Arth Ganga Project: District Varanasi

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

One of the oldest cities of the world, Varanasi, popularly known as Kashi or Banaras is the spiritual capital of India. The district, situated at the banks of river Ganga, has high mythological, cultural, historical, and educational importance.

The total geographical area of the district is 1535 Km^2, out of this area, the total cultivable land is 95748 ha, the permanent pastures are 24 ha, the Cultivable wasteland is 2560 ha. The barren and uncultivable land constitutes 2151 ha. Majorly based on the fertile characteristics soil types are sandy to sandy loam, loam to clay loam, Sodic soils/saline. The district is divided into four Agro-ecological situations namely, Irrigated clay loam soil, Irrigated loam soil, Waterlogged clay condition, and Sodic / Saline soil. With the net sown area of 95748 ha and gross cropped area of 134073 ha, the Cropping intensity of the district is 176%. The net irrigated area is 82206 whereas the rainfed area is 13542. The net sown area increased from 62.62% in 2010-11 to 66.05% in 2017-18 whereas the area for non-agricultural use increased over the period from 17.52% to 22%. The major farming system is divided into resource-rich, resource-poor, and landless. The major crops types are wheat, rice, paddy, sugarcane, pulses, etc. Among the horticulture fruits and vegetables are mango, guava, sponge gourd, bitter gourd, potato, etc. along with medicinal and aromatic and plantations like banana, etc. In 2017-18, the nitrogen share increased to 71.58%, while the phosphorus share decreased to 23.72%, and the potassium share decreased to 4.7%. The overall use of chemical fertilizers has reduced in the district from 518.38 kg/ ha GSA in 2010-11 to 458.17 kg/ ha GSA in 2017-18. The livestock consists of cattle and goats, buffalos, goats, sheep; along with poultry and fisheries. There are many small and medium scale industries among which Silk industries have gained utmost popularity. The industries are one of the main economies of the district. The tertiary sector occupies around 62% share in the district economy with an average annual growth rate of 8.12%, with its share increasing from 59.01% in 2011-12 to 62.90% in 2018-19. The district economy grew with an average annual growth rate of 7.02%. Agriculture grew at an average annual growth rate of -2.74% from 2011-12 to 2018-19 with its share declining from 50.87% in 2011-12 to 30.72% in 2018-19. The share of livestock increased from 42.46% to 62% with an average annual growth rate of 11.25%.

The total forest cover of the district is only 17.1 km^2. There is no prominent forest cover in the district. Out of total forest cover, the maximum area is covered by Open Forest (16.10%) followed by Moderately dense forest (1%). The share of forestry and logging is around 5.92% in 2018-19, but it grew with an average annual growth rate of 19.74% along with mines and quarrying with an inconsistent annual growth rate of 7.02%. The share of area under trees and gardens increased from 1.63% in 2010-11 to 1.7% in 2017-18. The district has 1015 plant species belonging to 601 genera and 116 families. There are numerous tourist attractions in the city. The turtle wildlife sanctuary, many famous temples of religious importance like Kashi Vishwanath (abode of one the jyotirlinga), Sankat Mochan, etc. along with mosques, church, gurudwara, and 88 ghats, etc. shows the diversity and acceptance of all religions thus viable to attracting a large number of tourists.

There are many tourist attractions nearby the main district such as Sarnath, fun city, archeological site, Ramnagar fort, Vindhyachal, Chandraprabha sanctuary, etc. which are important destinations. In addition, there are many fairs and festivities which are popular. The number of domestic and foreign tourists has been increasing since 2015 with some fluctuations but still, these numbers can be improved with better advertisements, management, upgrading structures, and improving facilities. The district comprises small and medium-sized 1130 wetlands which mostly 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.

The main source of lightning is electricity (62.04%) closely followed by kerosene (36.98%) while only 0.42% is the usage of Solar energy. Solar Rooftop Systems have been installed at various government offices along with RO and Solar High Mast Lightning System. Electricity consumption in agriculture has increased significantly from 381.2 kWh in 2014-15 to 611.84 kWh in 2019-20, a net increase of approximately 60.50%. The main fuel source is LPG/PNG (38%) followed by cow dung cake (30.90%) and firewood (25.19%). The production of biomass is high in the district owing to agriculture and industrial wastes. Biogas potential from animal and agricultural waste is calculated approximately as 1 crore m^3/year and 14 crores m^3/year respectively. Biomass plants have been reported such as a Co-generation power plant. A small hydropower plant has been proposed.

The district has a high scope of improving its overall development. Various measures should be taken to increase green cover/ forest in the state such as Miyawaki plantation, afforestation, wetlands improvement, agroforestry along with eco-tourism, etc. Farm mechanization, use of drip and sprinkler irrigation, commercialization, cooperative and organic farming, etc. would improve the agricultural scenario in the district. The monitoring and maintenance of industrial wastes is the need of the hour. Creating awareness and strict implementation of laws along with the use of technologies and conducting the research could aid in sustainable development.

1 DISTRICT OVERVIEW

1.1 INTRODUCTION

Varanasi is a district of Uttar Pradesh with its administrative headquarters located at Varanasi city. The district encompasses a geographical area of 1535 sq. km. and in terms of geographical

area it occupies 67th rank in state and 542nd rank in India. In the year 2019, there was a total 1.11% forest area of the total geographical area.

Administration wise, the district is divided into two tehsils namely Varanasi and Pindra. There is 1 Lok Sabha seat and 8 Assembly constituencies in the district. Moreover the district comprises 2 sub-district, 39 towns and 1294 villages. The total population of the district is 3676841 divided into the 2079790 in rural and 1597051 in urban areas. In the district 33.20 per cent pertains to the category of working population. Main workers constitute 25.04 per cent of population. Of the total working population in the district 16.22per cent are cultivators, 14.92 per cent engaged as agricultural labourers, 13.83 per cent in household industry and 55.04 per cent as other workers. . In rural areas of the district as much as 26.41 per cent of working population is cultivators as against only2.72 per cent in urban areas. In case of other workers, the composition of rural and urban proportion is 41.53 and 72.92 per cent of working population.

The district has a good agricultural and industrial base and a reasonably good infrastructure of various facilities. But the district has only some large scale and few medium scale industries. Among the large scale industries, Diesel locomotive works. (D.L.W.) Varanasi is established in Varanasi, others are Vibhuti Glass Work, Ram Nagar, B.H.E.L. Varanasi and medium scale industries are Cinni Engs. Work ,Tyre and Rubber Industries and Boolie Engs. Work. Varanasi has long been famous for Handicrafts work too. Varanasi is world famous for its very fine silk and Banarasi saris. One of the leading industries in Varanasi is silk weaving. Some other foremost industries in the district are automobiles, glass beads, bangles, etc. Every year a huge chunk comes from these industries remarkably helping in its economy. The agriculture sector also contributes in its economy to some extent.The core agricultural products in the district are rice, wheat, pulses, mangoes, etc.

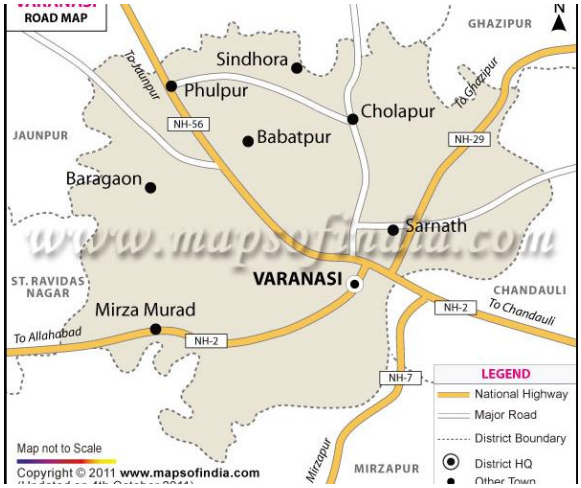


Figure 1 Map of the district

1.2 DEMOGRAPHIC PROFILE OF VARANASI

- Geographical Area: 1535 Sq. Km.
- Administrative Divisions:[1]

  District Headquarters: Varanasi

  No of Municipalities: 3

  No of Tehsil: 3

  No of Blocks: 8

  No of Gram panchayats: 760

  No. of Nyay Panchayat:108

  No. Of Villages: 1360

- Demographic and socio-economic indicators:[2]

  Population: 36,76,841 (Census 2011)

  Population density (Total persons per sq. km): 2395

  Sex ratio: 913

  Literacy: 75.60%

- Occupation/ other Livelihood source: Muslin, Silk fabrics, perfumes, ivory works
  - Major Rivers: Ganga
  - Forest Area: 17.1 Sq. Km. (No major forest)

Table 1 demographic overview

1.3 AGRO CLIMATIC PROFILE OF THE DISTRICT

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

[2] https://www.censusindia.gov.in/2011census/dchb/DCHB_A/09/0966_PART_A_DCHB_VARANASI.pdf

1.4 ECONOMIC PROFILE OF VARANASI

The primary sector has less impact on the district economy because it contributes only around 12.38% of the district GDP. However, this sector's average annual growth rate from 2011-12 to 2018-19 is remarkable (4.25%). But, its share decreased from 13.2% in 2011-12 to 10.51% in 2018-19. The share of the secondary sector also decreased slightly from 27.80% in 2011-12 to 26.59% in 2018-19. It increases with an impressive average annual growth rate of 6.43%. The tertiary sector occupies around 62% share in the district economy. The sector grew with a remarkable average annual growth rate of 8.12%, with its share increasing from 59.01% in 2011-12 to 62.90% in 2018-19. Overall, the district economy grew with an average annual growth rate of 7.02%. The growth in the tertiary sector is more than in the other two sectors. Steps should be taken to increase the productivity of the primary sector so that it can grow at a higher rate.

Table 1: Trends in Gross District Domestic product in Varanasi 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	1462.51	3080.26	6538.71	11081.49	-	-	-	-
	(13.20)	(27.80)	(59.01)	(100)				
2012-13	1572.07	2942.26	6269.90	10784.24	7.49	-4.48	-4.11	-2.68
	(14.58)	(27.28)	(58.14)	(100)				
2013-14	1548.02	3172.27	7625.98	12346.27	-1.53	7.82	21.63	14.48
	(12.54)	(25.69)	(61.77)	(100)				
2014-15	1494.66	3075.07	8581.39	13151.12	-3.45	-3.06	12.53	6.52
	(11.37)	(23.38)	(65.25)	(100)				
2015-16	1987.93	3751.51	9619.85	15359.29	33.00	22.00	12.10	16.79
	(12.94)	(24.43)	(62.63)	(100)				
2016-17	2095.36	3988.27	10111.61	16195.24	5.40	6.31	5.11	5.44
	(12.94)	(24.63)	(62.44)	(100)				
2017-18	1762.38	4395.28	9835.92	15993.59	-15.89	10.21	-2.73	-1.25
	(11.02)	(27.48)	(61.50)	(100)				
2018-19	1845.30	4669.95	11047.06	17562.31	4.70	6.25	12.31	9.81
	(10.51)	(26.59)	(62.90)	(100)				
Average Growth Rate					4.25	6.43	8.12	7.02

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

We further break down the primary sector GDP to know which subsector is lagging and which is driving the primary sector growth. Table 2 shows that agriculture with the horticulture sector grew at an average annual growth rate of -2.74% from 2011-12 to 2018-19. Consequently, its share went down from 50.87% in 2011-12 to 30.72% in 2018-19. On the other hand, the share of livestock increased from 42.46% to 62% in the same period, with a remarkable average annual growth rate of 11.25%. It shows the importance of livestock in Varanasi District and the increased dependency of citizens on livestock products. The share of forestry and logging in the total agriculture and allied sector is small, around 5.92% in 2018-19, but it grew remarkably well with

an average annual growth rate of 19.74%. The fishery and aquaculture subsector share is very minimal, around 1.37% in 2018-19, and it grew with a low average annual growth rate of 2.65% from 2011-12 to 2018-19. Mines and quarrying also recorded a remarkable annual growth rate of 7.02%; however, its growth is not consistent over the years. 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 well during the time period of the study, with all its subsectors doing well. More work can be done on improving the agriculture (including horticulture) sub-sector as it has the most significant impact on the primary sector.

Table 2: Gross District Domestic Product Trends from Agriculture and allied activities in Varanasi 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	714.73	596.56	71.67	21.98	1404.94	57.57	1462.51
	(50.87)	(42.46)	(5.10)	(1.56)	(100)		
	-	-	-	-	-	-	-
2012-13	683.98	656.76	164.85	23.04	1528.63	43.45	1572.07
	(44.74)	(42.96)	(10.78)	(1.51)	(100)		
	[-4.30]	[10.09]	[130.01]	[4.79]	[8.80]	[-24.53]	[7.49]
2013-14	679.13	712.77	88.30	23.75	1503.94	44.08	1548.02
	(45.16)	(47.39)	(5.87)	(1.58)	(100)		
	[-0.71]	[8.53]	[-46.44]	[3.09]	[-1.62]	[1.46]	[-1.53]
2014-15	621.98	727.68	90.63	25.39	1465.69	28.97	1494.66
	(42.44)	(49.65)	(6.18)	(1.73)	(100)		
	[-8.41]	[2.09]	[2.65]	[6.90]	[-2.54]	[-34.28]	[-3.45]
2015-16	649.48	1112.73	160.01	25.92	1948.13	39.80	1987.93
	(33.34)	(57.12)	(8.21)	(1.33)	(100)		
	[4.42]	[52.91]	[76.54]	[2.09]	[32.92]	[37.39]	[33.00]
2016-17	668.62	1156.48	171.16	31.72	2027.98	67.38	2095.36
	(32.97)	(57.03)	(8.44)	(1.56)	(100)		
	[2.95]	[3.93]	[6.97]	[22.38]	[4.10]	[69.29]	[5.40]
2017-18	489.78	930.82	193.51	33.27	1647.39	114.99	1762.38
	(29.73)	(56.50)	(11.75)	(2.02)	(100)		
	[-26.75]	[-19.51]	[13.06]	[4.91]	[-18.77]	[70.66]	[-15.89]
2018-19	556.48	1123.29	107.22	24.76	1811.76	33.54	1845.30
	(30.72)	(62.00)	(5.92)	(1.37)	(100)		
	[13.62]	[20.68]	[-44.59]	[-25.59]	[9.98]	[-70.83]	[4.70]
Average Growth Rate	-2.74	11.25	19.74	2.65	4.70	7.02	4.25

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 has a share of approximately 38.06 in 2018-19. The share has decreased over the years as the average annual growth in this sector is only by 3.96%. The share of the electricity, gas, and water supplies subsector has increased from 6% in 2011-12 to 8.49% in 2018-19 as this subsector grew with a remarkable average annual growth rate of 13.89%. The share of the construction sub-sector increased from 46.82% to 53.45% in the same period as the average annual growth rate is high (8.52%). It indicates that the secondary sector in Varanasi is heavily dependent on the Manufacturing and Construction sub-sectors.

Within the tertiary sector, the transport, storage, and communication subsector made up the highest share of (34.13%) in 2018-19, followed by the Real estate (23.83%), Public administration (12.20%), and financial services (10.50%). Average annual growth is observed highest in Public Administration (21.96%), followed by transport, storage and communication (12.52%), financial services (8.94%), real estate (7.58%) and lowest in Trade & hotel (5.68%). All the subsectors in secondary and tertiary sectors have performed well during the study period. More work needs to be done to improve manufacturing and trade & hotel subsectors. Public Administration and 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 Varanasi 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	47.18	6.00	46.82	100	25.76	10.52	9.96	24.16	13.94	15.67	100
2012-13	40.31	8.64	51.05	100	30.63	9.94	11.46	27.25	7.55	13.17	100
2013-14	40.34	9.06	50.59	100	26.63	8.78	10.65	23.69	18.60	11.65	100
2014-15	35.87	10.06	54.07	100	30.34	7.94	10.66	22.66	17.01	11.39	100
2015-16	37.09	6.04	56.87	100	32.41	8.92	10.34	21.79	15.65	10.89	100

2016-17	40.10	8.43	51.47	100	31.52	9.43	9.91	22.04	16.66	10.44	100
2017-18	39.64	8.72	51.65	100	33.98	8.89	9.61	24.94	12.00	10.58	100
2018-19	38.06	8.49	53.45	100	34.13	8.81	10.50	23.83	12.20	10.53	100
Average Growth Rate	3.96	13.89	8.52	6.43	12.52	5.68	8.94	7.58	21.96	2.35	8.12

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 1526.78 sq. km². The forest area represents 0.04% of the total declared area. The share of cultivable wasteland increased from 1.50% in 2010-11 to 1.66% in 2017-18, which is not a good development indicator. Barren and uncultivable land share decreased from 1.45% in 2010-11 to 1.25% in 2017-18; however, the decrease could have been more significant. The share of area under trees and gardens increased from 1.63% in 2010-11 to 1.7% in 2017-18. The current fallow land showed a remarkable decline over the period, from 13.79% in 2010-11 to 3.12% in 2017-18. The net sown area (NSA) has also increased over time, from 62.62% in 2010-11 to 66.05% in 2017-18. The area for non-agricultural use increased over the period from 17.52% to 22% (Table 4). Overall, the land use pattern shows that the acreage for non-agricultural use has increased significantly.

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

	Total Reported Area (ha)	Area under forest	Cultivable wasteland	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	152678	0.04	1.50	13.79	1.47	1.45	17.52	0.02	1.63	62.62
2011-12	152678	0.09	1.92	12.04	3.23	0.82	17.65	0.02	1.54	62.68
2012-13	152678	0.03	1.49	13.31	1.47	1.44	18.31	0.02	1.61	62.33
2013-14	152678	0.04	1.84	10.47	3.27	1.26	18.47	0.02	1.89	62.75
2014-15	152678	0.04	1.91	10.45	2.74	1.28	18.98	0.02	1.91	62.68
2015-16	152678	0.04	1.91	3.12	4.02	1.26	21.64	0.01	1.90	66.11
2016-17	152678	0.04	1.87	3.11	3.94	1.25	21.86	0.01	1.83	66.09
2017-18	152678	0.04	1.66	3.12	4.17	1.25	22.00	0.01	1.70	66.05

Source: Compiled from http://updes.up.nic.in/spiderreports/intialisePage.action
And District-wise Development Indicators file.

2.1.2 Trends in Operational Land Holdings

In Varanasi district, the total number of operational farms increased from 268 thousand in 2010-11 to 274 thousand in 2015-16, a net increase of 2.24%. While in the state, their numbers increased from 23,325 thousand in 2010-11 to 2,822 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 99.09% 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.

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

	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.)
Varanasi	2010-11	93.77	5.17	0.94	0.11	0.00	268
	2015-16	95.27	3.82	0.84	0.06	0.00	274
							[2.24]
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

i- The Trend in Cropping Patterns

Rice and Wheat dominate the agriculture of the district. Table 6 shows the area devoted to various crops over the last eight years. In 2017-18, wheat made up the highest share of GCA (42.02%), followed by Rice (29.20%) and Bajra (3.26%). These three crops constitute around 74.48% of the GCA. The area shared by the total cereals has remained consistent over the years (81.33% in 2014-15), with a sudden fall observed in latter years (78.04% in 2017-18). The main pulses produced are Chickpeas, Arhar, and Peas, while the other pulses have negligible production. The total pulse acreage has remained consistent throughout the study period (average, 7.42%). Thus, the food grains cover a majority (average, 87.42%) of the GCA. Mustard is the only major oilseeds crop produced, and the total oilseed acreage has remained consistent over the years (average, 0.67%). The area under Sugarcane and Potato also remained consistent over the years. In general, there is no significant change in the cultivation pattern reported in the district during the study period. The average cropping intensity in the district is 163.70.

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	30.42	29.02	30.43	29.08	30.43	29.16	29.16	29.20
Wheat	43.78	44.67	43.78	44.74	43.79	41.97	41.98	42.02
Bajara	3.41	3.52	3.40	3.51	3.40	3.26	3.26	3.26
Other Cereals	3.74	3.71	3.73	3.71	3.71	3.56	3.56	3.56
Total Cereals	81.35	80.92	81.34	81.05	81.33	77.94	77.96	78.04
Chana	1.38	1.42	1.38	1.42	1.38	1.32	1.32	1.32
Matar	1.85	1.84	1.85	1.84	1.85	1.77	1.77	1.78
Arhar	2.69	2.71	2.68	2.71	2.68	2.57	2.57	2.57
Other Pulses	1.61	1.61	1.61	1.62	1.61	1.54	1.54	1.55
Total Pulses	7.53	7.59	7.52	7.60	7.52	7.21	7.21	7.22
Total Foodgrains	88.88	88.51	88.86	88.64	88.85	85.15	85.17	85.26
Mustard	0.46	0.47	0.46	0.47	0.46	0.44	0.44	0.44
Other Oilseeds	0.23	0.22	0.23	0.22	0.23	0.22	0.22	0.22
Total Oilseeds	0.69	0.68	0.69	0.68	0.69	0.66	0.66	0.66
Sugarcane	2.52	2.56	2.52	2.56	2.52	2.42	2.42	2.42
Potato	2.03	2.10	2.03	2.11	2.03	1.95	1.95	1.95
Net Sown Area	60.58	61.58	60.30	61.75	60.64	61.29	61.28	61.31
Gross Sown Area (in 1000 Ha)	157.81	155.41	157.82	155.17	157.82	164.70	164.66	164.48
Cropping Intensity	165.07	162.40	165.84	161.95	164.91	163.17	163.18	163.09
Source: http://updes.up.nic.in/spiderreports/intialisePage.action								

Table 7 shows that the yield per hectare of most crops varies from year to year. However, it has increased in the latter years of the study. Wheat and Rice are the major crops in the district, and their per hectare yield (33.93 qtls and 27.45 qtls respectively, in 2017-18) are low. Per hectare yield of total cereals has increased from 23.61 qtls in 2010-11 to 29.70 qtls in 2017.18. Similarly, per hectare yield of total pulses increased from 9.99 qtls in 2010-11 to 11.47 qtls in 2017-18. The yield of total oilseeds has increased from 8.62 qtls in 2010-11 to 13.79 qtls in 2016-17, which is a significant improvement. It can be due to the availability of hybrid seeds in the district. However, the improvement in the yield of oilseeds is not uniform. The average yield of Sugarcane is only 549.99 qtls/ha. Similarly, the average yield of Potato is low at 192.23 qtls/hs. 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 Varanasi District (Qtls)								
Crop/Year	**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**
Rice	20.11	22.22	24.49	21.82	24.92	19.62	25.71	27.45
Wheat	27.81	30.19	30.79	27.39	18.69	23.88	34.60	33.93

Bajara	11.54	15.85	12.72	10.39	10.94	7.37	6.62	10.97
Total Cereal	23.61	25.96	27.04	24.14	20.53	21.07	29.14	29.70
Chana	9.57	12.44	11.48	9.70	3.88	10.16	19.48	13.22
Matar	16.52	14.20	11.78	8.22	6.78	10.78	14.46	12.11
Arhar	7.73	9.02	10.62	11.01	8.94	8.26	7.98	13.85
Total Pulses	9.99	10.46	9.73	8.76	6.88	8.97	12.24	11.47
Total Food Grains	22.46	24.63	25.57	22.82	19.37	20.04	27.71	28.15
Mustard	11.91	13.73	12.62	10.03	7.79	3.91	19.38	10.67
Total Oilseeds	8.62	10.10	9.03	7.33	5.82	3.04	13.79	8.04
Sugarcane	445.44	497.35	516.74	607.44	632.40	591.61	683.82	425.08
Potato	178.11	179.57	170.86	231.94	210.63	169.77	197.82	199.17
Source: http://updes.up.nic.in/spiderreports/intialisePage.action								

ii- Trends in Production of Principal Crops

Table 8 shows the trends in the production of the main crops over the years. Rice and Wheat, dominate the production. In 2017-18, Rice (131.83 thousand tonnes) wheat (234.53 thousand tonnes) formed a major part of the total cereal production (381.18 thousand tonnes). Coming to pulses, Chickpeas, Peas, and Arhar occupied the highest production. Chickpeas, peas, and Arhar productions were 2.88 thousand tons, 3.54 thousand tons, and 5.86 thousand tons, respectively, in 2017-18. Although these pluses show variation in the production across years, they still represent around 90% of the total pulse production. Mustard production was 0.77 thousand tons, which represented around 88% of the total oilseed production in 2017-18. Sugarcane production was 169.31 thousand tons in 2016-17. Potato production was 63.95 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, fluctuated over the years, partly due to changes in nature 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 Varanasi District (in 1000 Tons)

Crop/Year	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Rice	96.55	100.22	117.61	98.44	119.66	94.24	123.46	131.83
Wheat	192.14	209.61	212.73	190.19	129.20	165.02	239.15	234.53
Bajara	6.22	8.67	6.83	5.66	5.87	3.96	3.55	5.89
Other Cereals	8.21	8.00	9.93	9.27	8.78	7.21	7.91	8.93
Total Cereals	303.12	326.49	347.10	303.56	263.51	270.43	374.07	381.18
Chana	2.09	2.75	2.50	2.14	0.84	2.21	4.24	2.88
Matar	4.82	4.06	3.44	2.35	1.98	3.15	4.22	3.54
Arhar	3.28	3.81	4.50	4.64	3.78	3.50	3.38	5.86

Other Pulses	1.67	1.72	1.12	1.20	1.56	1.80	2.69	1.35
Total Pulses	11.87	12.33	11.56	10.33	8.16	10.65	14.53	13.62
Total Foodgrains	314.99	338.83	358.66	313.89	271.67	281.08	388.60	394.80
Mustard	0.86	0.99	0.91	0.73	0.56	0.28	1.40	0.77
Other Oilseeds	0.07	0.08	0.07	0.05	0.07	0.05	0.10	0.10
Total Oilseeds	0.93	1.07	0.98	0.78	0.63	0.33	1.50	0.87
Sugarcane	177.42	197.60	205.82	241.34	251.89	235.64	272.37	169.31
Potato	57.19	58.63	54.81	75.78	67.63	54.51	63.52	63.95
Source: http://updes.up.nic.in/spiderreports/intialisePage.action								

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 Sugarcane (0.12%), followed by Mustard (0.13%) and wheat (0.21%), and the highest in Rice (2.85%). The variability in the area under total pulses (0.32%) is much less than the variability in the area under total cereals (0.94%). Since Rice and wheat dominate the production, the variability in the area under total food grains is, therefore, also relatively high (0.89%).

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	47.29	1.35	2.85	110.25	14.48	13.13	23.29	2.78	11.93
Wheat	69.19	0.15	0.21	196.57	36.41	18.52	28.41	5.26	18.53
Bajara	5.39	0.04	0.79	5.83	1.60	27.48	10.80	2.91	26.93
Total Cereal	127.72	1.21	0.94	321.18	44.14	13.74	25.15	3.43	13.63
Chana	2.19	0.02	0.70	2.46	0.95	38.71	11.24	4.37	38.89
Matar	2.90	0.03	0.94	3.44	0.95	27.57	11.86	3.26	27.47
Arhar	4.23	0.01	0.23	4.09	0.87	21.26	9.68	2.06	21.29
Total Pulses	11.85	0.04	0.32	11.63	1.99	17.08	9.81	1.67	17.03
Total Food Grains	139.57	1.24	0.89	332.81	45.90	13.79	23.85	3.26	13.68
Mustard	0.72	0.00	0.13	0.81	0.33	40.03	11.26	4.51	40.04
Total Oilseeds	1.08	0.01	1.10	0.89	0.34	38.22	8.22	3.13	38.12
Sugarcane	3.98	0.00	0.12	218.92	36.91	16.86	549.99	92.69	16.85
Potato	3.22	0.03	0.80	62.00	7.27	11.72	192.23	21.76	11.32
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 Mustard (40.03%), followed by chickpeas (38.71%), peas (27.57%), and Bajra (27.48%). High variation in

the production of oilseeds is partly due to variation in the land area under them and partly due to the high rate of oilseeds and non-availability of hybrid oilseeds. Improvement in crop insurance conditions and better market accessibility can lower this variation. Variability is lowest in Potato (11.72%), followed by Rice (13.13%) and Sugarcane (16.86%)

In the case of yield, the greatest variability is estimated in Mustard (40.04%), chickpeas (38.89%), and peas (27.47%). Yield variability in total cereals (13.63%) and total food grains (13.68) is lower as compared to that in total pulses (17.03%). Several factors, such as climate change, market prices, rainfall patterns, etc., influence the variability in agricultural production.

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 greater share in VOP than GCA. Varanasi is mainly a food grain production district; therefore, food grains accounted for around 87.42% of the gross area of the crops. Similarly, total foodgrains account for nearly 80.08% of the total value of the agricultural product. Three crops - wheat, paddy, and Potato together accounted for, on average, around 74.97% of GCA and 78.35% of the total VOP. The total value of the product has also increased significantly from Rs.486.26 Cr. in 2011-12 to Rs.985.92 Cr. in 2017-18.

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

Crop	% share in	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Wheat	GCA	43.78	44.67	43.78	44.74	43.79	41.97	41.98	42.02
	VOP	45.68	46.31	41.39	36.60	30.46	40.77	41.75	41.32
Paddy	GCA	30.42	29.02	30.43	29.08	30.43	29.16	29.16	29.20
	VOP	29.37	27.34	28.84	26.84	34.71	27.81	29.15	33.70
Total Cereals	GCA	81.35	80.92	81.34	81.05	81.33	77.94	77.96	78.04
	VOP	77.99	76.86	72.86	65.76	68.01	70.81	72.32	77.46
Total Pulses	GCA	7.53	7.59	7.52	7.60	7.52	7.21	7.21	7.22
	VOP	7.13	7.46	6.89	6.25	5.55	8.29	8.68	8.32
Total Food Grains	GCA	88.88	88.51	88.86	88.64	88.85	85.15	85.17	85.26
	VOP	85.12	84.32	79.75	72.01	73.56	79.10	81.00	85.78
Total Oil seeds	GCA	0.69	0.68	0.69	0.68	0.69	0.66	0.66	0.66
	VOP	0.50	0.52	0.49	0.41	0.41	0.27	0.61	0.43
Potato	GCA	2.03	2.10	2.03	2.11	2.03	1.95	1.95	1.95
	VOP	5.52	5.30	7.21	9.44	11.67	9.54	8.35	7.78
Sugarcane	GCA	2.52	2.56	2.52	2.56	2.52	2.42	2.42	2.42
	VOP	8.76	9.77	12.45	18.08	14.24	11.01	9.98	6.01
Paddy + wheat + potato	GCA	76.23	75.79	76.24	75.93	76.26	73.07	73.09	73.17
	VOP	80.56	78.94	77.45	72.88	76.83	78.12	79.24	82.80

Total Agriculture	GCA (1000 Ha)	157.81	155.41	157.82	155.17	157.82	164.70	164.66	164.48
	VOP (in Cr Rs)	486.26	535.87	712.33	784.74	681.22	673.91	936.04	985.92
Per Worker VOP (Rs.1000 at current prices) in Varanasi		-	23.60	22.94	23.05	29.98	29.06	33.73	36.88
Per Worker VOP (Rs.1000 at current prices) in UP		-	40.66	48.69	52.50	52.11	56.48	61.97	69.69
Source: http://updes.up.nic.in/spiderreports/intialisePage.action And District-wise Indicator reports									

Table 10 shows that the total value of agricultural produce per agricultural worker in Varanasi district increased from Rs.23.60 thousand in 2011-12 to Rs.36.88 thousand in 2017-18, a net increase of 56.29% at current prices, while in UP it increases from Rs. 40.66 thousand to Rs.69.69 thousand, a net increase of 71.40%. Thus, the per worker value of agricultural output is much higher in the state than in the district. The rate of growth per worker value of output in the district is lesser than in the state. The ratio of per worker value of the district's output to the state average has decreased from 0.5804 in 2011-12 to 0.5292 in 2017-18.

2.1.4. 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 59.47% of the total fertilizers used, while the proportions of phosphorus and potassium were 30.65% and 9.88%, respectively. In 2017-18, however, the nitrogen share increased to 71.58%, while the phosphorus share decreased to 23.72%, and the potassium share decreased to 4.7%. 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 that can be due to several factors such as rainfall patterns, cultivation patterns, etc. Although the overall use of chemical fertilizers has reduced in the district from 518.38 kg/ ha GSA in 2010-11 to 458.17 kg/ ha GSA in 2017-18, still the authorities can take steps to reduce their consumption further, as chemicalization of agriculture degrades soils and water resources. There is a need to incentivize the farmers to use organic and biofertilizers.

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

Fertilizer/Year	2010 -11	2011 -12	2012 -13	2013 -14	2014 -15	2015 -16	2016 -17	2017 -18
Nitrogen	308.29	262.68	178.36	117.57	122.47	110.92	107.02	327.94
Phosphorous	158.88	115.33	102.05	29.30	35.07	41.51	41.40	108.67
Potassium	51.20	26.15	10.54	4.05	7.10	7.46	8.91	21.55
Total	518.38	404.16	290.96	150.92	164.64	159.89	157.33	458.17

Gross Sown Area (Ha)	157808	155412	157817	155171	157823	164699	164657	164479
Source: http://updes.up.nic.in/spiderreports/intialisePage.action								

2.1.5. Irrigation Structure and Status

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 canals (203 km), number of Government tube wells (773), number of wells (431), and the number of ground-level pump set (14) has remained constant since 2010-11. Shallow, medium, and deep tube wells increased by 1.17%, 248.68%, and 33.55%, respectively, in 2018-19 compared to 2010-11. The district's percentage net and gross irrigated areas have shown consistency over the years, with an average of 87.61% and 83.89%, respectively.

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

Name/Year	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Length of Canal (KM)	199	199	203	203	203	203	203	203	203
No. of Govt. Tube wells	766	766	772	772	773	773	773	773	773
No. of Wells	431	431	431	431	431	431	431	431	431
No. of Ground-level Pump set	14	14	14	14	14	14	14	14	14
Shallow Tube well	17349	17349	17430	17459	17459	17459	17459	17524	17553
Medium Tube well	76	110	177	202	202	202	202	224	265
Deep Tube well	444	452	529	554	558	558	558	583	593
% Of NIA	91.52	85.03	84.05	86.72	85.05	89.49	89.49	89.50	-
% Of GIA	83.84	83.57	83.86	83.73	83.91	84.03	84.09	84.05	-
Source: http://updes.up.nic.in/spiderreports/intialisePage.action									

Canals and groundwater (GW) are the main irrigation sources in the district. The canal's share in the NIA (average, 10.07%) has increased over the years. The share of wells and tube wells in NIA (average, 89.91%) 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 Varanasi(in %)

Source/Year	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Canal (surface Irri.)	8.56	10.23	9.36	10.08	9.72	10.87	10.87	10.88
Wells And Tube-wells (GW Irri.)	91.41	89.77	90.61	89.91	90.25	89.11	89.11	89.11

Others	0.03	0.00	0.03	0.00	0.03	0.02	0.02	0.02
NIA (1000 ha)	87.50	81.37	79.98	83.09	81.39	90.33	90.30	90.26
Source: http://updes.up.nic.in/spiderreports/intialisePage.action								

Table 14 shows that a majority area under Rice (average, 100%), Wheat (average, 100%), Potato (average, 100%), and Sugarcane (average, 100%) is irrigated. Percentages of the irrigated area under pulses (average, 24.26%) and oilseeds (average, 31.44%) are relatively less.

Table 14: Trends in Crop-wise Irrigated Area in Varanasi(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	99.94	99.94	99.94	99.94	100	100	100	100
Total Cereal	91.37	91.23	91.39	91.25	91.45	91.45	91.45	91.45
Total Pulses	24.45	23.96	24.34	23.87	24.36	24.36	24.36	24.36
Total Foodgrains	85.70	85.46	85.71	85.48	85.77	85.77	85.77	85.77
Total Oilseeds	29.02	38.85	28.97	38.85	28.97	28.97	28.97	28.97
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								

2.1.6. Electricity Intensity 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 381.2 KWH in 2014-15 to 611.84 KWH in 2019-20, a net increase of approximately 60.50%. It is a cause of concern, as it can increase the burden on non-renewable resources and create waste disposal problems. The percentage share of the agriculture sector (average, 10%) in the total electricity consumption in the district is very minimal. It can be due to high electricity consumption in secondary and tertiary sectors. Since electricity consumption has increased over the years, the authorities need to switch to more sustainable modes of electricity production, such as solar panels.

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)	381.2	394	536.3	601.53	588.2	611.84
% of electricity consumed in Agriculture sector to total consumption	10.26	9.62	10.94	11.87	9.35	9.18
Source: District-wise Development Indicators file.						

2.1.7. Status of Agriculture Markets

Table 16 shows the marketing infrastructure in the district. It has one main market and five sub-markets, which have remained constant over the period. The number of regulated mandis per lakh hectare of Net area sown had decreased from 6.26 in 2013-14 to 0.99 in 2018-19, which is a notable issue as it is very important for farmers to have proper access to mandis for them to be able to sell their produce.

Table 16: Status of Agriculture Markets in Varanasi

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.)	5	5	5	5	5	5	5
Total Markets (No.)	6	6	6	6	6	6	6
No. of Regulated mandis per lakh Ha. of net area sown	6.26	3.93	-	0.99	1.04	0.99	-

Source: District-wise Development Indicators file and District-wise Statistical Report

2.1.8. 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 year of the conversion.

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 the project should be periodically done through MIS, 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. To sustain the organic farming initiative, a long-term system of payments for ecological services may be evolved to retain the existing farmers and motivate others to move towards this sustainable farming system. There is no assured market for these products, and

farmers do not get premium prices. 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 and Namami Gange Schemes in the district. The district has 663 groups in eight development blocks. The highest number of groups are in Baragaon (173), Pindra (111), followed by Sevapuri (102), Cholapur (74), and Chiraigaon (71). Together, these five blocks constitute around 80% of the total number of organic clusters in the district. 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. Only Baragaon block has organic clusters (3) under the Namami Gange scheme. More work needs to be done to increase organic clusters under the Namami Gange scheme.

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

S. No.	Block	Scheme	No. of groups	No. of farmers in groups			
				Total	Average	Median	SD
1	Arajiline	PKVY	67	2383	35.56	35	10.85
2	Baragaon	PKVY	170	4880	28.7	27	7.81
		Namami Gange	3	78	26	24	6.24
3	Chiraigaon	PKVY	71	2937	41.36	44	10.38
4	Cholapur	PKVY	74	3173	42.87	45.5	15.97
5	Harahua	PKVY	49	1389	28.34	26	7.98
6	Kashi Vidyapeeth	PKVY	16	589	36.81	39	12.11
7	Pindra	PKVY	111	1973	17.77	18	7.76
8	Sevapuri	PKVY	102	2910	28.52	26	13.93
9	District Total	PKVY	660	20234	30.65	28	13.32
		Namami Gange	3	78	26	24	6.24
		Total	663	20312	30.63	28	13.3

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

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/PFOs/contract farming, etc. Organic farming could be an economically viable option in the district if the government builds strong marketing networks linking farmers, processors, and distributors with the easy certification process and minimizes farmers' risk by protecting their farm income through payments of ecosystem services. A long-term system of

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:

- The major problem of the farmers was poor marketing of the organic products and not being able to fetch a premium.
- Scaling up organic production is another problem. The marketing problem is even more serious in the case of perishable vegetable crops. Contract farming companies and Farmer Producers' companies can be encouraged.
- To get the scheme's benefit, farmers generally practice organic farming only on a small part of their land (less than one ha).
- 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.
- The knowledge and awareness level regarding practices under organic farming was inadequate among farmers.

2.2. Trends in Livestock

Livestock forms an integrated part of the rural economy. From Table 18, we can infer that the number of indigenous and exotic male cattle has decreased considerably from 98997 in 1997 to 2714 in 2019 and from 19467 in 1997 to 5707 in 2019, respectively. On the other hand, indigenous and exotic female cattle increased considerably from 106777 in 1997 to 127463 in 2019, and from 47231 in 1997 to 170965 in 2019, respectively. Thus, the total number of cattle increased from 272472 in 1997 to 306849 in 2019, thus, a net increase of 12.61%. Similar inferences can be drawn from the buffalo data as the number of male buffalo decreased, but the number of female buffalo increased. Thus, a net increase of 69.13% in 2019 compared to 1997 is observed in the total population of buffalo. A significant reduction in the indigenous sheep population is observed (75.37%) in 2019 compared to that in 1997. During the same period, the population of exotic sheep also decreased significantly, thus, indicating a decrease in the total sheep population by 73.47%. The total population of goats increased from 108020 in 1997 to 124528 in 2019, a net increase of 15.28%. The total pig population decreased considerably from 47169 in 1997 to 1557 in 2019.

It is significant to note that the number of female cattle and buffaloes has substantially increased over the period, indicating the growth of livestock products, including milk. The substantial decline in the number of male cattle and male buffaloes also shows the rising farm mechanization and declining relevance of animal power, mainly because of the high maintenance cost of livestock. The livestock subsector has around 50% share in the agriculture and allied activities sector and grew at a significant average annual growth rate of 11.25% from 2011-12 to 2018-19.

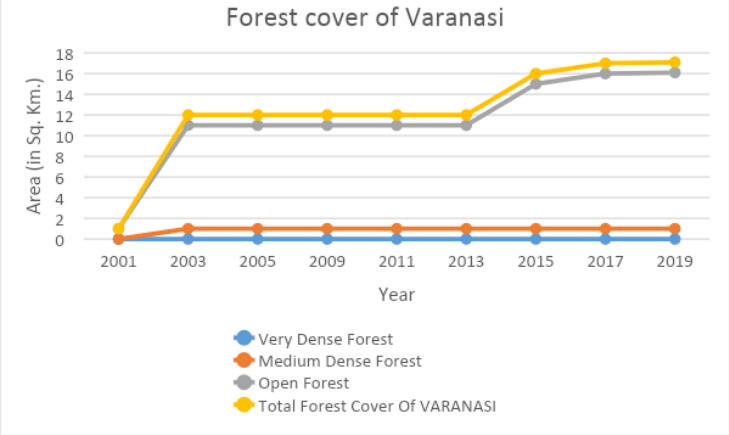
Table 18: Trends in Livestock population (in numbers) in Varanasi						
	Category	1997	2003	2007	2012	2019
Indigenous Cattle	Total Male	98997	51400	63979	48926	2714
	Total Female	106777	87746	77974	138735	127463
	Total	205774	139146	141953	187661	130177
Exotic Cattle	Total Male	19467	11481	14704	12213	5707
	Total Female	47231	25364	30083	40837	170965
	Total	66698	36845	44787	53050	176672
Total Cattle		272472	175991	186740	240711	306849
Buffalo	Total Male	34021	36016	42435	53081	5149
	Total Female	110056	107573	103171	241991	238536
	Total	144077	143589	145606	295072	243685
Sheep	Total Indigenous Sheep	34472	15570	10803	15763	8488
	Total Exotic Sheep	1967	936	741	298	1177
	Total Sheep	36439	16506	11544	16061	9665
Goat	Total	108020	104912	105517	162090	124528
Pig	Total Indigenous Pig	24657	6549	2877	7261	1314
	Total Exotic Pig	22512	830	421	1118	243
	Total Pig	47169	7379	3298	8379	1557
Total Livestock		613927	449885	453369	723579	-
Total Poultry		321939	354144	320266	287082	-
Source: http://updes.up.nic.in/spiderreports/intialisePage.action And http://dahd.nic.in/animal-husbandry-statistics						

Table 19 shows that the Varanasi 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 (18) and cattle development centres (27) have remained consistent over the years. Number of man-made reproduction centres has decreased from 53 in 2011-12 to 49 in 2018-19. There are very few sheep and pig development centres in the district (9 and 1), respectively, which might be one of the reasons for the declining sheep and pig population in the district.

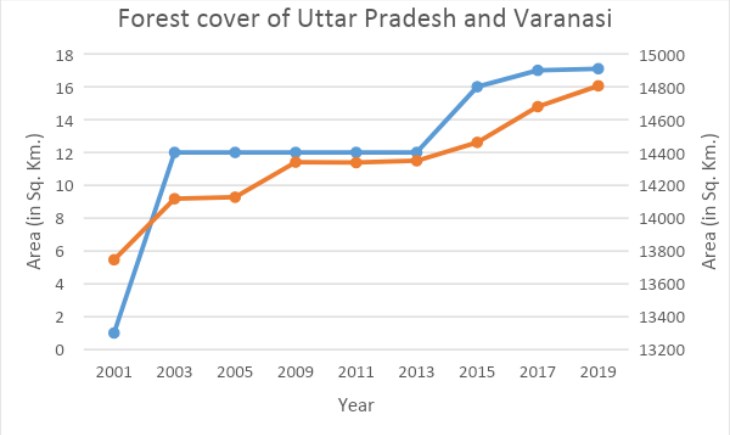
Table 19: Year-wise number of Cattle Hospitals and Development Centers									
Category	2010 -11	2011 -12	2012 -13	2013 -14	2014 -15	2015 -16	2016 -17	2017 -18	2018 -19
Cattle Hospital	17	17	17	18	18	18	18	18	18
D- category Cattle Dispensary	3	3	3	3	3	3	3	3	3
Cattle Development Centre	27	27	27	27	27	27	26	30	27
Man-Made Reproduction Centre	46	53	53	53	53	49	49	49	49
Cattle Reproduction Center	1	1	1	1	1	0	0	1	1

Sheep Development Center	9	9	9	9	9	9	9	9	9
Pig Development Center	1	1	1	1	0	1	1	1	1
Poultry Unit	1	1	1	1	1	0	0	1	1
Source: http://updes.up.nic.in/spiderreports/intialisePage.action									

2.3 Forestry



According to the ISFR reports, there are no major forests found in the district. As per the latest assessment of ISFR 2019, Varanasi has a total of 17.1 Sq. Km. of forest area, majorly open forest, followed by medium dense forest.



According to FSI assessment, the forest cover of Uttar Pradesh has increased over time, but in the case of Varanasi, no major forest cover is found, and over time the forest cover has increased significantly.

2.3.1. Biodiversity: The district's biodiversity data includes 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 yields. A research study performed by Arvind Singh on observation on the flora of Varanasi district concluded that with an area of 1535 km^2, 1015 plant species belonging to 601 genera and 116 families were recorded.

Table 1 Bird species recorded in the district.

Number of species	347
Number of rare/accidental species	3
https://avibase.bsc-eoc.org/checklist.jsp?region=INggupah	

Forest cover (in sq. km.)

Geographical area	Very dense forest	Mid dense forest	Open forest	Total	% of Geographical area `	Change with respect to 2017 assessment	Scrub
1535	0	1.00	16.10	17.10	1.11	0.10	0.00

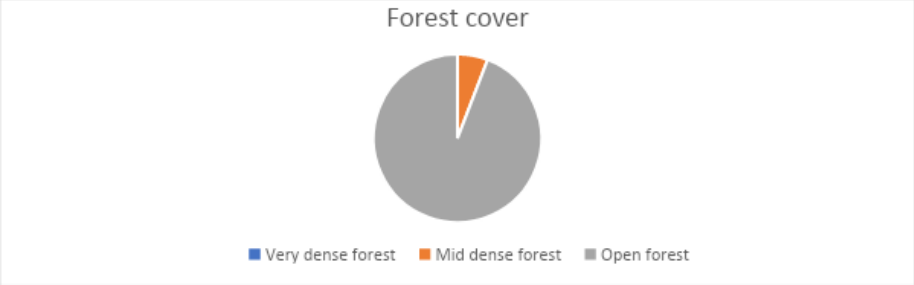


Table 2 change in land use in Varanasi turtle sanctuary between 1974 to 2016

	Change in different land-use classes		
Year	**Water**	**Sand**	**Vegetation**
1974	0	0	0
1988	3.29	-1.45	-90.13
1994	14.76	-20.3	41.45
2000	-11.33	-3.21	60.53
2003	4.77	-20.84	123.03
2008	-22.26	17.64	-65.79
2011	-14.26	3.8	35.53
2013	-11.29	-5.43	90.95
2016	-11.9	0.12	59.87
Mean	5.36(±3.88)	(-3.29 (±3.93))	28.38(±23.22)

2.4 Tourism

Domestic/foreign visitors in different years in Varanasi

	Varanasi			Sarnath				
	Domestic	**Foreigner**	**Total Varanasi**	**Domestic**	**Foreigner**	**Total Sarnath**	**Total**	**% change in total tourists**
2013	4966161	285252	**5251413**	838566	362113	**1200679**	**6452092**	
2014	5202236	287761	**5489997**	899457	374268	**1273725**	**6763722**	**4.83%**
2015	5413927	302370	**5716297**	924552	388102	**1312654**	**7028951**	**3.92%**
2016	5600146	312519	**5912665**	957320	409242	**1366562**	**7279227**	**3.56%**

2017	5947355	334708	**6282063**	1024589	430682	**1455271**	**7737334**	**6.29%**
2018	6095890	348970	**6444860**	1070035	435752	**1505787**	**7950647**	**2.76%**
2019	6447775	350000	**6797775**	1132615	336136	**1468751**	**8266526**	**3.97%**
2020	876303	106189	**982492**	384760	76308	**461068**	**1443560**	**-82.54%**

Table-1; Source: Dept. of Tourism, Uttar Pradesh Government

a. The above-given data table-1 is taken from the Uttar Pradesh tourism website. The data table shows the number of tourists visiting Varanasi and Sarnath for tourism from 2013 to 2020. The tourist visits are bifurcated into two different groups – Domestic and Foreign tourists.

b. In the year 2013 Varanasi received a total **6452092** tourists out of which 10.03% were international visitors. Total number of Domestic travelers were 5804727 and total international travelers were 637365.

c. In the year 2014 Varanasi received a total **6763722** tourists out of which 9.79% were international visitors. Total number of Domestic travelers were 6101693 and total international travelers were 662029. The district experienced a total growth of 4.83% in total number of tourists compared to the previous year.

d. In the year 2015 Varanasi received a total **7028951** tourists out of which 9.82% were international visitors. Total number of Domestic travelers were 6338479 and total international travelers were 690472. The district experienced a total growth of 3.92% in total number of tourists compared to the previous year.

e. In the year 2016 Varanasi received a total **7279227** tourists out of which 9.92% were international visitors. Total number of Domestic travelers were 6557466and total international travelers were 721761. The district experienced a total growth of 3.56% in total number of tourists compared to the previous year.

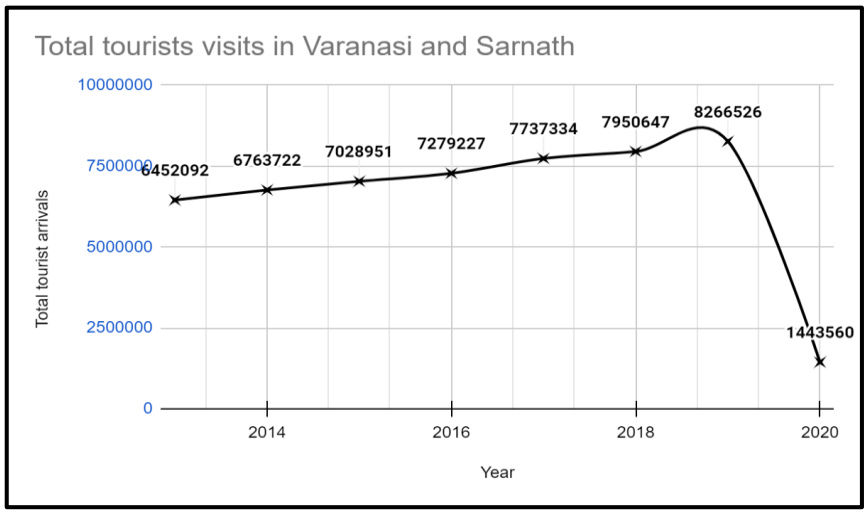
f. In the year 2017 Varanasi received a total **7737334** tourists out of which 9.89% were international visitors. Total number of Domestic travelers were 6971944 and total international travelers were 765390. The district experienced a total growth of 6.29% in total number of tourists compared to the previous year.

g. In the year 2018 Varanasi received a total **7950647** tourists out of which 9.87% were international visitors. Total number of Domestic travelers were 7165925 and total international travelers were 784722. The district experienced a total growth of 2.76% in total number of tourists compared to the previous year.

h. In the year 2019 Varanasi received a total **8266526** tourists out of which 8.30% were international visitors. Total number of Domestic travelers were 7580390 and total international travelers were 686136. The district experienced a total growth of 3.97% in total number of tourists compared to the previous year.

ARTH GANGA PROJECT: DISTRICT VARANASI

i. In the year 2020 Varanasi received a total of 1443560 tourists out of which 12.64%% were international visitors. Total number of Domestic travelers were 1261063 and total international travelers were 182497. The district experienced a total growth of 82.54% in total number of tourists compared to number in the previous year



Graph-1; Source: Dept. of Tourism, Uttar Pradesh Government

a. The Graph-1 shows the total tourists in Varanasi from 2013 to 2020. The data is collected from the official site of Uttar Pradesh Tourism Department. From the graph it is visible that the number of tourists is following an upward curve from 2013 to 2019 and reached a peak in 2019. In the year 2020 the number of tourists suddenly dropped to 1443560.

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

Table-2; Source: Dept. of Tourism, Uttar Pradesh Government

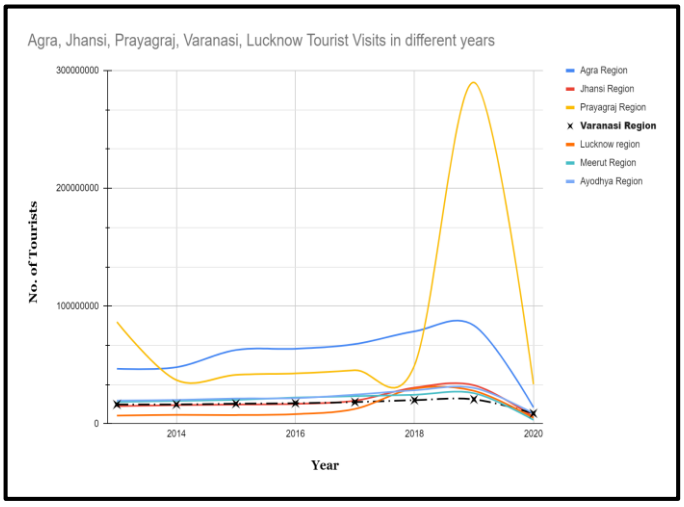
a. The above-given graph shows the number of visitors who visited Uttar Pradesh from 2016 to 2020. The number of domestic tourists increased to 3.4% compared to 2015, and foreign tourists increased to 1.69%. In the year 2017, the growth rate increased to 9.56% in domestic tourists and 12.65% in foreign tourists.
b. Data shows that 2018 has been a fruitful year for Uttar Pradesh tourism. Uttar Pradesh encountered a 21.6% increase in tourist numbers from the previous year, a significant change in numbers. However, the pattern is not similar in Kanpur
c. 2019 was a year when the global event Kumbh Mela 2019 was organized in Prayagraj (a District in Uttar Pradesh). The results are visible in the numbers (given in the data table above), 87.14% increase in the number of tourists compared to 2018. The data also shows foreign visitors increased to 25% in 2019. The enhanced response of tourists shows the consumer behavior, which majorly depends on advertisements. A commodity that has been presented to be associated with the emotions of consumers has a high potential to sustain and perform better than its competitors.
d. The surge in the number of tourists in Kumbh Mela 2019 is attributed to expensive advertisements, extra-standard facilities, and a political campaign. All this together made the event a mega event. Security aspect in such an organization is a significant factor which influences the success and failure. Kumbh Mela 2019 witnessed extra tight security and surveillance to prevent stampedes and violence in the Mela.
e. Such grand organization of events are also a factor on which the number of tourists to other districts (especially domestic tourists) and states (especially foreigner tourists) depend. Although the number of tourists did not significantly increase in Kanpur during Kumbh Mela 2019.
f. The scenario of foreign tourists is worse compared to state data. Even the mega event Kumbh mela could not increase the number of foreign tourists in Kanpur. This signifies the lack of transfer of information.
g. The district witnessed the increased growth in number of domestic tourists but not in foreign tourists. It is necessary to understand the shortfalls before working on upcoming policies and agendas.

Tourist arrival at different tourist regions in Uttar Pradesh

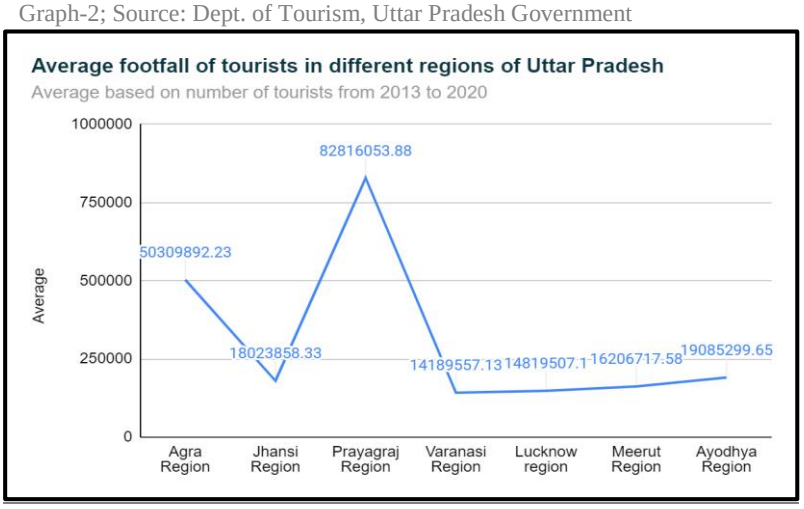
	Agra Region	**Jhansi Region**	**Prayagraj Region**	**Varanasi Region**	**Lucknow region**	**Meerut Region**	**Ayodhya Region**
2013	46752319	15024280	86467808	16404458	6993124	18584494	19720991
2014	48051954	15867723	37140534	16471443	7622268	19472352	20255491
2015	62685236	16349869	41599957	17062843	7462102	20357566	21495262

2016	63740422	16923331	42806944	17511717	8226118	22331685	21804393
2017	67694348	19623512	45496610	18444613	12642302	23448136	24776761
2018	78502264	30711347	49498342	20083978	30019040	24672410	28503743
2019	83542888	32768418	289959139	20761307	28003813	26025786	30465946
2020	13998820	5894496	33618724	8893239	5005142	3317703	8788908

Table-3; Source: Dept. of Tourism, Uttar Pradesh Government



Graph-2; Source: Dept. of Tourism, Uttar Pradesh Government



Graph-3; Source: Dept. of Tourism, Uttar Pradesh Government

	Yearly Average Tourist footfall from 2013-20	Rank
Agra Region	50309892.23	2
Jhansi Region	18023858.33	5
Prayagraj Region	82816053.88	1
Varanasi Region	**14189557.13**	**6**
Lucknow region	14819507.1	7
Meerut Region	16206717.58	4
Ayodhya Region	19085299.65	3

Table-4; Source: Dept. of Tourism, Uttar Pradesh Government

a. The above-given data table-3 and 4 and Graph-2 and 3 is taken from the Uttar Pradesh tourism website. The data table shows the number of tourists visiting Varanasi, Lucknow, Prayagraj, Meerut, Ayodhya, Jhansi and Agra Region for tourism from 2013 to 2020.

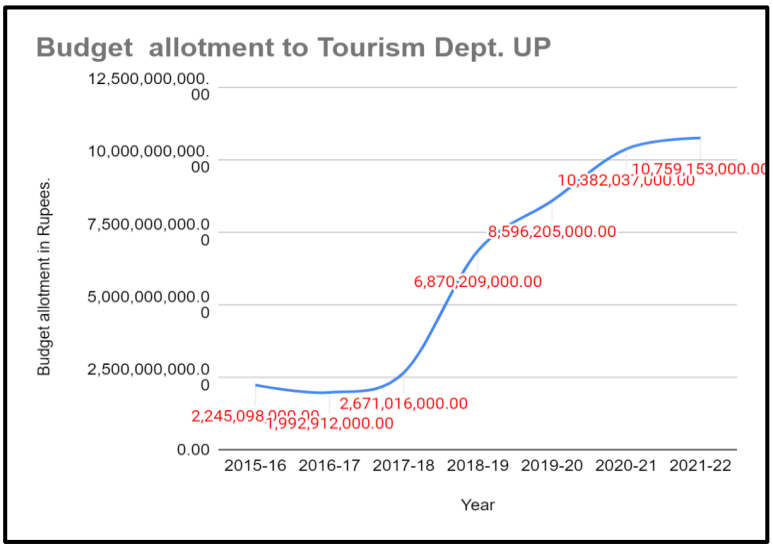
b. From the graph-3 and table-4 it is evident that Varanasi is at rank 6 out of 7 in the number of tourists in average tourist footfalls in the last eight years.

c. From the graph-3 and table-4 it is evident that Prayagraj is at rank-1 and attracted the highest number of tourists in the last eight years. At number two Agra tourism lies followed by Ayodhya tourism at 3rd position.

Budget allotted/ Expenditure in different years by tourism dept.

Budget -Department of Tourism, in Different Years		
Year	**Budget in Rupees**	**Percent increase or decrease**
2015-16	2,245,098,000.00	
2016-17	1,992,912,000.00	-11.23%
2017-18	2,671,016,000.00	34.03%
2018-19	6,870,209,000.00	157.21%
2019-20	8,596,205,000.00	25.12%
2020-21	10,382,037,000.00	20.77%
2021-22	10,759,153,000.00	3.63%

Table-5; Source: Dept. of Tourism, Uttar Pradesh Government



Graph-3; Source: Dept. of Tourism, Uttar Pradesh Government

The above-given table-5 and graph-3 shows the budget sanctioned for the Department of Tourism, Uttar Pradesh, from the Financial Year (FY) 2015-16 to 2021-22. In the initial FYs, which are 2015-16, 2016-17, 2017-18, the amount sanctioned to the department is significantly low. In the FY 2018-19 Department received a 157.21% increased budget. Which followed a 25% increase in the next FY-2019-20. A similar trend is visible in the number of tourists, skyrocketing in the same years. This directly implies that the money spent is directly proportional to the tourists in particular FY.

2.5 Wetlands

The district has a few wetlands consisting of lakes like Jalkhata Tal (27.41 Ha). Table 1 represents the number of wetlands and their area representation in the district. There are around 49 wetlands sized greater than 2.25 Ha and 1081 less than 2.25 Ha areas. The region consists of small and medium-size wetlands only, generally less than 50 Ha in the area, and there are around 7 wetlands with more than 50 Ha.

Table 1: Wetland Data of Varanasi District

	Total Number of		
	Wetlands:	Area (ha)	Aquatic Vegetation

Natural Wetlands	NRCD	NWIA	Diff.	<2.25	<5	<10	<20	<50	<200	<500	<1000	>1000	
Lake/ponds	5	8	3	0	0	0	0	5	0	0	0	0	5
Ox-bow lakes/cut off meanders	0	1	1	0	0	0	0	0	0	0	0	0	0
High altitude Wetlands	0	0	0	0	0	0	0	0	0	0	0	0	0
Riverine Wetlands	3	3	0	0	2	0	1	0	0	0	0	0	0
Waterlogged	11	11	0	0	0	1	3	1	6	0	0	0	10
River/Stream	0	17	17	0	0	0	0	0	0	0	0	0	0
Man-made Wetlands	NRCD	NWIA	Diff.	<2.25	<5	<10	<20	<50	<200	<500	<1000	>1000	AV
Reservoirs/Barrages	0	0	0	0	0	0	0	0	0	0	0	0	0
Tanks/ponds	0	0	0	0	0	0	0	0	0	0	0	0	0
Waterlogged	4	9	5	0	0	2	1	0	1	0	0	0	4
Salt pans	0	0	0	0	0	0	0	0	0	0	0	0	0
Total (1130)	23	49	26	1081	2	3	5	6	7	0	0	0	19

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

- The district comprises 1130 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.
- Half of the wetlands (>2.25 ha) have aquatic vegetation.

2.6 Energy

2.6.1. Solar Energy

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. Various capacity solar power plants are being installed for electricity generation from solar energy.

According to 2011 census (as depicted in figure), majority of households use electricity as the main source of lightning.

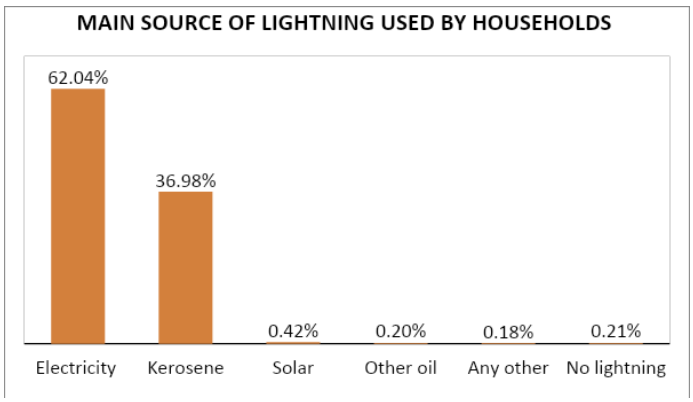


Fig. 1

The annual reports on UPNEDA website mention the various solar plant units installed at the government buildings and other places in the district. Solar Rooftop Systems have been installed at various government offices such as Kashi Vidyapeeth-135 kW, Collectorate Bhawan-104 kW, DLW Varanasi-1100kW, Craft and Museum Varanasi-100 kW, Trade facilitation and Craft museum centerVaranasi – 100 kW, Commisioner Office- 35 kW, Vikas Bhawan- 75 kW, Banaras Hindu University- 8000 kW, IIT BHU-1500kW, Trade facilitation & craft Museum center- 700kW, Northern Eastern Railways Varanasi -1463.48 kW, Collectorate – 104kW, Cantt High School- 10 kW and Cantt Board Offive- 40 kW. . Also 10 Solar High Mast Lightning System have been installed in the district in the year 2018-2019. and 365 R.O water plants in the district.

2.6.2.Biomass Energy

Uttar Pradesh New and Renewable Energy Development Agency (UPNEDA) is the nodal agency which makes 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. Biomass-based co-generation in the state sugar mills and rice husk based-electricity generation projects are being encouraged. The district has a good base for the agriculture and the industries and hence generates its biomass mainly from these two sectors mainly. With 95748 ha as the net sown area and 134073 as the gross sown area, the district has a cropping intensity of 176%. The major crops cultivated in the district are rice, wheat, maize, pearl millet, pea and sugarcane with their productivity recorded as 1608 kg/ha, 2344 kg/ha, 3056 kg/ha, 1159 ka/ha, 1391 kg/ha and 41264 kg/ha respectively.The district's biomass generation from agro-residues is 220.1 kT/Yr and that from forest and waste land is 22.2 kT/Yr [Kumar et. al. (2017)].

In the district Varanasi a few biomass plants have been reported such as a Co-generation power plant (Non-bagasse based) at Ganga paper mill, Biomass gasifiers at M/S Palni food

products, M/S Triakkam Flourmil and Bholanath limited. According to 2011 census about 38% households use LPG/PNG, 30.90% use cowdung cake, 25.19% use firewood as a cooking fuel (Fig.1).

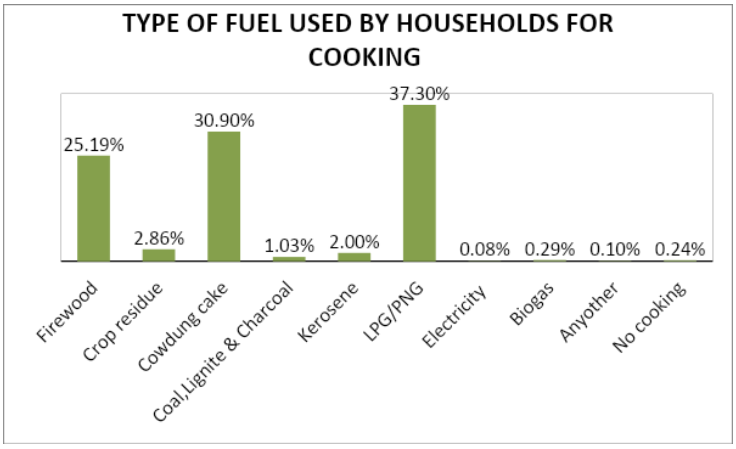


Fig. 1

2.6.3.Biogas Energy

As existing biogas plant data is unavailable for the district, biogas potential has been evaluated by average livestock and agricultural waste production. Biogas potential from animal and agricultural waste is calculated approximately as one crore m^3/year and fourteen crores m^3/year respectively. This amount of biogas generation can efficiently complete the energy demand of the district.

2.6.4.Hydropower Energy

Nonconventional energy development agency UP has identified a site for a small hydropower project of capacity 15 MW with the project name of Karmnasa in Varanasi.

3 QUALITATIVE DATA ANALYSIS

3.1 AGRICULTURE, ALLIED ACTIVITIES,

3.2 FORESTRY

The forests are mainly tropical by mixed deciduous type of trees having varying growth depending upon the nature of the soil and moisture. Banarasi Langra, a delicious and yellowish betel leaf (Maghai Paan) grown in the district is famous throughout the country.
A natural forest is being developed by using Japan's Miyawaki method of afforestation on the outskirts of Undi village in Varanasi. Japan's Miyawaki is a technique pioneered by Japanese botanist Akira Miyawaki, that helps in building dense, native forests.
The approach is supposed to ensure that plant growth is 10 times faster and the resulting plantation is 30 times denser than usual. It involves planting dozens of native species in the same area and becomes maintenance-free after the first 3 years. This will also help in environmental protection and will also encourage eco-tourism.[3]
On the plantation drive on the large scale in the state of Uttar Pradesh, noted river engineer and retired professor of Banaras Hindu University, Prof. U. K. Chowdhary has also cautioned against unscientific plantation of trees in the surrounding area of the river body, which may aggravate the threat of floods.[4]

3.2.1. Biodiversity : The turtle wildlife sanctuary stretches for 7 kilometers along the river from Ramnagar fort upstream to Malviya Bridge. The western bank of the sanctuary is where Varanasi is located. With over 80 Ghats and hundreds of pilgrims passing through each day, the bank is practically finished. On the eastern side, a massive sand bar is generating a large meander. The Sanctuary provides a haven for the riverscape's wildlife, particularly the scavenging turtle species. These turtles reduce the river's organic load by providing unburned/partially burned corpses.

The Uttar Pradesh government has chosen to include "river ranching" within the Namami Gange initiative as part of its attempts to keep the Ganga pollution-free and clean while protecting the river's environment. The department of fisheries will release about 15 lakh fish into the river in the Varanasi district.

3.3 ENERGY

[3] https://www.tribuneindia.com/news/schools/natural-forest-being-developed-in-varanasi-japanese-style-230365
[4] https://timesofindia.indiatimes.com/city/varanasi/uttar-pradesh-expert-warns-against-unscientific-plantation-of-trees-in-river-basin/articleshow/84223289.cms

5.5.1. Solar

A lot of solar plant units have been installed at various government buildings in the district. The district is quite progressive in the solar energy sector, an article in The Times of India is testimony to this. According to this article- A unique floating solar energy exhibition was organized under the Suraj Se Samriddhi (prosperity through the sun) campaign at Assi Ghat in the midstream of Ganga on Friday afternoon. The floating exhibition displayed messages about the need to increase the use of solar energy in every sphere of society and keep the environment safe. Organized by Climate Agenda, an organization working for the protection of the environment, this exhibition was inaugurated by the district project officer of Uttar Pradesh New & Renewable Energy Development Agency (UPNEDA), Ranvijay Singh. The exhibition passed through all important ghats. Campaign organizer Ekta Shekhar said that under its energy policy, the state government has made several announcements for full cooperation in achieving the country's solar energy goals by 2024. "Along with it, the government has also announced plans to convert five cities, including Varanasi, into solar cities. Suraj Se Samriddhi campaign is being conducted in nine cities of the state in order to ensure that solar energy becomes a possibility at all levels in our society," she added

Another article in MERCOM reads- Bids Invited to Install a 2 MW Solar Project at a Water Treatment Unit in Varanasi. According to this article The Uttar Pradesh Jal Nigam has invited bids to develop a 2 MW solar power project at the water treatment plant at Bhelpur in Varanasi. The scope of work will include the survey, investigation, supply, construction, installation, testing, and commissioning of the project along with a 3,000 KVA, 0.415 kV/33 kV electric substation.

5.5.2. Biomass

The district Varanasi has its source of biomass waste from agriculture as well as the industries. Some of the sources available mention that the district has a few of the biomass plants in the district. A decade old article in The Times of India mentions that a biomass-based power plant, established in Fatehullar village of Ghazipur, is bolstering the integrated agri-processing and enhancing the rural economy in the state. The power plant was first-of-its-kind in UP. This biomass plant has employed around 600 people.

According to times nownews.com - India's largest energy integrated company, National Thermal Power Corporation (NTPC) plans to generate power from urban waste. As waste management is a problem in rapidly growing urban cities, the thermal power giant has come up with a solution using waste-to-energy technology. The process has been co-developed with a Chennai-based orthopaedic surgeon. Through the process of Torrefaction (a thermal process to convert biomass into a coal-like material). According to the *Times of India* report, NTPC will use torrified coal made out of carbonised waste at its various plants such as Indore, Bhopal, Hibli and Varanasi centre.

A news article in The Hindu about the BGE states that Biezel Green Energy (BGE) is not a known name, except perhaps in the vicinity of Varanasi, where the company has a production unit. BGE was set up three years ago by two scientists from Indian Institute of Science, Bengaluru —

Preetam Singh and Konda Shiva. BGE produces hydrogen and other fuels from biomass, using a technology invented by Singh and Shiva. They call it 'thermally accelerated anaerobic digestion', or TAD.

Singh tells *Quantum* that the TAD reactors can process 1,500–2,000 kg of biomass over 36 hours to produce hydrogen, methane, bio-coal and liquefied natural gas. One kg of biomass splits into 35-40 grams of hydrogen, 140-170 grams of methane, 280-300 grams of bio-coal — of a high calorific value of 6,500–8,000 kCal/kg, depending on the biomass used. BGE's experience shows that the biomass gasification route is the cheapest. At ₹5 a kg for 1,500 kg of biomass (that BGE pays) and ₹7 a kWhr for 900 kWhr of electricity, the raw material cost per kg of hydrogen for a 60-kg batch yield works out to ₹230 ($3); add other variable costs and overheads, you still end up around $5 — even without counting the value of by-products. This appears too fantastic, when the market price of ultra-high pure 'five-nine' (99.999 per cent) hydrogen is around ₹2,000 a kg; but Singh insists this costing is actual, not theoretical. BGE is already selling hydrogen to NTPC, where it is used as a coolant. Biezel is currently aiming towards building a full-scale plant by December 2021 near Varanasi. With a modular scheme based on 25 reactors, it will produce one tonne of hydrogen per day and cost around 3.5 million US dollars. Beyond this plant, Dr Singh and the team at Biezel Green Energy are actively seeking additional business partners to achieve their scale up objectives in India and overseas.

5.5.3. Biogas

To produce electricity and lessen reliance on non-renewable energy, the Varanasi Municipal Corporation plans to build five biogas-based power plants across the city (thermal power). These five sites are Durgakund, Assi ghat, Pushkar pond, Kanji house in orderly Bazaar, and Beniabagh. The biogas plant will treat biodegradable waste in the area and generate biogas that could be further used for electricity or thermal application.

5.5.4. Hydropower

The state runs national programs for hydropower generation, such as the small hydropower project program. Uttar Pradesh New and Renewable Energy Development Agency and Uttar Pradesh Hydropower Corporation are in charge of minor hydropower development in the state and have identified one site in the district.

3.4 TOURISM

Shri KASHI VISHWANATH TEMPLE

Kashi Vishwanath is locally known as the Golden Temple, it is a temple of Lord Shiva, the presiding god of the city. Varanasi is believed to be the centre at which the first ***jyotirlinga*** (symbol of Lord Shiva), was established by Lord Shiva, establishing supremacy over other gods. It is also believed that lord Shiva brought Ganga to earth first at Varanasi from heaven.

MAA ANNAPURNA TEMPLE

Maa Annapurna temple is located nearby the Kashi Vishwanath temple, Annapurna is believed as the "Goddess of Food", and one who diminished starvation and poverty.

SANKATHA TEMPLE

"Goddess of Remedy " Devi Sankatha temple is located near the Sindhia Ghat. Inside its temple premises there is a giant statue of a Lion. Also, there are nine temples denoting nine planets and chakras.

KALBHAIRAV TEMPLE

It is the ancient temple located near the Head Post Office, Visheshar Ganj of Varanasi. Deity Kal Bhairav is said as "Kotwal Of Varanasi", and beliefs say that without his permission no one can stay in the city Varanasi.

MRITUNJAY MAHADEV TEMPLE

This temple of Lord Shiva is situated on the way of Daranagar to Kalbhairav temple there is a Well of much religious importance. just besides this temple, water of this well is believed to possess a mixture of underground streams and has healing property.

NEW VISHWANATH TEMPLE

The New Vishwanath Temple is situated in the premises of Banaras Hindu University/BHU, a space for worship planned by Pandit Madan Mohan Malviya (the founder of BHU) and constructed by the Birla group.

TULSI MANAS TEMPLE

This modern temple is dedicated to Lord Rama which is situated at the place where Tulsidas (author of Ramcharitmanas), lived and composed the epic "Shri Ramcharitmanas", which recites the life of Lord Rama. Inscribed *shlokas* can be seen on the wall of the temple.

SANKATMOCHAN TEMPLE

Besides the Assi river stream Assi Ghat, near Banaras Hindu Temple this renowned temple of Lord Hanuman is situated. "Sankatmochan" the god who protects from the troubles, is another name of Hanuman, and that is why temple is famous as Sankatmochan temple. It is believed that the temple is founded by Goswami Tulsidas. Many monkeys can be seen inside the temple generally denoted as *Vanar Sena*.

DURGA TEMPLE

Commonly called the 'Monkey temple' it is one of the best-known temples. The magnificent stonework on the walls of temple make is superfine construction. The temple was built in the

18th century, it is the nice example of NAGRA Shilp. Deity DURGA is said as the symbol of Strength and Power. There is a pond/ water body adjacent to the temple called "Durgakund"; people believe that the water of the pond is sacred and had magical features.

BHARAT MATA TEMPLE

Bharat Mata Temple was inaugurated by Mahatma Gandhi in 1936 and established a perfect map of India carved out on the marble. The Temple was tributed by the nationalists/patriot Babu Shiv Prasad Gupta (awarded Barat Ratana) and shri Durga Prasad Khatri, leading numismatists, and antiquarians.

Ganga Ghats

Benaras has 88 ghats at the bank of river Ganga. Most of the ghats are used for taking holy dip and puja ceremonies, whereas two ghats are used exclusively as cremation activities.

Most ghats were rebuilt after 1700 AD by Maratha.

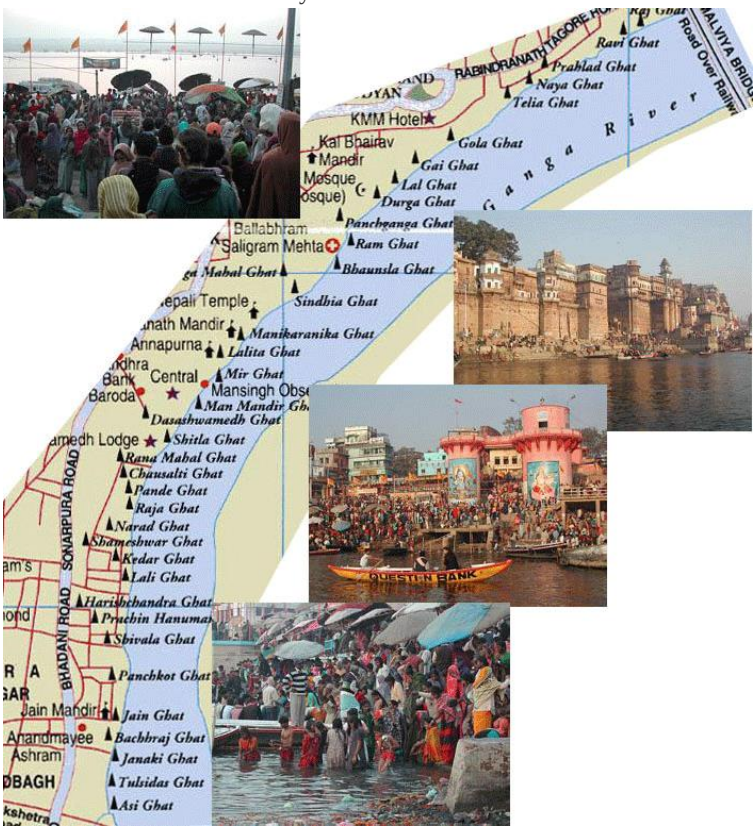


Fig-3,Source- Varanasi.nic.in, Ganga Ghats in Varanasi

ARTH GANGA PROJECT: DISTRICT VARANASI

Sarnath is a Buddhist religious place located 10 kilometres from Varanasi near the confluence of the Ganges and the Varuna rivers. Lord Buddha preached his first sermon at Sarnath after receiving enlightenment.

Several GI tags that Varanasi owns

Banarasi Saree
Varanasi Soft Stone Jali Work
Banaras Gulabi Meenakari Craft
Varanasi Wooden Lacquerware and Toys
Banaras Metal Repousse Crast
Handmade Carpet of Bhadohi
Varanasi Glass Beads
Ghazipur Wall Hanging
Mirzapur made Durries

Excursions

S.No	Destination	Distance from Varanasi	Importance
1.	Sarnath	10 kms	Lord Buddha preached his first sermon.
2.	Ramnagar	14 kms	Museum and Temples
3.	Vindhyanchal	70 kms	One of the Shakitipeeths, Vindhyavasini Devi Temple.
4.	Chunar Fort	40kms	Fort
5.	Kaushambi	185kms	Buddhist Pilgrim
6.	Chandraprabha Sanctuary	70 kms	Rajdari and Devdari waterfalls
7.	Kaimoor Wildlife sanctuary	130 kms	Mukha waterfall
8.	Jaunpur	70 kms	Atala mosque, Jama Masjid, Lal Darwaza Masjid, Khalis Mukhlis Ki Masjid, Shahi Bridge, tombs of

			Sharqui Sultans, Shitla Chowkiya Dham, Trilochan Mahadev temple, Yamadagni Ashram
9.	Vindham Fall	80kms	Waterfall

Data analysis

- **a.** From table-1 it is evident that the number of total tourists in Varanasi increased from 2013 to 2019.
- **b.** Varanasi tourism encountered the highest percentage change in tourists in the year 2017, which was a 6.29% increase compared to previous year.
- **c.** The growth in the number of total tourists in Varanasi is not constant in these years, although the range lies between 3 to 6% change.
- **d.** 2020 encountered a drastic decrease in the number of total tourists, which was due to pandemic like conditions and lockdown worldwide
- **e.** The number of tourists increased in 2017 in Varanasi was highest of all 6.29%, and a similar trend can be seen in Table-2 where the number of tourists in Uttar Pradesh experienced a peak of 9.61% whereas previous year it was 3.37%. It can be interpreted that interventions at state level can influence the number of tourists in the district.
- **f.** In the year 2019, Uttar Pradesh experienced an 87.14% increase in the number of tourists, whereas Varanasi showed just 3.97% increase in the number of tourists. A neighboring district Prayagraj showed a 536% growth in the number of tourists due to Kumbh Mela-2019. Varanasi failed to attract tourists from Allahabad to the district in the particular year. This might be due to underpromotion and advertisements.

3.5 WETLAND

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. 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 is known as land to attain salvation and freedom from the cycle of birth and re-birth. The district also has various Geographical Indications (GI) of goods like Banaras Brocades and Sarees, Varanasi Soft StoneJali Work, Banaras Gulabi Meenakari Craft, Banaras Metal Repousse Craft, Hand made Carpet of Bhadohi, Mirzapur Handmade Dari and many more. The data collected and analyzed shows the region's production

and possible product that can be derived from the raw product. The list of sources and the possible products are mentioned below:

- Pulses, rice, and wheat production are recommended as commercial crops in the region, leading to flour and pluses.
- Products like oil and finished pulses can be derived from crops and millets.
- 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 historical values and has ponds like lotus lake, Lakshmi kund, surya sarvor, Nadesar tal, sankuldhara pokara, etc.
- The region has a large production of dairy products, leading to increased animal husbandry. Wetlands can support the growth of fodder for the animals in the region.

4 ACTION PLAN DEVELOPMENT

4.1 AGRICULTURE

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4.2 FORESTRY

In July 2019, the government of Uttar Pradesh took 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 a minimum support price (MSP) for the timber produced by farmers with a buy-back arrangement. This in turn will motivate them to plant more trees, which would benefit the economy as well as the environment.[5]

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.

4.2.1. Biodiversity: To prevent the biodiversity in the river Ganga, a well-planned strategy is needed to check pollution in rivers, and their tributaries, especially in the Sai river as most of the district sewage goes there. Rivers and ponds represent a shared heritage of the people who live

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

near them. Residents must be made aware of this and its significance in terms of overall quality of life. The necessity of fresh air and oxygen pockets in polluted cities, for example, might be used to persuade individuals of the importance of having a park, pond, or wetland in their neighborhood.

4.3 TOURISM

Eco-tourism- Eco-tourism is also known as responsible travel to natural tourism spots that conserve and preserve the environment along with assisting local communities to sustain. Eco-tourism focuses on enriching personal experiences in tourism by bringing awareness and promoting natural existing habitats, cultures, and societies.

Conservation through providing market-linked long-term solutions, eco-tourism brings effective economic incentivisation schemes for promoting and enhancing bio-cultural diversity. Eco-tourism assists in the protection of the natural and cultural heritage of our motherland earth.

Capacity building and employment generation for the local communities through eco-tourism approaches. By creating opportunities and empowering local communities to fight unemployment, poverty, hunger and achieving sustainable development goals.

Principal of Ecotourism-

- Eco-tourism aims at bringing together the concept of nature conservation, community empowerment and sustainable tourism through-
- Reducing physical, behavioural, social, and psychological impact on nature.
- Awareness about environment and cultural awareness and a sense of respect toward nature
- Providing positive experience to both traveller and host.
- Conservation of natural habitat
- Creating memorable interpretative experiences to tourists that bring sensitivity to host countries' political, environmental, and social climates.
- Design, construct and operate and supply economical facilities.

  Recognize the rights and spiritual beliefs of the Indigenous People/localites in the community and work in partnership with them to bring empowerment.

Sustainable Tourism

It is a type of tourism in which all the needs and desires of a tourist/ and other stakeholders of the tourism industry are fulfilled without compromising the ability of the future generation to utilize the tourism. Several goals of Sustainable Developments Goals are also seen associated with sustainable tourism. Life below water and life on land are impacted by human activities if the tourism place is a water body or forest area; hence it is the duty of all of us to take care of the sustainability aspect in tourism. Sustainability for locals/natives can be provided by including them in trade and business activities.There is a sense of responsibility of different stakeholders associated with tourism to develop sustainable tourism. In which each stakeholder takes care of

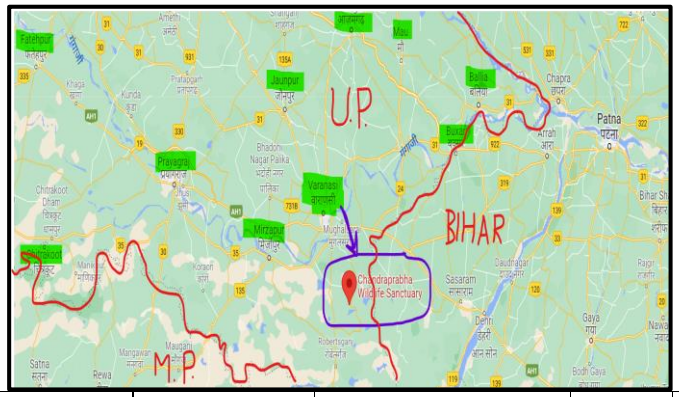
other stakeholders and biotic and abiotic factors. For example, reducing the Carbon footprint per visitor, using eco-friendly vehicles to roam around, supporting local businesses.

One example of sustainable tourism is promoting tourists to travel off-season. It will reduce the impact of seasonal unemployment on the marginal traders and other workers in the tourism sector. Offering eco-friendly services is another example of sustainable tourism. Providing tourists with a cycle to roam around nearby places with help in reducing carbon footprint and it economical. It is aimed at the minimum negative impact on the environment created by tourism activities.

Chandra Prabha Wildlife Sanctuary-

The sanctuary is located 70 kilometers from the city center at the eastern boundary of Uttar Pradesh. The site attracts huge number of tourists because of its scenic view at Rajdari and Devdari waterfall and wildlife. Huge variety of fauna and flora can be seen at this place including Black Duck, gharial, Cheetal, Sambar, nilgai, porcupine, wild boar, Indian gazelle, python and many more. An area of 9600 hectares is allotted to wildlife sanctuary and an additional area of 66000 hectares is allotted surrounding the sanctuary to Kashi Forest division.

Figure-2 Source Google maps. Showing *Chandraprabha Wildlife Sanctuar*



Projections and Monitoring matrix

Sector	Intervention	Strategy	Total cost	Expected Outcomes
Tourism	**Research**	• Based on various data and matrices, it is possible to predict the reason and motivation for tourism. Through extensive qualitative and		A well-researched document as a reference for other processes. Factors that affect tourism in Uttar Pradesh.

		quantitative research, it is also possible to determine the variables affecting tourism in Uttar Pradesh. ● Research must be free from all the political pressures and influences. ● The researchers must ensure that the field data and secondary data are correct and not modified while entering the new records. ● Need to involve unbiased researchers.		Define the determinant of tourism activity.
	Planning	● Action plans can be developed for intervention based on the research and analysis of different data and reports. ● Developing an Action plan is vital because results depend on how it is planned. ● Planning must consider the social status of the State and the image in the tourists' minds.		Planning to be based on research and previous lessons. Realistic planning for successful implementation. .

		• No place should be given to non-practical projections. • Planning about when to organized Mahotsav/ festivals/ fairs to pump the local economy • Separate planning for different demographics of tourists for comfort and leisure tours. For example, while planning the tour packages and tariffs, it is crucial to consider the demography of tourists. Foreign tourists ask much for hygiene while local tourists ask much for discounts. Hence these concerns must be included. • Need to develop the sites as per a set of standards to attract a wide range of tourists. • Brand Manufacturing		

		to increase tourism activity. ● Organizations of grand events. ● Use of allocated budget.		
	Implementations	● Various schemes can be developed, such as tourist packages, tariff plans etc., to attract more and more tourists. ● Mahotsav and Fairs to be organized to rejuvenate the local economy and attract tourists. ● Developing tourist circuits. ● Developing eateries ● Connecting tourism with local culture and food. ● Extensive marketing for advertisement. ● Famous face as brand ambassador. Ravi Shankar (musician) belongs to the city can be a face. ● Intensive branding and marketing. ● Development of tourism spots		To attract more number of tourists and maximize the revenue from tourism. To improve the image of the State and not let the other social factor affect the revenue of tourism.

		and heritage sites. ● Availability of information on government websites along with tour packages. ● An extensive market research for the development of strategies		
	Impact Assessment of results	● Calculating what the touch points are. ● The reason for failure ● The reason for the success ● Lesson for next planning		To learn the lesson and find out the root cause of success and failure, to be used further with modification

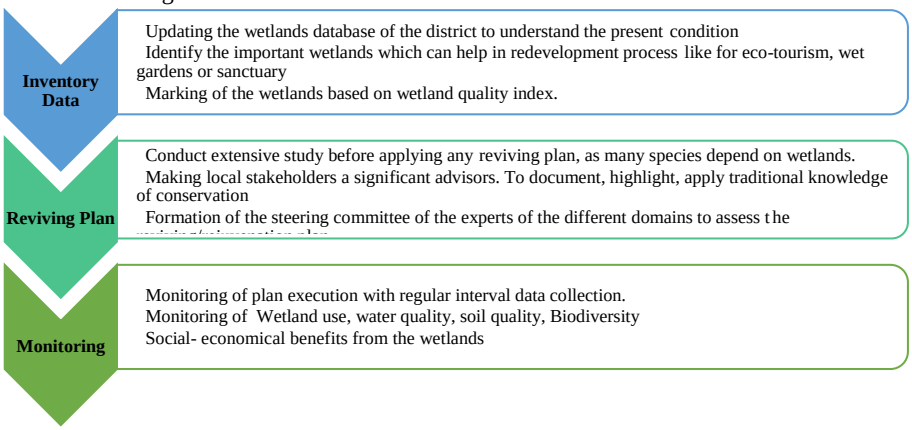
SWOT analysis of Tourism

S No.	Strength	Weakness	Opportunity	Threat
	● Great religious significance ● Kashi Vishwanath Temple ● Assi Ghats of Ganga ● Benaras Hindu University ● Sarnath ● Birthplace of many great Musicians of India	● Unable to attract significant number of tourists. ● Compared to other tourist spots of the UP, Varanasi lies at the bottom in number of tourists footfall. ● Failed to use its image in	● BHU can be a centre of tourism studies and direct implementation at the district level. ● Chandraprabha Wildlife Sanctuary- an ecotourism centre. ● Hinduism and Buddhist religious centre. ● Connects the culture of Uttar Pradesh and Bihar.	● Political negligence. ● Rapid urbanisation. ● Non-sustainable development plans. ● Lack of upgradation in policies. ● The *panda*- who are known for burglary and cheat to tourists.

	● Numerous GI tags which influence economy ● Chandraprabha Wildlife Sanctuary	bringing a greater number of tourists. ● Lack of Cleanliness. ● Failed to take benefit of Kumbh mela 2019 in Allahabad.	● District tourism can use celebrity faces to attract tourists.	

4.4 WETLANDS

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



4.5 ENERGY

4.5.1 Solar

The district has been quite progressive in the solar energy sector and it seems that the people in the district are quite aware of the solar energy. To make solar energy more common among the people it is important that the schemes related to solar energy becomes more and more popular among the people in the district. The farmers should be encouraged to use solar pumps under the Kusum Yojana and wherever required the infrastructure related to solar feeder should be developed, so that farmers get uninterrupted power supply. This will help the farmers to incorporate advanced technology in the farming activities and raise their yield and hence the income. The industrial sector should be provided with the net metering facility especially the small cottage industries and the MSMEs. So that they are easily inclined towards solar energy and they don't have to wait for longer durations after investing a huge sum of capital at once. Solar energy can be used for both heating and lightning purposes in the industries. Those industries involving use of high temperature water for industrial processes should be encouraged to use solar heaters. People should also be encouraged for the grid connected solar rooftop panels under the National Solar Mission.

Projection and monitoring

To begin with, the farmers should be made aware and encouraged about the solar energy and the policies in the district. Followed by this should be the infrastructural development required for the solar feeder segregation. Also the infrastructure required for setting up grid connected solar panels should be made stronger. Policies for the industrial sector should be formulated so that the small scale industrialists are benefitted from it and are able to work by reducing the causal factors of pollution. The industries should also be encouraged to use solar heaters etc. for the heating purpose.

4.5.2 Biomass

The district has been performing well in utilizing the biomass wastes for the energy production. Presently it is required that the agro-wastes are also included for the biomass energy production other than the urban wastes. Also the concerned authorities should keep a check on the prices of the agricultural wastes. The burning of agricultural wastes would also stop if the waste .produced is diverted towards the energy production. Also the sugar and the rice mills should be encouraged to have their own biomass plants. The energy generated could be utilized by the mill themselves and the extra could be sold to the state. This way the mill owners could own more profit. Also a well- developed transportation system should be planned which would include all the biomass waste sources. This transportation should solely be dedicate for this- purpose.

Projection and monitoring matrix

The district already has a set base, but still farmers are needed to make aware so that they can easily sell their agricultural wastes and not sell them. This should be the primary step by the

authorities. Followed by this should be fixing the rates of the biomass wastes so that neither the buyers nor the sellers are at loss.

Further the government should make the state resources easily available to the entrepreneurs so that there are no obstacles. It should be made obligatory for the rice mill and the sugar mill owners to use the wastes for energy production at their mills itself or should send it to the nearby biomass based power plants.

A transportation system also needs to be developed so that there is ease in carrying the biomass wastes from one place to other. Bagasse based co-generation plants, biomass based gasifiers and the Industrial waste based power projects are best suited for the district.

4.5.3 Biogas

Biogas plant removes biodegradable matter and produces biogas that can be further used for cooking in rural areas. In Tiwaripur and Wajidpur village, Gaushala exists but has poor condition. The district should focus on the maintenance of cow shelters and construct a biogas plant near them.

4.5.4 Hydropower

The district has a great potential to generate electricity from hydropower, but only one site has been identified/investigated at present. More research should be done to determine the exact number of plants that can be built.

5 RECOMMENDATIONS

5.1. Agriculture and allied sectors Groundwater shares over 89% of NIA in the district. Number of medium and deep tube-wells increased by 248.68%, and 33.55%, respectively during the study period, while the number of sallow tube-wells increase only by 1.17%. It indicates to the depletion of water table. Therefore, Drip and Sprinkler irrigation systems should be encouraged, especially for vegetable and fruits cultivations. It will help to increase the water use efficiency and productivity of crops. To reduce groundwater exploration, the district needs to construct more tanks and ponds under MGNREGA.

- Food grains consisted of over 85% of GCA and the total value of agricultural products. In contrast, Sugarcane and Potato together comprised only 4.37% of GCA, but their share in value of agricultural output was 13.79%. It indicates that the monoculture (Rice-Wheat cropping system) need to be changed towards high-value cash crops such as horticulture. The government can promote micro and small units for horticulture products processing.

- The livestock subsector is the key driver of agriculture economy of the district. Its share increased from 42.46% in 2011-12 to 62% in t2018-19, with a remarkable average annual growth rate of 11.25%. Dairy farming need to be promoted through creating an efficient marketing network, adoption of cross-breed and setting up dairy and dairy-based processing units. Goats, Sheep and poultry farming can be promoted to improve local livelihood.

- Fishery & aquaculture has a huge scope for raising income and livelihood through effective implementation of PM Matsya Yojana.

- Organic farming should be encouraged to boost soil health, reduce water-use and ensure ecological, economic and social sustainability of agriculture. It could be an economically viable option if the government builds strong marketing networks linking farmers, processors, and distributors with the easy certification process and minimizes farmers' risk by protecting their farm income through payments of ecosystem services. A long-term system of incentive and regulation needs to be evolved to retain the existing farmers and motivate others to move towards the sustainable farming system.

- Training to prepare the Vermicomposting and Green manuring should be organized for the farmers. Moreover, salt-tolerant crops varieties and gypsum application should be promoted in the salt-affected areas.

- About 99% of farmers in the district are small and marginal with landholdings less than two hectares. They can contribute substantial to livestock, vegetables and other labour-intensive allied farm activities. There is a need for adoption of a group farming model by these farmers to get the benefit of economies of scale in production, transport and marketing and to improve their bargaining power.

- There is scope for collective farm mechanization like a combine harvester, seed cum fertilizer drill, zero-till seed cum fertilizer to increase the benefits for farmers.

- Poly house and greenhouse could be commercially used for the high revenue crops, like capsicum, chili, onion, garlic, and strawberry. Medicinal crops like tulsi, mentha, lemongrass, etc. and fruits like papaya, mango, guava, and banana should also be promoted by establishing local market, processing units and cold storage. Commercialization of flower cultivation like Rose, Arhul (hibiscus), Chalemi (jasmine), marigold, gladiolus could generate more income for the farmers.

- Since electricity consumption in agriculture has increased over the years, there is a need to promote the use of solar energy in agriculture.

- Agriculture production is vulnerable to natural and market risks. A compulsory and subsidized crop insurance system must be adopted to protect farmers' livelihood and income.

- Beekeeping can provide good earnings for small landholding farmers.
- The farmers should use resources conservation technologies such as zero-tillage, laser land leveller, mulching, etc.
- Processing units and market access should be provided for Mango, which has good productivity in the district.
- Salt-affected areas of the district can be used for Amla and Karonda orchards.
- Mushroom cultivation for the local youth could be beneficial. There is a need for proper training and market of mushrooms.
- The district is one of the hubs of vegetable cultivation. So, increasing cropping intensity with short-duration crops will give more returns to the farmers.
- There is huge scope for poultry farming. So, poultry feed processing units should be developed in the district.
- There is scope for collective farm mechanization like a combine harvester, seed cum fertilizer drill, zero-till seed cum fertilizer to increase the benefits for farmers.
- The district has ample scope to acquire drip and sprinkler irrigations for promoting vegetable and fruits cultivation.
- Commercialization of flower cultivation like Rose, arhul (hibiscus), chalemi (jasmine), marigold, gladiolus could generate more income for the farmers.
- Processing units and market access should be provided for mango which has a good productivity in the district.
- Organic farming of the district could be promoted by the government's assistant and also need for training and awareness to the farmers.
- Salt-affected areas of the district can be used for Amla and Karonda orchards.
- There is a need to build milk processing units and market access for direct selling of raw milk should be provided.
- Mushroom cultivation for the local youth could be beneficial. There is a need for proper training and market of mushrooms.
- The district is one of the hubs of vegetable cultivation. So, increasing cropping intensity with short-duration crops will give more returns to the farmers.
- Farmers of the district need training for pesticides and fertilizer application. Also, there is a need to introduce some schemes for the farmers toward organic cultivation.

- Greenhouse and poly house should be built especially for high revenue crops, flowers, orchids cultivation will generate more earnings to the farmers.
- There is huge scope for poultry farming. So, poultry feed processing units should be developed in the district.
- There is a need for a cooperative farming model across the different villages of the district.

5.2. Forestry

Varanasi is located on the bank of river Ganga. According to ISFR 2019, 17.1 Sq. Km. The area of Varanasi is covered with forest. As discussed above, the forest cover of Varanasi has increased slightly as compared to the previous assessment of ISFR 2017. No major forest was 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 rivers etc.). Government can promote the afforestation, agroforestry activities by providing output based incentives.

5.2.1. Biodiversity.

- As the district's top place includes the Ganga river, ghats, and temples, the importance of rivers and the effect of pollution should be spread from these places.
- It is recommended to increase plantation in the district as a very low percentage of area is under forest.
- The government needs to build a Sewage treatment plant in the district as the Wazidpur drain carries around 54 MLD comprising mostly industrial waste.

5.3. Tourism

Maintaining heritage buildings: There are several heritage buildings in the city such as Baba Vishwanath Temple, Durga Mandir etc, which are very old monuments, and a proper care and inspection is necessary to maintain its beauty throughout the years**.**

Accessibility: There is an immediate need to improve road infrastructure. The traffic flow will be boosted by good highways and approach points to a specific tourist site.

Safety and security: The system should undoubtedly make provisions that the policies and procedures designed to ensure the safety and security of tourists are implemented effectively. For all travellers, Uttar Pradesh's image must be promoted as a safe and secure tourism destination.

There must be strict laws for local Pandas who are known for burglary and cheating with travellers.

Promotion and selling: 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.

Appointing brand ambassador: Appointing a brand ambassador can help promote Varanasi tourism even more. It is critical to capitalize on their celebrity and fan base for UP tourism to get traction and warmly receive visitors**.** There are numerous celebrity faces that come from the land of Kashi.

Upgrading the skills: The hospitality business should be appropriately groomed and capable of offering the best service possible to tourists. Investing in training schools will assist the young generation in concentrating on their work and acquiring the necessary skills to make the experience worthwhile. Also, training sessions for guides can benefit individual guides and help them earn livelihood and the tourism sector to embrace more tourism. These training sessions can also help know the actual number of available tourists guides in the city. And the same information can be uploaded on the website for customer support.

- Tourists are a source of income for the natives; developing local marketplaces such as specialized malls for locally made handicrafts can give a place to sellers and buyers simultaneously. Usually, local markets (selling original articles) are scattered throughout the city; a specialized marketplace will help the sellers showcase their product at excellent places, and buyers can find a wide variety of ranges at the same site. Banarasi Sarees, Meenakri, Soft stone Jali work etc can be promoted and incentivisation of artisans to motivate them for being associated with the art and craft form to make it alive.
- Letting tourists know about community-based initiatives such as women-led Self-Help Groups and Social Enterprises will support tourism and such industries. As it can bring business to enterprises**.**
- Development of COVID 19 protocol friendly tourism packages to boost the tourism sector economy after the pandemic.
- Ghats can be developed on the verge of international standards to attract more and more foreign tourists. Regular inspection of water quality at ghats and deploy of team that can inspect the other elements such as food stalls, tourist guide availability, drinking water, restrooms etc. for tourists at ghats.
- Supporting tourism can also help flourish other sectors such as local handicrafts, restaurants and eateries, travel agencies, local vendors and many more as all of these are in a symbiotic relationship.
- Assi ghat walk, Heritage walks and Dharmik walk can be continued by the dept. of tourism U.P. on the regular or once in a week/fortnight basis.

Recommended Projects

Banaras is very famous for Banarasi Silk Saree- Government can intervene in the production of Silk Sarees and make a mandate of cap on the business to cease corporates to take on this locally produced silk. Intervention and incentivisation by the government authority can motivate local

artisans to continue production of arts and crafts. Similarly other forms of crafts and artisans can be motivated, and art forms can be preserved.

Hot Air Balloon Ride in Varanasi: Recently a hot air balloon fest was organized in Varanasi from November 17 and 19 2021. The event was organized by the UP tourism department. The ticket was also economical, 500 INR per head for one ride which lasted 45 minutes and covered all the beautiful ghats of Varanasi. It can be made available throughout the year for tourists to experience Kashi from the 1000 ft above.

5.4. Wetlands

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

- Introduction of improved cultivars and production technologies for pulses and oilseeds.
- Diversification through introducing vegetable, mushroom, beekeeping, fruits, medicinal plants, dairy, poultry etc. for nutritional security
- It is recommended to rejuvenate and restore the water bodies of the district.
- 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 by creating a market for selling handicrafts nearby.

5.5. Energy

5.5.1. Solar

The district Varanasi, has been quite progressive in the solar energy sector. If the industrial and the agriculture sector will be supported by the solar energy then district would definitely set itself as an example for others. Developments in the economic sector with the help of solar energy would lead to progressive and sustainable livelihood in the district.

5.5.2. Biomass

The district is doing well in biomass energy production and if a few steps are taken by the concerned authorities then its performance would get a shot up. These can be planning a transportation system, rice and sugar mills having biomass based plants and the new entrepreneurs getting an easy environment for setting up biomass plants. Bagasse based cogeneration plants, biomass based gasifiers and the Industrial waste based power projects are best suited for the district. This will also lead to increase in employment and hence there will be an overall development in the district’s economy as well as the livelihood.

5.5.3. Biogas

- Increase cattle shelter capacity, maintain cow shelter in Tiwaripur, Wajidpur, and other villages, and set up a biogas plant.

5.5.4. Hydropower

- It is recommended to construct and check the potential of hydropower in the canal of Ahrira Dam.

6. Discussion during the Report Presentation

- Jalaj is active at the ghaats as Jalaj Safari and training units.

- The opportunity of utilizing the ashrams as wedding venue will be explored.
- The place already holds a great mythological importance and experience a large number of tourist footfalls.
- Organic Farming has been implemented in various clusters in large scale.
- Natural Farming workshops will be organized in association with NMCG.
- 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.

~~6~~7 REFERENCES

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~~7~~6 APPENDICES

Table 3 Crop production in the district.

Crop/Year	2015-16	2016-17	2017-18
Non-grain crops (Metric Tonne)	10978	16027	14490
Grain crops (Metric Tonne)	270429	374066	381179
Sugarcane (Metric Tonne)	235639	272365	169310
Potato (Metric Tonne)	54514	63521	63953

Table 4 Livestock population in the district.

Livestock	2003	2007	2012
Cattle (Cow)	175991	186740	240711
Buffalos	143589	145606	295072
Sheep	16506	11544	16061
Goat	104912	105517	162090
Pigs	7379	3298	8379
Chicken	354144	320266	287082
Other Poultry	1844	179063	7809
Horses and Ponies	37	34	141

Table 5 Biogas potential from animal waste.

Livestock	Residue type	Total population as of 2012	Manure yield* (kg/day)	Total manure generation annually (kg)	Average collection (75%)	Dry manure after removing Moisture content	Manure required for biogas* (kg/m^3)	Biogas potential (m^3/yr)
Cattle	Manure	240711	10	87,85,95,150	658946362.5	131789272.5	25	5271570.9
Buffalo	Manure	356180	15	1,95,00,85,500	1462564125	292512825	25	11700513
Sheep	Manure	16061	1	58,62,265	4396698.75	879339.75	25	35173.59
Goat	Manure	162090	1	5,91,62,850	44372137.5	8874427.5	25	354977.1
Pig	Manure	8379	2.5	76,45,838	5734378.125	1146875.625	25	45875.025
Poultry	manure	2,94,891	0.1	1,07,63,522	8072641.125	1614528.225	25	64581.129
Total		**10,78,312**						**17472690.74**

Table 6 Biogas potential from agricultural waste.

Crop	residue type	Total crop production (tons) (2017-18)	Residue production ratio	Residue amount (tons)	Average collection (70%)	Moisture content	Residue amount after removing	Biogas potential [m3/(tons of dry matter)]	Overall biogas potential (m3)

							moisture (tons)		
Maize	straw	5246	1.5	7869	5508.3	15	4682.055	800	3745644
Wheat	straw	234528	1.5	351792	246254.4	30	172378.08	800	137902464
Sugarcane	Bagasse	169310	0.33	55872.3	39110.61	80	7822.122	750	5866591.5
Total		**409084**							**147514699.5**