most are waterlogged and lake/ponds/tanks.
- The wetland size is small and medium-sized in general.
- The number of natural wetlands is more than man-made.
- Many wetlands (man-made and natural) are waterlogged one's or pond type
- Many wetlands have aquatic vegetation.

2.5 ENERGY

2.5.1. Solar

The Uttar Pradesh New and Renewable Energy Development Agency (UPNEDA) is the nodal agency which looks after the growth and expansion of renewable energy in the state. UPNEDA takes efforts to develop the capacity in renewable energy sources such as solar energy, small-scale hydro-electricity and biomass-based electricity production in the state.

According to the 2011 census, kerosene was the main source of lightning used by 84.79% households, followed by 13.48% using electricity and only, 1.15% using solar (Fig. 1).

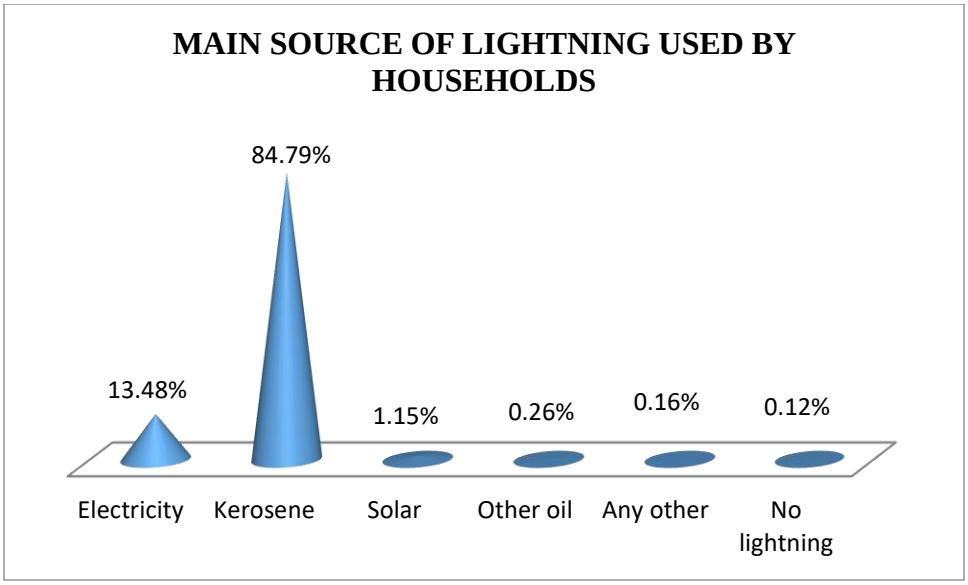


Fig. 1

The district has not witnessed many solar energy units installations, as not much can be noted from the available sources.

2.5.2. Biomass

The Uttar Pradesh New and Renewable Energy Development Agency (UPNEDA) is the nodal agency which looks after the growth and expansion of renewable energy in the state. UPNEDA takes efforts to develop the capacity in renewable energy sources such as solar energy, small-scale hydro-electricity and biomass-based electricity production in the state.

According to the 2011 census, 52% households use firewood for cooking followed by 32% of them using cow dung cake, 8 % crop residue and 8 % LPG/PNG (Fig. 1)

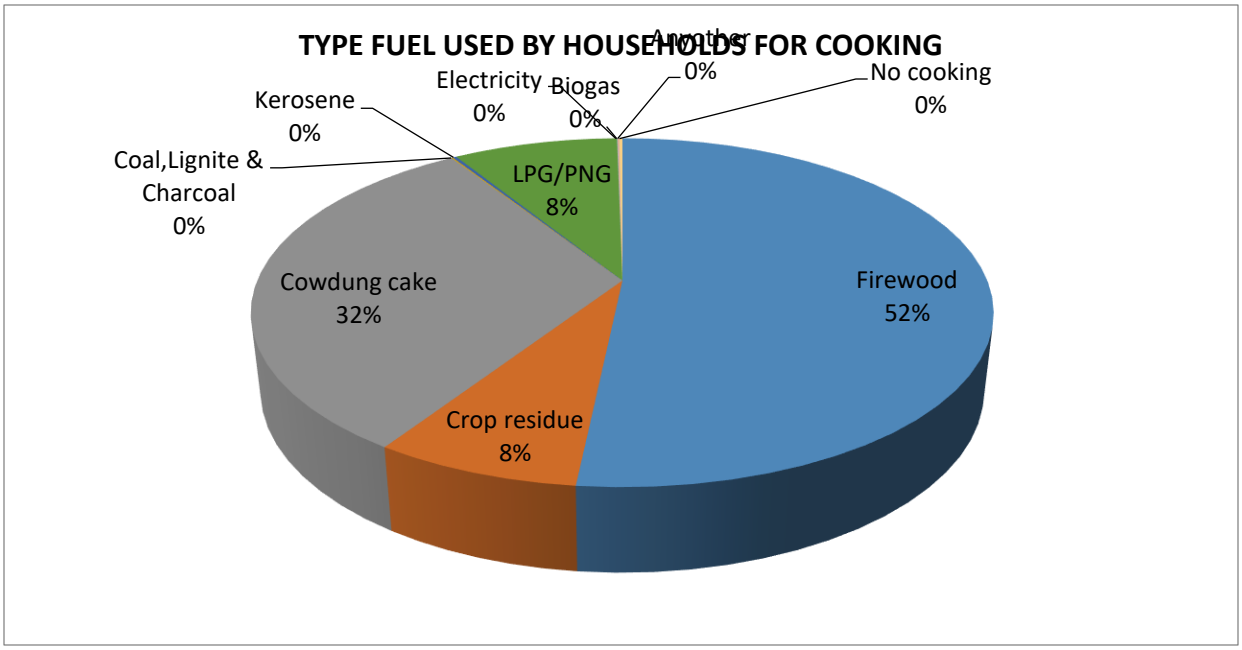


Fig. 1

Majority of population in Dehradun is mainly dependent on agriculture as their primary occupation. Rice, wheat, sugarcane maize, etc. are some of the major crops and enterprises engaged in agriculture.

The net sown area of the district is 433300 ha with the cropping intensity of 130%. The district has a 12300 ha of forest land. A total of 11200 ha of cultivable wasteland is there in the district, with 39100 ha of current fallows.

Table.1 gives an account of productivity of some of the major crops in the district. The productivity of the crops appears to be good consequently a good amount of crop residue would be produced.

CROP	PRODUCTIVITY (kg/ha)
Rice	2122
Wheat	3233
Maize	1384
Masoor	940
Rapeseed Mustard	970
Sugarcane	51012

Table 1

The district has two industrial waste based biomass plants by the name Baghauli Distillery and Saif Yeast Bakers, of 2 MW each. The district produces 1730.9 kT/yr of agricultural biomass and 16.2 kT/yr forest based biomass.

2.5.3. Biogas

One anaerobic digestion plant exists in the district of 0.73 MW eq. as per the data. Biogas potential from animal waste is calculated as three crores m^3/year and eighty-three crores m^3/year. This amount of biogas generation can efficiently complete the energy demand of the district.

Food industry waste-based bio-methanation project by M/s Saf Yeast Co. Pvt. Ltd., 101, UPSIDC, Industrial Area, Sandila, Distt. Hardoi, U.P.	0.73 MW eq. (8820 m3 biogas/day)	2006-07
https://www.globalmethane.org/expo-docs/india10/postexpo/ag_kishore.pdf		

2.5.4. Hydro Power

Two sites have been identified/investigated for a small hydro project by NEDA of 0.35 MW and 1.018 MW capacity. UPNEDA investigated one project in the Hardoi district of 1200 kW capacity whose phase two pre-feasibility report has been completed.

Table 4 Project investigated by UPNEDA.

Phase 2: Pre-feasibility report completed		
Name of project	District	Capacity
Hardoi canal	Hardoi	1200 kW

Table 5 identified/investigated the site of the small hydro project by NEDA.

Name of project	**District**	**River/canal**	**Chanage/location**	**Discharge (cumecs)**	**Head (m)**	**Capacity (kW)**
Hardoican	Hardoi	Hardoi canal	16-4-0 mile	113.80	1.37	1018.00
Hardoican	Hardoi	Hardoi canal	21-5-0	40.00	1.25	350.00

3 QUALITATIVE DATA ANALYSIS

3.1 FORESTRY

The use of timber in house construction, furniture and agricultural implements etc. is around 61.38 million cum. By using alternatives we can reduce this which in turn will result in reduction in tree felling. In the context of State of Uttar Pradesh 10.495 million people are using fuel wood from forests. Taking an average family size of 5 persons per family it can be concluded that 2.1 million families are directly dependent on forests for fuel wood. By giving them alternative sources of energy it will be possible to reduce Carbon dioxide to the tune of 2.1 million tonnes annually.

To increase forest resources in the country, Ministry of Environment, Forest and Climate Change is implementing a number of Schemes under which financial assistance is provided to State/UT

Governments. Some of major schemes of the Ministry are National Afforestation Programme (NAP) and Green India Mission (GIM), Integrated Development of Wildlife Habitat (IDWH), Intensification of Forest Management Scheme (IFMS), Project Tiger and Project Elephant including funds under Compensatory Afforestation Fund Management and Planning Authority (CAMPA).

3.1.1. Biodiversity

Sandi bird sanctuary was established in 1990 to safeguard and conserve the natural environment, surrounding coastal vegetation for migrating birds, and the region's residents. The sanctuary lies nineteen kilometers away on the Hardoi-Sandi Road in Sandi, Uttar Pradesh's Hardoi district. The lake has a total size of 309 hectares (3.09 km^2). The River Garra, historically known as the Garun Ganga, runs close to the sanctuary.

3.2. ENERGY:

As per the data of the year 2013, Hardoi district energy consumption is around 699 TJ/year and 3.5 GJ/capita/year. GHG emission of 48,446 Ton CO_2 equivalent and 0.246 Ton CO_2 equivalent/capita has been evaluated for the district.

3.2.1. Solar

The district Hardoi has a good solar potential and if efforts in the right direction are made then the district can develop its economy and livelihood in a sustainable manner. A recent news article in a local daily, with the heading ‘24 kW solar power plant to be set up at CHC’ mentions - To deal with the power crisis, a 24-kilowatt solar plant will be installed by HCL Foundation at the Community Health Center (CHC) located in the town. On Thursday, the officers and employees of the Foundation inspected the CHC building and marked the place. In rural areas, power supply is affected due to one reason or the other. In such a situation, doctors, employees of CHC have to face a lot of problems due to non-availability of supplies. There is also difficulty in treatment. Till now, in case of no power supply, health services are maintained by running generators in CHCs, but soon it will get rid of it.
The district needs to increase its installation of solar energy plants and needs to plan for the betterment of the farmers in the district.

3.2.2. Biomass

The economy of the district Hardoi mainly depends on agriculture and hence produces biomass in form of agricultural waste in large amounts. Although the district has done some progress in the biomass energy production field but needs to work more upon it. The district also deals with the problem of stubble burning which can be proved from many of the news articles regarding this problem in the district. Such as an article with the heading ‘UP: Burning of stubble in Hardei cost the farmers, a fine of Rs 65 thousand on 16’ which reads Burning of stubble in the fields in Shahabad of Hardoi has become a cause of trouble for 16 farmers. A fine of Rs 65 thousand has been issued to the concerned farmers by issuing notices. There are orders from the government level to take strict action against the farmers who burn stubble in the fields. The intention is to save the general public from pollution and to keep the environment pure.

The district also has seen establishment of biomass plants in the district, such as mentioned in the news article of a national daily, with the heading, 'DCM Shriram gets green nod for Rs 188 crore UP distillery plant' reads- Diversified business conglomerate has received green nod to set up a molasses-based distillery, along with a cogeneration power plant, in Hardoi district of Uttar Pradesh at a cost of Rs 188 crore. The proposal is to set up 200 kilolitres per day (klpd) molasses-based distillery and 6 mw co-generation power plant at Hariawan village.

3.2.3 Biogas:

Food industry waste-based bio-methanation project is present in the district. The district has a high potential to generate biogas from agricultural, animal, and human waste.

3.2.4. Hydropower:

The National level program runs in the district for hydropower generation, such as the small hydropower project program. The implementation of small hydropower in the State is carried out by Uttar Pradesh New and Renewable Energy Development Agency. Two small hydropower sites have been identified in the district, and a pre-feasibility report of one site has been prepared.

3.3 TOURISM

Best Time to Visit-

October- November and February- March

How to reach

1. New Delhi(Capital of India):394 km by railway track & road
2. Lucknow (Capital of Uttar Pardesh):102 km by railway track & 110 by road
3. Kanpur:140 Km by road
4. Bareilly:142 km by road
5. Unnao: 110 km by road
6. Sitapur:72 km by road

Places of interest

- **Historical tourism**

- **BAWAN-PURI,HARDOI**

Nakatiya Devi temple is situated near the pond named Suraj kund which is to the east of Bawan village. There are many broken statues under the Peepal tree in front of this temple. This temple is quite ancient.

It is a legend that due to the attack of the weapon the idol of Kusumbi Devi was broken, since then it is known as Nakatiya Devi. Residents of Bawan and nearby villages offer prayers in this temple before performing any favourable work.

•Cultural tourism-

Saravan Devi Temple

Shravan Devi Temple is located in Uttar Pradesh's Hardoi district headquarters. This temple is considere d to be one of the Goddess's Shaktipeeths. The Karna portion of Mata Sati is said to have fallen at this lo cation, hence the temple's name, 'Shravan Devi Mandir.'

- **Ecotourism**

Sandi Bird Sanctuary

Sandi Bird Sanctuary is a sanctuary for birds.Sandi Bird Sanctuary is 20 kilometres from Hardoi on Har doi Road. Sandi road is 110 kilometres and 390 kilometres from Lucknow and Delhi, respectively. The Lucknow-
Delhi Rail Route connects it to the rest of the world. Sandi Bird Sanctuary, with an area of 3.09 hectares, is located in Hardoi district on the Hardoi-
Sandi Road, adjacent to the Deher Jheal and the Garra river. The Bombay Natural History Society has d esignated this sanctuary as a "important bird location." Sandi Wildlife Sanctuary was established in 199 1 on the Sandi Welands. It covers 309 hectares and is located on the Hardoi-
Sandi road, roughly 20 kilometres from Hardoi Tower.In everyday usage, it is referred to as "Deher Jhee l." The 'Garra' river (formerly known as the 'Garunganga' river) flows adjacent to the Sandi Bird Sanctua ry. he Sanctuary's mission is to safeguard and conserve the wetland, with a focus on local and migratory birds, as well as their natural habitat, which includes aquatic plants and animals. The Ministry of Enviro nment and Forests, Government of India, has classified this wetland as part of the National Wetland Con servation Program.

Heritage tourism

Victoria Hall Hardoi

District Hardoi was established between 1850 and 1863 under the supervision of District Magistrate W. S. Chapper. During the 1857 freedom struggle, there was a major battle between the East India Compan y's soldiers and the freedom fighters from Madhoganj and Hardoi's Ruiya. The job of forming districts w as put on hold for a while, but it was eventually completed by the time the Victoria Charter came into eff ect in 1877. After the British Parliament abolished the Company's sovereignty in India, Queen Victoria was given the title of 'Kaiser-e-
Hind' by the British Parliament. The Queen issued an universal amnesty to the 1857 revolutionaries.On t

he occasion of Queen Victoria's enthronement on February 16, 1886, District Magistrate Lieutinent Colo nel HarnsFort convened a conference with local inhabitants who had been involved with the 'Company' i n the 1857 battle and devised a proposal to erect a 'Ghantaghar' (Clock-
tower) as a memorial. Following the erection of the clock tower, a massive clock from the United Kingd om was mounted on top of the tower, which only worked until 1959-
60. Its beautiful alert and sound of 'bells' could be heard up to five miles away till then, which speaks vol umes about the historic occasion.To the east of Bawan village is a pond named Suraj Kund and near that pond is Nakatiya Devi temple. In front of this temple there is a Peepal tree under which there are many broken statues . This temple is quite ancient. It is a legend that the idol of Kusumbi Devi was broken due to the attack of the weapon, since then it is known as Nakatiya Devi. Residents of Bawan and nearby villages offer prayers in this temple before performing any auspicious work.

- **Cultural tourism-**

Saravan Devi Temple

Shravan Devi Temple is located in the headquarters of Hardoi district in Uttar Pradesh. This temple is considered to be one of the Shaktipeeths of the Goddess. It is believed that the Karna part of Mata Sati had fallen at this place, hence the name of the temple was 'Shravan Devi Mandir'.

- **RAJA NARPATI SINGH SMARAK,RUIYAGARHI, MADHOGANJ HARDOI**

Around two kilometres on the northside of Madhoganj town is the small village of Ruia Garhi. It is famous for King Narpat Singh- a great freedom fighter. After capturing the majority of Avadh, the British attempted to invade Hardoi, but were thwarted due to Raja Narpat Singh's steadfast bravery and strategy. During the fifth war, the British attacked with a large army and cannons. Even in this adverse circumstance, Narapati Singh's troops dealt the British with a stern response. However, at this point, the British began to uproot his armies with their sheer numbers and canons, and the king was martyred.

Dhobiya Ashram

A Hindu ashram situated in Dhobiya, Pihani, Hardoi. Pihani Town is roughly a seven-kilometer drive west from here. Around Naimishanaya, 84 thousand Vaishnavas are said to have performed penance, and this Ashram sits on the boundaries. To the north-eastern side of the ashram, a natural water source acts as a unique attraction for visitors. The Gomti River, which flows alongside the Dhobia Ashram and is only a short distance away, adds to the picturesque setting.

Nawab Diler Khan's Tomb in Shahabad

Shahabad is a city and a municipal board in Uttar Pradesh's Hardoi district. It was once one of Oudh's few large cities, but it quickly declined in later times, and it is now reduced to a town. Shahabad, is an iconic town abound in historical monuments. It was built in 1680 A.D. for Nawab Diler Khan, an

Afghan officer despatched by Shah Jahan to put down an insurgency in Shahjahanpur. He was the same man who overthrew the Pande Parwar bandits of Angni Khera. Joseph Tiefenthaler, one of the first European geographers to write on India, visited the town in 1770 and described it as " a town of significant circumference, with a palace of bricks in the midst, strengthened by fortress-like towers, with a vestibule and a covered colonnade."

- **SHRI BABA MANDIR, HARDOI**

Hardoi Baba Temple is about 400 years old. This historic temple is situated just a short distance from Prahalad Ghat at the centre of the city. It was renovated around 1949, in the courtyard of which there is a peepal tree known as '*Hardoi baba ka darbaar*'. There is Ram Navmi mela (fete) during Chaitr month of Hindu calendar, approximately 24 days after Holi (probably in March).

- **HATYA HARAN TEERTH, HARDOI**

About 150 km from Lucknow,the capital of Uttar Pradesh, Hatya Haran Teerth is located in the holy Namisharnya Parikrama area in the Sandila tehsil of Hardoi district. Thousands of years ago, when Lord Rama had killed Ravana, he was blamed for Brahma Hatya.In order to erase that Sin, Lord Rama also came to the bath in this lake.Since then, people have been able to get rid of murder, cow slaughter and other sins by coming here on this holy pilgrimage here.

- **PRAHLAAD KUND,HARDOI**

In the Past, Hardoi was the city of Hiranyakashyap and He was a traitor of Hari(God), so he named the City as Haridrohi. His son Prahlad was a devotee of Lord Hari and in order to kill him, Hiranyakasip had set up his sister Holika in the fire. Holika was a boon that she would not burn by fire. Holika and Prahlad sat down in Agni Kund. In which Holika was consumed in the fire and the devotee Prahlad was saved by Lord Vishnu.

- **SANKAT HARAN MANDIR SAKAHA, HARDOI**

Lord Shiv devotees across the country have faith towards the ancient Shiv Temple located about 20 km from the district headquarters. This Temple located in Sakha village is known as "Shiva Sankat Haran Temple Sakaha". There is an atmosphere of fare here throughout the month of Sawan. A large gathering of Kanwariyas and Shiva devotees takes place here. It is believed that here the sufferings of the devotees of Lord Shiva go away, hence the name of Shivalaya is Shiva Sankat Haran.

Nearby places-

Rauza Sadar Jahan, Pihani, Uttar Pradesh – 27km

The Mughal era Jama Masjid of the town 'Damaske Awadh' boasts of five hundred years old history of Pihani. This mosque, built during the time of Humayun, is considered to be the main shrine of Sunni Muslims here. The beautiful building of the mosque is a mirror of the mastery of the artisans of the old times.The Jama Masjid, adjacent to the Rauz of Mufti Sadar Jahan, located in Katra Bazar, was built during the period of Sadar Jahan itself. Mufti Sadar Jahan used to be the Chief Justice in Humayun's court. In 1540 AD, when Humayun was defeated in the battle between Sher Shah Suri and Humayun, Sadar Jahan took shelter in the forests of this area. After this, after Humayun's throne again, this place was given the form of a jagir to Sadar Jahan. Then he settled the settlement here and built this mosque here. The magnificent and dated building of the mosque is still a center of faith among Muslims of the entire area

Handloom-

Hardoi is noted for its fabric weaving and production of items such as loincloths, gamcha, shirts, and more. Every year, weavers in the Mallawan region produce goods worth 70 crores. Weavers make up about 5,000 people employed in this industry. Since a long time, artisans-based in Hardoi are actively involved in Zari and Zardozi cluster has been in this area, and many artisans have successfully engaged in this job.

Data Analysis-

There was no major percentage change in Indian tourists coming to Hardoi between 2015- 2016. There was slight increase of 1% in 2017 and a massive increase in the year 2018. In 2019, there was a decline of 2% among the Indian tourists.

While total number of foreign tourists visiting Hardoi was relatively low, in fact the number is less than 100 in all these 5 years.

SWOT analysis-

Strength	Weakness	Opportunities	Threat
● Hardoi has plethora of tourist spots of cultural, religious, heritage importance. ● Sandi Bird Sanctuary is a	● Poor maintained properties diminishing the existing beauty of Hardoi. ● Lack of proper hotels/ resorts or	● Sandi Bird Santuary can be promoted for Ecotourism and can be targeted to not only nature or	● As UP government changes a lot rules/ policies tend to get manipulated.

destination for migratory birds halt here every year.	electricity is one major concern along with under developed roads.	adventure enthusiasts but also science science students. ● Local handlooms should be produced on a large scale and then sold to right target audience. ● Tourism melas/ fete can be organised.	● With more and more tourists coming in, maintaining the natural look of Hardoi will be hampered. ● Waste management is another threat if not taken care of.

3.4. WELANDS:

The wetlands are the source of many ecosystems and habitats for various species. The wetlands create a unique ecosystem that supports many species simultaneously like aquatic, terrestrial, and human beings. The district has many potential sources and opportunities to harness valuable products using the scheme and start the pilot project. Local stakeholders directly or indirectly depend on the wetland for their income and small-scale business. These businesses can be a great opportunity can be turned into a large-scale production hub using the right approach. The region has a good amount of production of maize and rice. The region is known for its large kund, medicinal plants and sugar agriculture. The data collected and analyzed shows the region's production and possible product derived from the raw product. The list of sources and the possible products are mentioned below:

- Medicinal plants, flowers and fruits like mango and guava production are recommended as commercial crops in the region, leading to ayurvedic medicine, jam, and juices.
- Production of sugarcane is reasonably high, which can turn into the products like sugar and other products.
- The district stats show a good amount of finger millet, pearl millet, bajara in the region, which can be promoted.
- Also, this region is a belt of large varieties of oil production in the region like mustard, linseed, castor seeds which can turn into a valuable market for oil production in the region.
- The district is famous for its kund or man-made ponds.
- The region has a large production of dairy products, leading to an increase in animal husbandry. Wetlands can support the growth of fodder for the animals in the region.

4 ACTION PLAN DEVELOPMENT

4.1 FORESTRY

In July 2019, government of Uttar Pradesh taken the initiative to plant 22 crore saplings. The Forest Department involved the farmers as stakeholders to plant seedlings in their fields. Farmers are expected to sow quality planting material such as clonal plants, which are not available in the UP forest department nurseries. There is also the need to have minimum support price (MSP) for the timber produced by farmers with buy-back arrangement. This in turn will motivate them to plant more trees, which would benefit the economy as well as the environment.[1]

Projections & Monitoring Matrix

Outcome indicators can be forest produce, buyback of products by the state, annual gross income generated by these outputs, contribution of the forest output in the district domestic product.

4.1.1 Biodiversity –

- According to Hindustan Times 2021, about 15 lakh fish of different species will be released into the river by the department of fisheries in 12 districts, and Hardoi is one of those districts.

4.2 Tourism

- **'Travel Uttar Pradesh' plan-** To provide visitors a better awareness of how humans affect the environment and to instil a greater respect for ecosystems it can be clubbed with a major city like Prayagraj . In the Hardoi district, there is a big chance to establish events around river ganga not only on religious grounds but also cultural grounds as well. The project will reduce the detrimental effects of traditional tourism on the environment while also enhancing local people's cultural integrity. This initiative will also increase visitor traffic in the area.
- **Sustainable tourism-**
  To create event that works around art and heritage. That event consecrates not only the international standards of elegance and artistic genius but also the state of being en vogue.. To grow sustainably at various touch points like temples and monastery must be considered with respect to developing the local trade and involving the local folks.

[1] https://www.teriin.org/article/special-drive-tree-plantations-uttar-pradesh-faces-several-challenges

Projections and Monitoring matrix

Sector	Intervention	Strategy	Total cost	Expected Outcomes
Tourism	**Research**	● The cause and motive for tourism can be predicted using various data and matrices which available on various government official websites as well as private organizations have done their bit too. It is also feasible to discover the elements affecting tourism in Uttar Pradesh through significant qualitative and quantitative research. ● All political pressures and influences must be removed from research to bring as much transparency as one can. ● When adding new records, the researchers must ensure that the field data and secondary data are correct and unaltered. This would be specific prizes to the competition's winners. Hundreds of players competed in numerous international competitions, including the Olympics and Para Olympics. The players have returned to India with medals, setting new records. Developing the Khelo India Centre and an international class indoor gymnastics stadium in the area. It is necessary to enlist the help of unbiased researchers.		As a reference for other processes, a well-researched document. Tourism in Uttar Pradesh is influenced by a number of factors. Understand multiple factors that influence tourism activity. To be able to understand and work upon all the listed factors and create a need for travel for people within and outside the country! Research and prior lessons will be used to inform the planning process. For a successful implementation, realistic planning is required.
	Planning	● Research and analysis of various data and reports can be used to generate action plans for intervention. ● Developing an active action plan is critical because the results are		

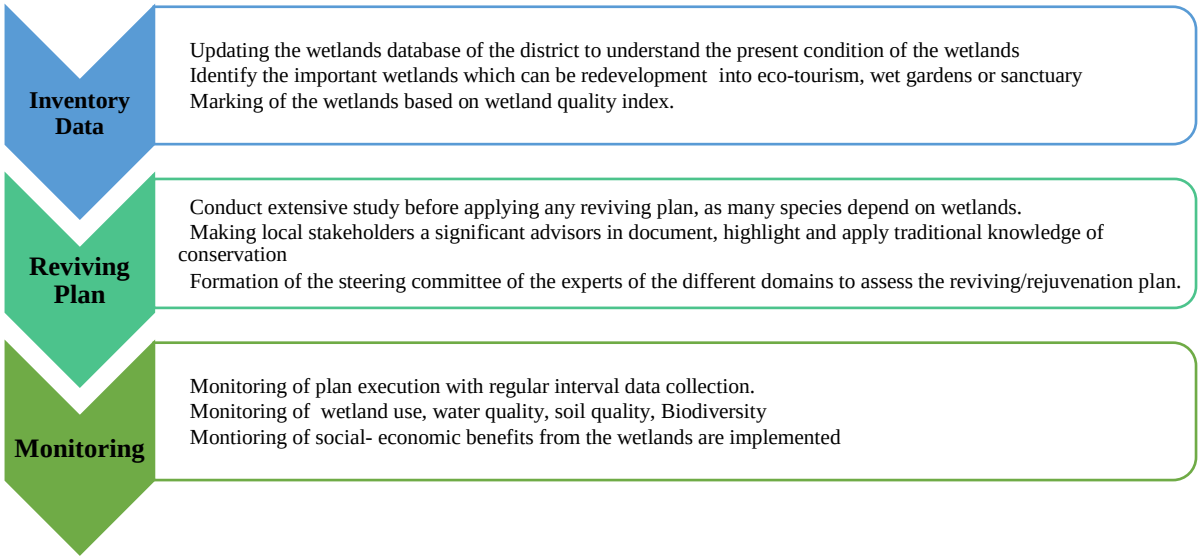
		dependent on how it is prepared and later implemented as well. ● Planning must take into account the state's social position as well as the impression that tourists have of the country. ● Non-practical forecasts should be avoided at all costs. ● Making plans for all major festivals and occasions like Ramnavmi. Finding out carious elements of the temples that can be utilized to weave stories in and around Hardoi and Bareilly. ● Hindu temples can be commercialised. Other involved things like flower vendors, incense sticks, and other worshipping things can be standardized across the state under the umbrella of UP Tourism. Every retailer in the vicinity of the temple does their hardest to make as much money as possible from the pilgrims and guests who come to pay their respects. ● This standardization should be incorporated under Brand Manufacturing to increase tourism activity throughout the state. ● Organizing various spiritual and religious events which hold meaning and significance. ● Complete use of allocated budget.		
	Implementations	● To attract more tourists, various schemes such as tourist packages, sustainable collaborations, and so on can be devised at ground level.		To increase total number of tourists and increase tourism earnings from all possible tangents and at every touch point.

		• Mahotsavs and fairs will be held to boost the local economy and attract visitors. • Establishing a link between tourist and local culture and cuisine. • Advertorial promotion that has an over-all extensive approach to capture the right audience. . • A significant amount of branding and marketing which can be clubbed with other cities like Agra. • The development of tourist attractions and maintenance of temples in and around Hardoi. • Information about travel packages should be available on government websites and various other touch points like social media channels. • However, “commercial marketing” efforts can be targeted at potential customer segments interested in visiting such pilgrimage centers/sites due to a desire to learn more about “cultural heritage.” Ganga arti culture • Eco-tourism activities boosted by Ganga Festivals which happen. Along with these proper sanitisation, maintaining hygiene on the banks of river Ganga is very important.		To boost the state's image while ensuring that no other social issue has an impact on tourism earnings. Create a flowchart to constantly maintain the set standards of tourism and consider feedback of tourists. This must include major points of sanitation and clean drinking water.
	Impact Assessment of results	• Figuring out where all touchpoints. • The understand the cause of failure and work upon it.		• To learn the lesson and establish the root cause of success and failure, which will be applied in

		• Reasoning to comprehend all the aspects. • Planning for future considering all over aspects of that can be covered.		the future with modifications.

4.3 WETLANDS

The district is comprised of some of the healthy and wealthy wetland ecosystems. They directly or indirectly support millions of people and provide goods and services. They support all life forms through extensive food webs. They are 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 must be taken on different fronts. The action plan below gives a glimpse of the action and development required to protect, conserve, rejuvenate the wetlands existing and extinct.



4.4 ENERGY

4.4.1. Solar

Efforts should be made in the district to make the people aware of the solar energy, especially the farmers. It is important so that they are able to make most profit out of it. Kusum Yojana should be promoted in the district.

Moreover the state's DISCOMS are already in great debts, which is the reason of interrupted power supplies. So to bring profit to the DISCOMSs and to raise the agricultural standards in the district so that farmers are able to gain more profits, Kusum Yojana should be adopted aggressively in the district on the lines of Maharashtra's Krishi Vahini Yojana. These could be set up by the DISCOMs so that they can easily get profits.

Installation of solar rooftop panels should also be encouraged in the district under the Nation Solar Mission, phase II. The administration should try to provide financial assistance to the small cottage industries as well, to install solar rooftop panels. This would incline towards the solar energy.

4.4.2. Biomass

The district Hardoi can take forward its economy by powering the farmers of the district. This can be done by bringing in the production of biomass energy, which will not only help to keep the environment clean but also add to the farmers' income. Moreover it will also solve the problem of stubble burning in the district. The district cultivates sugarcane, rice and wheat mainly, so the best suited projects for the district can be husk based biomass gasifier and the bagasse based biomass plants. The husk based biomass plants can be developed on the lines of the Husk Power Systems from Champaran, Bihar. Community based biomass plants should be encouraged in the district, so that the investment is divided among the the group of people.

There is a need to develop awareness among people about the biomass energy, this responsibility should be given to those who can connect directly on one to one basis to the people such as village self-help groups, panchayats, etc. A proper transportation system should be developed so that there is easy transportation of the biomass wastes to the plants. The authorities responsible should make a easy business environment in the district, so that more and more people are attracted to it.

4.4.4. Biogas:

- Cow shelters like Tirwa Gaushala, Mayoni Gaushala, and Kachhauna Gaushala are not in good condition as per the local newspaper and should be maintained in regular intervals. Biogas plants should be constructed parallel to these gaushalas.

4.4.5 Hydropower:

Chiranjupurwa and Makkupurwa villages are prone to flooding in the district; therefore, canals near these villages should be made that can further be used for electricity purposes in the future.

5 RECOMMENDATIONS

5.1 AGRICULTURE AND ALLIED SECTORS

1. The district has lower productivity of sugarcane and rice as compared to the national average, farmers should adopt the high yielding varieties and/or hybrids varieties instead of traditional varieties to increase productivity.
2. The use of ferti-seed drill needs to be enhanced for wheat to achieve proper fertilizer use efficiency.
3. Using efficient harvesting management strategies, post-harvest losses for important fruits (mango, guava) can be reduced.
4. Conjunctive use of surface water and groundwater should be enhanced.
5. Dependencies on bore wells should be reduced, surface water harvesting structures (farm pond) should be constructed to facilitate irrigation and groundwater recharge.
6. Farmers should adopt SRI (System of rice intensification) for rice cultivation to increase yield.
7. Oilseeds like sunflower, til, mustard cultivation should be encouraged in the district.
8. More areas should be covered under drip irrigation, especially for the cultivation of vegetables and fruits.
9. Farmer can generate more income from spices cultivation such as garlic and turmeric.
10. Onion and potatoes are important cash crops in the district, so storage facilities, processing, and marketing can be developed.
11. To generate more income per unit area, farmers should be encouraged for the inter-cropping.
12. Application of green manuring, vermicomposting/FYM, bio-fertilizer need to be enhanced to restrict deteriorating the soil health.
13. Organic farming should be encouraged mainly for vegetable crops.
14. Resource conservation technologies like zero tillage can be extensively applied for wheat maize to reduce the cost of production and sowing time.
15. Dairy farming needs proper market access and adoption of cross-breed.
16. Goats and poultry farming can be promoted under the cooperative farming system.
17. Flood is a common phenomenon in the district; farmers should follow the crop advisory.
18. Farmers should be encouraged for pulses cultivation.

5.2 FORESTRY

Hardoi located on the bank of river Ram Ganga, Gomti, and Sai river. According to ISFR 2019, 143.85 Sq. Km. area of Hardoi is covered with forest. As discussed above, the forest cover of Hardoi has increases significantly from previous assessment 2013. Majorly, open forest found in the district. There is a wide scope of Afforestation on waste land, trees outside forest (on the sides of the roads, banks of river etc.). Government can promote the afforestation, agroforestry activities by providing output based incentives.

5.2.1 Biodiversity

It is recommended to form a green belt in village areas to prevent illegal cutting of green trees.

5.3WETLAND

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

- Sugarcane producing farmers need to learn about crop rotation as sugarcane is water-intensive and draws lots of nutrients from the soil too.
- It is recommended to promote organic farming near the wetlands to lower the pollution of the wetlands. Also, these practices help attract the market and increase the yield of crops. A scheme like millet mission will boost crops like millets, oats, and pulses. 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, sugarcane 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.
- It is recommended to promote the production of medicinal plants in the region to support the promote ayurvedic medicine and wetland can support the water supply for the cultivation.

- It is recommended to promote eco-tourism in the region as the region can develop with flower gardens around the wetlands area and biodiversity. It will attract visitors and help in the economic growth of the region. The economy generated by eco-tourism must be utilized to maintain the hotspot.

5.4 ENERGY

5.4.1. Solar

- ❖ People should be made aware of the solar and the schemes related to it.
- ❖ Kusum Yojana should be popularized in the district among the farmers.
- ❖ People should be encouraged to install solar rooftop panels under the National Solar Mission, phase II.

5.4.2. Biomass

- ❖ People should be made aware of the biomass energy and the policies government has made to take the biomass mass energy forward.
- ❖ Husk based biomass gasifier and the bagasse based biomass plantsshoud be promoted in the district.

5.4.3. Biogas

- It is recommended that Tirwa Gaushala, Mayoni Gaushala, and Kachhauna Gaushala be used to produce biogas or electricity.
- Promotion of household biogas plant and different incentive scheme should be spread through posters, or slogans. Tourist attraction places such as Hastinapur Jain temple or Shaheed Smarak should be targeted to conduct this activity.

5.4.4. Hydropower

- Investigating the Garra river sites to implement small hydropower projects of 5-6 MW capacity is recommended.

5.5. TOURISM

Beautification of existing tourist spots-

Religious institutions and locations are not targeted for "commercial marketing." In this context, the goal is to provide facilities, amenities, and conveniences, as well as raise awareness of the above to those who are interested in participating in such visits/pilgrimage.

To white wash old structures under the name of conservation, which decreases the majesty of the original structure, is a major problem in conservation. This appears to be a common occurrence in various UP monuments.) • Alternative ways for approaching the "original appearance" are available and well-established; wherever possible, they should be encouraged or enforced. • Preservation of old/walled cities by prohibiting polluting cars from entering the precincts

Safe and secure UP-

The image of Uttar Pradesh isn't as great as it can be in the eyes of outsider, not only among those who live outside the country but also who live within our nation. To make policies and implement those into ground realities is something to look up to..

Marketing through right channels-

Cross-selling tourism hotspots in neighbouring states can assist boost tourist inflows. Package deals should be devised and implemented for the benefit of both tourists and the government. Discounts and special offers on group travel are one way to encourage visitors to bring their families along on business trips.

Connecting trip to Hardoi with other major landmarks within the state

Hardoi is well connected to major cities in Uttar Pradesh. This can allow the tourists who are visiting cities like Agra, Allahabad or Lucknow to consider travelling to Hardoi as well. Eventually making it a part of the travel list of the visitors travelling from different locations to explore the state and its local cuisine and culture.

Clubbing wetlands-

Uttar Pradesh has 8 Ramsar Wetlands out of which one is in Hardoi (Sandi) .Environmental Controls for Tourism Projects in Uttar Pradesh should be clubbed together to promote these Ramsar Wetlands along with the rest of them present in the country to be knitted into the local place's natural and socio-cultural fabric while also contributing to its economic development is critical to its long-term sustainability. The local community obtains the greatest benefit from it. Given the rising popularity of UP tourism concepts such as nature tourism, eco-tourism, and rural tourism, a specialised environmental regulatory framework is required to safeguard tourism's long-term viability.

Restricting vehicle movement –

To promote sustainable practices within protected areas in a phased manner by: preventing unaccompanied private vehicles from entering; replacing smaller vehicles (Jeep, Gypsy) with larger vehicles to reduce overall vehicle traffic within the protected area; and eventually replacing all polluting vehicles with non-polluting electric vehicles. • Creating walk-ways, pre-marked nature trails, and other amenities to promote smooth tourist traffic within protected areas and assure safety.

Only employing local people-

Aside from these initiatives, the State Government should encourage the following to promote sustainable eco-tourism through community-based conservation: • Creating participatory management institutions for each protected area • Using traditional knowledge in all aspects of conservation • Disseminating diverse conservation advantages to locals • people in wildlife programmes, local residents have access to information. Conclusion In order to align tourist goals with broader environmental issues, the tourism sector, the local community, and the government must work together on a long-term basis. Aside from a solid policy environment for protecting and developing natural ecosystems, local communities must actively participate in environmental protection. More tourists might be welcome if a greater portion of their spending helped locals.

Investments for recycling-

Investments can be made to increase the carrying capacity of a site (i.e. in wastewater recycling, establishment of green corridors for wildlife, tourist awareness campaigns etc.) Environmental constraints may be alleviated by technological advancements or more efficient resource use. The carrying capacity is then determined by the amount of financial, technological, human, and natural capital available. The concept of environmental carrying capacity is thus of limited utility in determining the 'optimal' amount of tourism, where net tourist benefits are maximised. The state of Uttar Pradesh is rich in natural and human resources.

Sustainable Tourism Practices-

•For decades, Uttar Pradesh's tourism industry had lagged considerably behind the national average. The way the Yogi Government's devotion and strategy helped Kumbh establish global brand recognition and connect with more than 250 million people is a beautiful example of the government's legacy. From the standpoint of the cultural or spiritual economy, one must be aware that Uttar Pradesh is a rich and vast potential state, not only for major landmarks like Lucknow, Agra or Varanasi but also culturally rich places like Hardoi. However, today's culture and economy are emerging as complementary to one another, providing a boost to the tourism industry.

Local cultural excursions

Signing up for eco-friendly local cultural excursions that encourage local heritage is another method to practise sustainable travel in Hardoi on their tour itineraries.

Collaborating with sustainable organisations-

NGOs (non-governmental organisations) support community-development projects in the communities. Booking tours near your destination with smaller companies gives you a better opportunity of using your vacation money to support local employees and communities. Watching

cultural acts at posh hotels, on the other hand, may only send a sliver of that money back to the performers' home towns.

Promoting green practices at every step of travellers-

Starting with accommodation, this district should have the opportunity to go green. If one is staying for more than a day or two, trips should be planned and then executed accordingly. To avoid use of heaters or turn off air conditioners and other electronic devices. To build hotels with recycling programmes in place and follow their rules.This has to be the most straightforward method of promoting sustainable tourism.

Recommended Projects

Plastic free country, state and Hardoi-

When this is implemented, we're discouraging people from using those plastic bags that end up all over the place and contaminate water and waste systems. Small practices like carrying food in a tote bag on trips needs to be promoted, that too locally handmade. This is a simple thing to do, but it prevents the use of plastic bags, which harm the environment.

Organising local tour groups-

Choosing a tour group, company, or other entity that promotes sustainability whenever possible. For instance, a company that invests in the community, contributes to preservation, hires local employees, and obtains local goods is an example of a corporation that supports the local community.

A business that goes out of its way to lessen its negative environmental impact by implementing conservation measures, practising RRR (reduce, reuse, recycle), planting trees to counteract the impact, and encouraging employees to carpool, among other things.

Monitoring, Evaluation & Impact

	Broad objectives / recommendations	Key activities / interventions to be planned			Monitoring & Evaluation	Impact
		2022	2023	2024		
1.	To club with nearby cities like Agra and Bareilly to make a concrete travel plan for tourists and a destination venture for history and architecture. Beautification and cleanliness of ghats are required to attract tourists.	Club with ongoing government projects.	Create more opportunities for locals to connect with projects and historical excursions.	Evaluate and weigh the growth of past two years to bring new strategies to attract more tourists.	Intervention impact- RCTs, regression analysis, propensity scores, econometrics, structural equation modelling	Upgraded staff and facilities associated with UP State Tourism Corporation. Clean Ganga and more tourists.
2.	Creating poetry event and other mohatsavs.					

7. Discussion during the Report Presentation

- Hardoi has large no. of artisans active in cloth weaving which can be connected with the Jalaj Model.
- 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.

8. REFERENCES

- *https://censusindia.gov.in/2011census/dchb/0924_PART_B_DCHB_HARDOI.pdf*
- *https://www.censusindia.gov.in/2011census/dchb/DCHB_A/09/0924_PART_A_DCHB_HARDOI.pdf*
- *http://www.nicra-icar.in/nicrarevised/images/statewiseplans// Uttar%20Pradesh/UP46-Hardoi-26.07.14.pdf*
- *https://www.researchgate.net/publication/314836204_Survey_on_Present_Scenario_of_Biomass_energy_and_its_future_prospect_in_Uttar_Pradesh_India*
- *http://upneda.org.in/annual-report.aspx*
- *https://www.amarujala.com/uttar-pradesh/hardoi/hardoi-rs-65-thousand-fine-on-16-farmers-for-burning-stubble*
- *https://economictimes.indiatimes.com/industry/indl-goods/svs/chem-/-fertilisers/dcm-shriram-gets-green-nod-for-rs-188-crore-up-distillery-plant/articleshow/58821038.cms*
- *https://www.tripadvisor.in/Attractions-g7753810-Activities-Hardoi_Hardoi_District_Uttar_Pradesh.html*
- *https://cdn.s3waas.gov.in/s392c8c96e4c37100777c7190b76d28233/uploads/2020/08/20200804555.pdf*
- *https://www.amarujala.com/uttar-pradesh/hardoi/three-pilgrimage-places-in-the-district-declared-as-a-tourist-destination-budget-released-hardoi-news-knp610304980*
- *https://www.upecotourism.in/SandiBirdSanctuary.aspx*
- *https://www.yatra.com/india-tourism/hardoi-travel-guide*
- *https://www-amarujala-com.translate.goog/uttar-pradesh/hardoi/Hardoi-141424-37?_x_tr_sl=hi&_x_tr_tl=en&_x_tr_hl=en&_x_tr_pto=nui,sc*
- *http://www.uptourism.gov.in/site/writereaddata/siteContent/20200313111807327 6Year-wise-statistics2020.pdf*
- *http://www.uptourism.gov.in/pages/top/about-up-tourism/budget*
- *https://rsis.ramsar.org/ris/2409*
- *https://timesofindia.indiatimes.com/city/lucknow/up-now-home-to-8-ramsar-wetlands/articleshow/79253169.cms*
    - *https://censusindia.gov.in/2011census/dchb/0924_PART_B_DCHB_HARDOI.pdf*
    - *https://www.censusindia.gov.in/2011census/dchb/DCHB_A/09/0924_PART_A_DCHB_HARDOI.pdf*
    - *https://www.amarujala.com/uttar-pradesh/hardoi/solar-power-plant-will-be-set-up-in-chc-hardoi-news-knp6595004110*

6 APPENDICES

6.1 AUXILLLARY DATA

Table 1: Biogas potential from animal waste 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/m³)	Biogas potential (m³/yr)
Cattle	Manure	5,09,002	10	1,85,78,57,300	1393392975	27867859	25	11147143.8
Buffalo	Manure	6,24,238	15	3,41,77,03,050	2563277288	51265545 7.5	25	20506218.3
Sheep	Manure	20,047	1	73,17,155	5487866.25	1097573.25	25	43902.93
Goat	Manure	3,46,720	1	12,65,52,800	94914600	18982920	25	759316.8
Pig	Manure	29,362	2.5	2,67,92,825	20094618.75	4018923.75	25	160756.95
Poultry	manure	2,30,738	0.1	84,21,937	6316452.75	1263290.55	25	50531.622
Total	Manure	1760107						32667870.4

Table 2 Biogas potential from agricultural waste in the district.

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	87710	1.5	131565	92095.5	15	78281.175	800	62624940

Wheat	straw	1155223	1.5	1732834.5	1212984.15	30	849088.905	800	679271124
Sugarcane	Bagasse	2820667	0.33	930820.11	651574.077	80	130314.8154	750	977361155
Total		4063600							839632175.6

Table 3 Trends in Crop Production

Crop/Year	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**
Non-grain crops (Metric Tonne)	52320	47527	51275	46806	44800	38939	60599	69599	65164
Grain crops (Metric Tonne)	1425858	1452968	1601597	1453923	1571107	1092436	1383191	1589781	1637155
Sugarcane (Metric Tonne)	1442002	1520923	1834293	2123998	2307821	2303405	2304189	2361663	2820667
Potato (Metric Tonne)	306808	181126	196173	184991	188926	236266	219317	187599	179716

Table 4 Livestock trend in District.

Livestock	**2003**	**2007**	**2012**
Cattle (Cow)	571519	575961	509002
Buffalos	391740	464117	624238
Sheep	30615	23693	20047
Goat	327230	384310	346720
Pigs	48325	37778	29362
Chicken	126042	103723	227765
Other Poultry	5050	99279	2973
Horses and Ponies	3624	3212	4240
Others	6496	1554	1296