# Arth Ganga Project: District Samastipur

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*Submitted to*

National Mission for Clean Ganga (NMCG)

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# EXECUTIVE SUMMARY

Samastipur, with a few small industries, this agrarian district is located in the state of Bihar. The district is traversed by the rivers Ganga and Kosi.

The total geographical area of the district is 2,904 $Km^2$, out of this the permanent pastures are 69 ha, the Cultivable wasteland is 3930 ha, and the Land under non-agricultural use constitutes 62138 ha. The district's soil types are divided as, very deep- Calcareous fine loamy; Very Deep-Calcareous fine silty; Very Deep-Coarse loamy and very deep-Very fine cracking. With the net sown area of 184061 ha and gross cropped area of 252041 ha, the Cropping intensity of the district is 137%. The net irrigated land area is 66080 ha whereas the rainfed area is 117981 ha. The major crop types are rice, wheat, maize, etc. Among the horticulture fruits are, mango, banana, litchi, etc. Among the horticulture fruits are potato, brinjal, cauliflower, tomato, etc. Medicinal and Aromatic crops found in the district are Lemongrass, Java citronella, Mentha, etc. The livestock consists of cattle, buffalos, goats, sheep; along with poultry and marine as well inland fisheries.

The total forest cover of the district is only 153.36 $km^2$. There is no prominent forest cover in the district. Out of total forest cover, the maximum area is covered by Moderately dense forest (105.3 $km^2$) followed by Open Forest (48.06 $km^2$). The district consists of 359 species of birds present in the district and 10 accidental species. The district comprises of total 815, mostly small and medium-sized, waterlogged, and lake/ponds/tanks wetlands. The number of natural wetlands is more than that of man-made ones. There are ample tourist places like Thaneshwar Mandir, Hazrat Mazar, Vidyapati Dham, Malinagar, Khatu Shyam Mandir, Dhamaun, etc. Banghara Pokher is a region with high biodiversity and potential tourist attraction. The district is also known for Mithila paintings which aids the cultural beauty attracting tourists. There has not much data reported for the district.

The main source of lightning is kerosene (88.74%) closely followed by electricity (10.35%) while only 0.35% is the usage of Solar energy. The main fuel source is crop residue (49%) followed by firewood (37%) and LPG/PNG usage is only 5%. Sixty-four and twenty-nine biogas plants of $2m^3$ and $3m^3$ capacity have been installed during the years 2007-2008 and 2009-10 respectively. The total biomass power potential available in the district Samastipur is high enough. Along with a few other districts, Husk Power Systems (HPS) set up 20 more plants of 32 kW generating capacity in Samastipur. Biogas potential from animal waste is calculated approximately as 2 crores $m^3$/year and 31 crores $m^3$/year from agricultural waste. No hydropower plants exist in the district nor are identified for the district.

The district needs to enhance its use of renewable energy sources, especially high biogas potential if utilized will not only boost the economy but also reduce pollution. Afforestation, ecotourism, Miyawaki plantation, homestead forest, monitoring and creating awareness, etc. should be promoted in the district. Agricultural mechanization, Micro-irrigation, organic

farming, awareness and participation by the farmers, adopting poly house and greenhouses, gypsum application, Vermicomposting, and green manuring, Drip and sprinklers irrigation, water harvesting structures, adopting Indigenous Technical Knowledge, etc. are a few practices that need to be incorporated in the agriculture sector. Also, certain practices such as the cultivation of medicinal plants and Zaid crops, mushroom and flower cultivation, Poly house and greenhouse, inter-cropping, etc along with encouraging beekeeping, fisheries, dairy and animal husbandry, etc. should be adapted and encouraged in the district.

# 1 DISTRICT OVERVIEW

## 1.1 INTRODUCTION

Samastipur is one of the thirty-eight districts of Bihar in India. The district headquarters are located at Samastipur. The district is located on global map between 25°51' North latitude and 85°46' East longitudes. The district occupies an area of 2,904 square kilometers. The rank of the district in comparison to other districts of Bihar in terms of area is 14th. The district is surrounded by Bagmati and Darbhanga district in the north, Ganga River and Patna District in the south, Darbhanga and some part of Khagaria and Begusarai district in the east, Vaishali and some part of Muzaffarpur district in the west. In the year 2019, there was a total 5.28% forest area of the total geographical area. Administration wise, the district is divided into 4 sub-divisions Dalsinghsarai, Patori, Rosera and Samastipur. There are 2 Lok Sabha and 10 Assembly constituencies. The district comprises of 7 towns and 1246 villages.

According to 2011 census the district has a population of 4261566 including 2230003 are males and 2031563 are females. The district has a sex ratio of 945 females for every 1000 males and literacy rate of 61.86%. The work participation rate (WPR) in the district is 21.29 percent for main workers and 10.23 percent for marginal workers. Proportion of non-workers in the district is 68.48 percent. The work participation rate (WPR) at town level in the district is 23.95 percent for main workers and 3.55 percent for marginal workers. Proportion of non-workers in the district is 72.50 percent. The economic activity in the rural and urban areas of the district is supported by the fact that the cultivators (22.26%) and agricultural labourers (53.72%) together constitute 75.98 percent of the total workers of the district.

Agriculture is the principal economic activity of the district and nearly 83 percent of the total working population depends on it. Wheat, pulses and edible oil seeds are also grown here. Tobacco is processed and exported to distant places of the country. The district has also a rich endowment of fruits like mango, lichi and banana. These fruits in sizeable number are exported is sizeable quantity outside the state also. The district has some small industries such as sugar mill, paper mill, jute mill and railway factory. A huge chunk of revenue comes from these small industries every year.

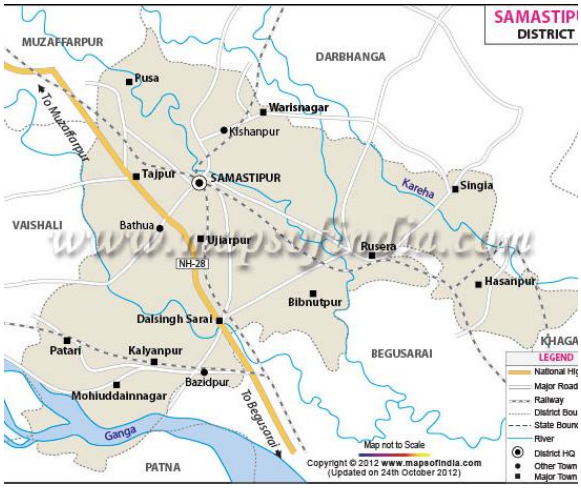



*Figure 1 Map of the district*

## 1.2 DEMOGRAPHIC PROFILE OF SAMASTIPUR

Geographic area: 2,904 $Km^2$
Altitude: 36 m
Rainfall: 879.6 mm (2018-19)
Forest area: 153.36$Km^2$
Rivers: Ganga, Kosi

Administrative Divisions:

| | |
|---|---|
| District Headquarter | Samastipur town. |
| No. of subdivision | 4 |
| No. of Blocks | 20 |
| No. of Villages | 1246 |

Demographic and Socio-economic Parameters:

| | |
|---|---|
| Population | 42,61,566 |
| Population Density | 1467 / $Km^2$ |
| Sex Ratio | 945 |
| Literacy | 61.86% |
| Occupation/Livelihood | Agriculture |

## 1.3 AGRO CLIMATIC PROFILE OF THE DISTRICT

## 1.4 ECONOMIC PROFILE OF SAMASTIPUR

The economy of the district is mainly dependent on agriculture. Since its soil is very fertile so the district is rich in almost all agricultural products. The chief agricultural crops in the district are paddy, maize, litchi, mangoes, potatoes, tobacco, chilli, turmeric, etc. The district has some small industries such as sugar mill, paper mill, jute mill and railway factory. A huge chunk of revenue comes from these small industries every year. In 2006 the ministry of Panchayati Raj declared it as one of the country's 250 most backward districts and it is currently receiving funds from the Backward Regions Grant Fund Programme (BRGF). In the year 2011-12 the gross domestic product in the district was Rs. 6,95,256 lakh at current price
and Rs. 4,20,763 lakh at constant prices in the year 2004-05. In the year 2011-12 the net domestic product n the district was Rs. 6,26,244 lakh at current price and Rs. 3,73,954 at constant prices in the year 2004-05. (IndiaStat).

# 2 QUANTITATIVE DATA ANALYSIS

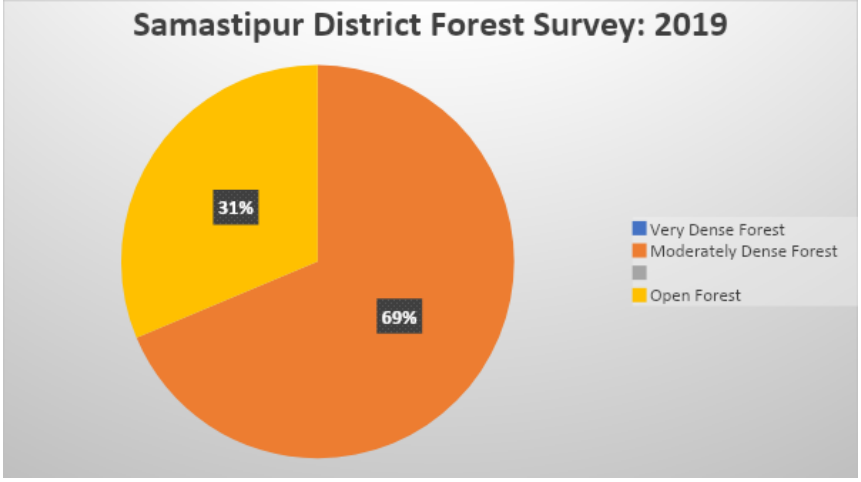
## 2.1 Agriculture and Allied Activities

## 2.2 Trends in Livestock

## 2.3 Forestry

District of Samastipur has 2904 $Km^2$ total geographic area. Forest cover area as per 2019 forest survey assessment is only 153.36 $Km^2$. This is 5.28% to the total area which makes district severely forest deficient area. The state has total 7305.99 $Km^2$ forest area which is 7.75% of total geographic area of the state.

Samastipur district does not have forest under the category of Very Dense Forest (VDF), 105.3 $Km^2$ of area comes under the category of Moderately Dense Forest (MDF) and 48.06 $Km^2$ is open forest (OF) as per 2019 assessment.



| Forest Survey of India 2019 Bihar State vs Samastipur Comparative Assessment | | | | | | |
|---|---|---|---|---|---|---|
| Area | Geographical Area | Very Dense Forest | Moderately Dense Forest | Open Forest | Total | %of Geographical Area |
| Samastipur | 2904 | 0 | 105.3 | 48.06 | 153.36 | 5.28 |
| Bihar | 94163 | 333.13 | 3280.32 | 3692.54 | 7305.99 | 7.76 |

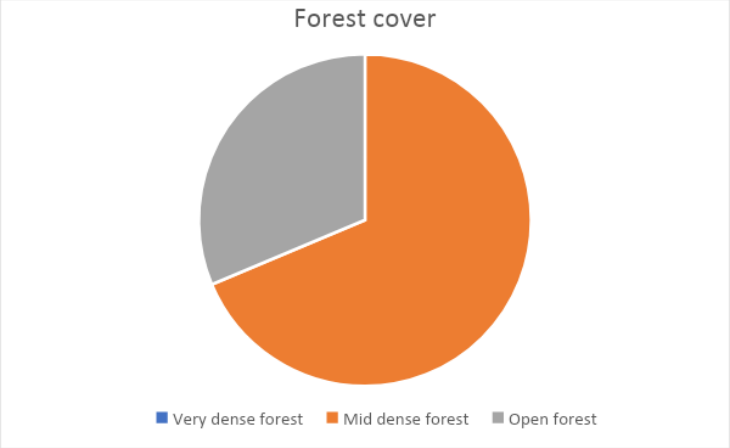
**2.3.1. Biodiversity:** The district's biodiversity data includes crop production, livestock population, bird species, and forest cover. The district has a forest area of 153.36 square km, in which 69% area is mid-dense forest, and 31% area is open forest. According to the world bird database (avibase), there are 359 species of birds present in the district, and ten species are in the accidental category.

*Table 1 Bird species recorded in the district.*

| | |
|---|---|
| **Number of species** | 359 |
| **Number of rare/accidental species** | 10 |
| *https://avibase.bsceoc.org/checklist.jsp?lang=EN&p2=1&list=clements&synlang=&region=INwhukut&version=text&lifelist=&highlight=0* | |

**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** |
|---|---|---|---|---|---|---|---|
| 2904 | 0 | 105.30 | 48.06 | 153.36 | 5.28 | -3.64 | 0.00 |




## 2.4 Tourism

## 2.5 Wetlands

The district has vast wetlands consisting of large lakes/ponds and waterlogged like Darjaniya Tal. Table 1 shows the number of wetlands and their area representation in the district. There are around 262 wetlands sized greater than 2.25 Ha and 553 less than 2.25 Ha areas. The region consists of mix of small and large wetlands, generally less than 200 Ha in the area but 4 are greater than 200 Ha.

**Table 1: Wetland Data of Samastipur 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 | 24 | 42 | 18 | 0 | 2 | 3 | 5 | 7 | 5 | 1 | 1 | 0 | 11 |
| Ox-bow lakes/cut off meanders | 10 | 41 | 31 | 0 | 4 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 2 |
| High altitude Wetlands | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Riverine Wetlands | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Waterlogged | 32 | 108 | 76 | 0 | 7 | 6 | 4 | 7 | 6 | 1 | 0 | 1 | 20 |
| River/Stream | 0 | 29 | 29 | 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 | 12 | 40 | 28 | 0 | 11 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 4 |
| Waterlogged | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Salt pans | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total (815)** | 78 | 262 | 184 | 553 | 24 | 11 | 11 | 17 | 11 | 2 | 1 | 1 | 37 |

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

- The district comprises 815 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.
- 15% of the wetlands (>2.25 ha) have aquatic vegetation.

Some of the known wetland exist in the district with their area (in Ha) are as follows:

| Natural wetlands (lake/ponds) | | | |
|---|---|---|---|
| 50 | Dasraha | 65.43 | Darjaniya Tal |

## 2.6 Energy

### 2.6.1. Solar Energy

BREDA i.e. Bihar Renewable Energy Development Agency, has been established to promote development of schemes on non- conventional energy sources. BREDA aims to work as a Catalyst for Change by utilizing the Best Renewable Energy Technology to cater to the ever growing Growth Potential of Bihar.

According to 2011 census, the main source of lightning used by the households is kerosene, followed by electricity. Only 0.35% households use solar as depicted in figure.

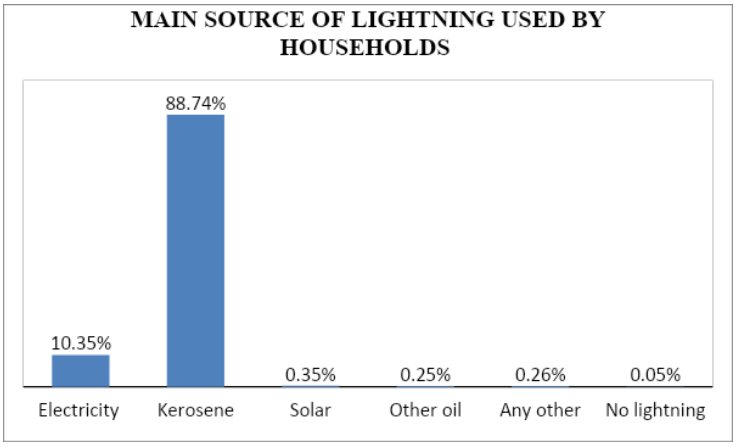



**Fig. 1**

The district has a good solar energy potential. According to Pugazenthi et. al. (2016), the total solar energy potential available in the district Samastipur is 0.1153.

### 2.6.2.Biomass Energy

## ARTH GANGA PROJECT: DISTRICT UTTARKASHI

BREDA i.e. Bihar Renewable Energy Development Agency, has been established to promote development of schemes on non- conventional energy sources. BREDA aims to work as a Catalyst for Change by utilizing the Best Renewable Energy Technology to cater to the ever growing Growth Potential of Bihar.

The district's economy is mainly dependent on agriculture. The net sown area of the district is 184061 ha. With 67980 ha as the area sown more than once in the district, the district's gross cropped area is 252041 ha, leading to a cropping intensity of 137%. Table 1

| CROP | PRODUCIVITY (kg/ha) |
|---|---|
| Rice | 3652 |
| Wheat | 3205 |
| Maize | 4433 |
| Greengram | 500 |
| Lentil | 850 |
| Banana | 31000 |
| Guava | 10000 |
| Litchi | 10000 |
| Potato | 2000 |

Table-1

According to the 2011 census 49% households use crop residue for cooking followed by 37% households using firewood, 7% using cowdung cake and only 5% using LPG/PNG (FIGURE).

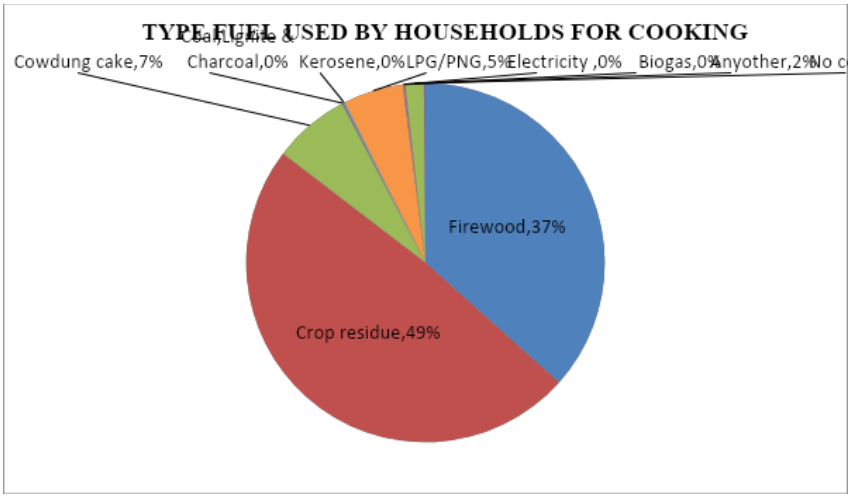



**Fig. 1**

The district has good biomass energy potential. According to Pugazenthi et. al. (2016), the total biomass power potential available in the district Samastipur is 0.3949.

### 2.6.3.Biogas Energy

Sixty-four and twenty-nine biogas plants of $2m^3$ and $3m^3$ capacity has been installed during years 2007-2008 and 2009-10 respectively. Biogas potential has been evaluated by average livestock and agricultural waste production. Biogas potential from animal waste calculated approximately as two crores $m^3$/year and thirty-one crore $m^3$/year from agricultural waste. This amount of biogas generation can efficiently complete the energy demand of the district.

### 2.6.4.Hydropower Energy

Samastipur is crossed by several rivers, including the Budhi Gandak, Baya, Kosi, Kamla, Kareh, and Jhamwari and Balan, both of which are offshoots of the Burhi Gandak. The Ganges also runs through the area to the south. No hydropower plants exists in the district, nor the future sites have been identified for the district.

# 3 QUALITATIVE DATA ANALYSIS

## 3.1 AGRICULTURE, ALLIED ACTIVITIES,

## 3.2 FORESTRY

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

Recently, The United States Agency for International Development and Bihar's Department of Environment, Forest and Climate Change jointly launched forest monitoring tool. which will use

satellite images and geo-analytics to improve forest monitoring, planning, and management in the state. This will help forests to pull more carbon out of the air, enhance water yields, and improve livelihoods for indigenous and tribal communities (Outlook, 2021).

**3.2.1. Biodiversity :** The Banghara Pokher is situated in village Ghataho of Samastipur District. The water of this Pokher is used for bathing and drinking for cattle. A study on fish diversity was performed in the Pokher and confirmed occurrence of 25 species. Because zooplanktons are severely impacted by environmental variables and respond fast to changes in water quality, it's diversity is one of the most important ecological factors in water quality and biodiversity evaluation. The intermediary connection between phytoplankton and fish is zooplankton. A study on Holi Pokher (situated in village Ghataho near village Kishunpur of Samastipur district) for zooplankton diversity confirmed that they are present in the Pokher abundantly (2561 per liter) shows healthy environment of the Pokher.

### 3.3 ENERGY

As per the data of the year 2013, Samastipur district energy consumption is around 200 TJ/year and 2.9 GJ/capita/year. GHG emission of 17126 Ton $CO_2$ equivalent and 0.252 Ton $CO_2$ equivalent/capita has been evaluated for the district.

#### 5.5.1. Solar

Samastipur has a good potential of solar energy and the administration has been putting efforts in making the district utilize its solar potential. An article in Hindustan with the heading "Solar power plant will be installed in 200 schools of Samastipur" mentions- Survey being done by the department: Under the Jal-Jeevan Hariyali Yojana, instructions have been given by the department to set up solar power plants in plus two schools. In the course of inspection, the roof of the school, premises etc. were checked. In this, the roof and premises of about 200 plus two schools have been found in a position to install solar power plants.

#### 5.5.2. Biomass

The district Samastipur, inspite of having biomass potential has not developed upto its capacity. An article in The Economic Times, with the heading 'Why wait for gas? NRIs power West Champaran with rice husk' reads- Like the rest of Bihar, villages of West Champaran district used to remain bereft of power-supply for most parts of the day. As night fell, the area used to be enveloped in darkness. All that is changing, thanks to the initiative taken by a small group of US-based NRIs, who have set up rice husk-based power-generating units in the area, lighting up some 500-700 households spread over 20 villages in the district, and changing the profile of the cluster altogether. The West Champaran experiment, according to ministry officials, was kicked off in February this year by a Patna-based NGO, Husk Power Systems (HPS), which aims to provide power to the villages ``in a financially sustainable, scaleable, environment-friendly and profitable manner.'' The technology employed is simple: It uses the husk-based gasifier technology to

provide electricity using 32 kWe (40 kVA) ``mini power plants'' that deliver power on a ``pay-for-use'' basis to households in the rice-producing belt of India. Enthused by the success of their first venture, the HPS now plans to set up 20 more plants of 32 kWe generating capacity in Samastipur and Lakhisarai, besides more villages in West Champaran. Similar projects are being conceived of in eastern UP and parts of West Bengal.

### 5.5.3. Biogas

A case study by Ranjeet singh in year 2002, reveals that there are 237 and 249 household biogas plants in Pusa and Kalayanpur block of the district. Out of which more than 50% biogas plants are in non-working condition.

### 5.5.4. Hydropower

The Bihar State Hydroelectric Power Corporation Limited (BHPC) is a government-owned corporation established under the Companies Act of 1956. The Company is in charge of investigating all hydroelectric potential and its development in the state. Hydropower plants are not present in the district presently nor the future sites have been identified.

## 3.4 TOURISM

## 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 district is has close connection with hindu devotees and the district is known for Mithila paintings and Mithili language. The data collected and analyzed shows the region's production and possible product that can be derived from the raw product. The list of sources and the possible products are mentioned below:

- Tobacco, potatoes, maize, rice and wheat production are recommended as commercial crops in the region, leading to flour.
- Jute and sugarcane production in the region turn into a valuable market for jute products and sugar etc.
- Samastipur is traversed by a number of rivers including Budhi Gandak, Baya, Kosi, Kamla, Kareh and Jhamwari and Balan
- Fruits like litchi, mango have high productivity in the district

# 4 ACTION PLAN DEVELOPMENT

## 4.1 AGRICULTURE

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## 4.2 FORESTRY

Samastipur district is a forest deficient area. There is no presence of dense forests in the district. The major occupation in the district is agriculture and small-scale businesses. That is why the Government of Bihar had drafted an Agroforestry policy in 2018. The district lies under the agriculture category III. This categorisation had been developed on the basis of climatic condition, the geography of the region, soil condition and water availability. Major crops in the district are Rice, Wheat, Lentils, and Gram pulse. The study has suggested a variety of trees in this zone. Eucalyptus, Arjun, Jamun, Kadam, Semal etc are the suggested tree species in the flood-prone zone; whereas Shisham, Gamhar, Melia, Teak etc for the non-flood zone. Litchi, Mango, Jamun, Kathal, Guava can be the most profitable money yielding tress as part of agro-horticulture. Medicinal plants like Kalmegh, Aswagandha, Sarpgandh, Satawar, Lemongrass, Safedmusli etc are viable options in agroforestry (Govt of Bihar, 2018). Below are the important species which can be included under agroforestry:

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

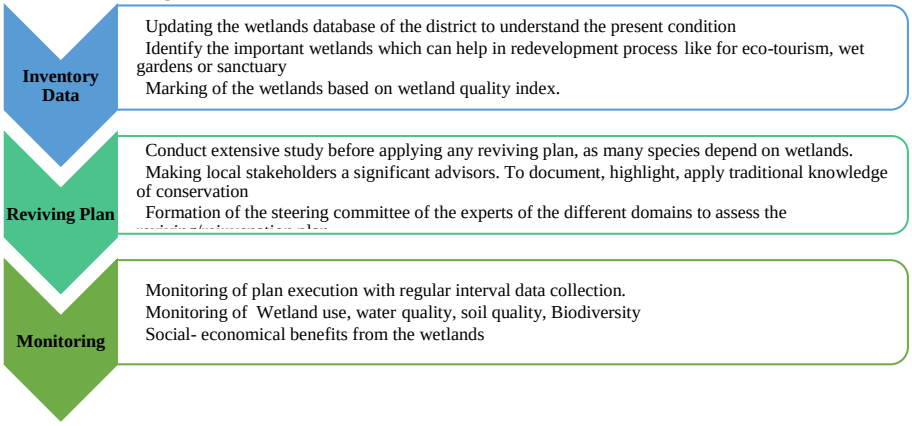
Afforestation on the riverbanks and open public spaces is another option that suits the Samastipur district. Miyawaki afforestation method has been adopted by many urban authorities in the world. This technique helps to build dense, native forests. This method ensures that plant growth is 10 times faster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

**4.2.1. Biodiversity :** Compared to the year 2017, in the year 2019 three percent of forest area has been decreased and now only five percentage of area is under forest. Action plan should be made for conserving remaining forest and to stop deforestation. Government should conduct investigation to know the reason of deforestation.

### 4.3 TOURISM

### 4.4 WETLANDS

The district is comprised of some of the healthy and wealthy wetland ecosystems. They directly or indirectly support millions of people and provide goods and services 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

5 The district has not witnessed much development in the solar energy sector, probably because the people are not aware. So initially it becomes important to make the people aware then only they will get inclined towards it. Awareness programs can be conducted with the help of local governments in both urban and rural areas. People should be educated about the policies of

the government. Development of infrastructure is also important to ease the installation of grid connected solar rooftop panels. In remote areas, where there are no power lines, off grid installations should also be provided with financial aid by the government.

**PROJECTION AND MONITORING MATRIX**

Firstly, awareness campaigns should be conducted and people should be made aware of the policies which they can take benefit of.
Secondly, farmers should be given special attention under Kusum Yojana, they should be educated about the components of the Kusum Yojana.
Thirdly, strengthening of the infrastructure of the district should be given importance so that grid connected solar rooftop panels are installed with ease.
Fourthly, some provision should be made for the small scale industries as well so that they could afford the benefits of solar energy.

#### ~~4.5.2~~5.1.1 Biomass

The district has not developed much in the biomass energy sector. Moreover it suffers from the problem of stubble burning. In order to bring development in the district in a sustainable biomass energy should be prioritized. The people should be made familiar with the biomass energy. A district wide survey should be conducted so that the best suited fallow lands are selected for the district, Samastipur. The land should be chosen in such a way that it is at a shorter distance from the various source centres of biomass wastes. There should be provision for rice mills and other biomass waste producing industries to have their own biomass plants in the district. Even a group of them can start up a single biomass plant. Biomass based gasifier power project and Biomass based Co-Generation Power Project should be promoted as they best suit the district. Also a proper transportation system should be developed so that there is no delay in the supply of biomass wastes to the biomass energy plants. The panchayats and the municipalities should come forward and set up community based biomass plants in the district with the help of government. Also the new entrepreneurs should be given priority when tendering the biomass units. This will create employment opportunities in the district and the district's economy and livelihood will flourish in a sustainable manner.

**PROJECTION AND MONITORING MATRIX**

Firstly, the people of the district should be made aware of the biomass energy along with the policies made by the government for the biomass energy sector. The harmful effects of the stubble burning should be taught to the farmers and they should be told about how can they use the agricultural wastes to produce biomass energy.
Secondly a district wide survey should be conducted recording the lands available to set up the biomass plants. The government should also fix the price of the biomass wastes.
Thirdly, the rice mills and the other biomass waste producing industry should be encouraged to have their own biomass plants. Biomass based gasifier power project and Biomass based Co-Generation Power Project best suit the district and should be popularized in the district.

Fourthly, a well-connected transport system along with a chain of storage centers should be established in the district.
Lastly, the new and the native entrepreneurs to the district should be given a chance with extra benefits to establish biomass plants in the district. Also the community based biomass plants should be popularized in the district.

### ~~4.5.3~~5.1.2 Biogas

Only the data of year 2008-2010 are available for installed biogas plants. If the biogas plants are installed after 2010, those data should be made available in districts website. 2-3$m^3$ capacity household plants should be constructed in rural areas. Government of Bihar should provide incentive to encourage people for installing biogas plants and training should be given to local people for operating those plants.

### ~~4.5.4~~5.1.3 Hydropower

The building of small hydropower projects is a crucial step toward meeting the state's energy needs and promoting economic development. Gandak river has a lot of potential to generate electricity for the district. Canal should be made to provide water for irrigation purpose and these canals can be further used to generate electricity.

# ~~5~~6 RECOMMENDATIONS

**5.1. Agriculture and allied sectors**

- Short-duration Zaid crops should be introduced so that farmers get more income from their land.
- Drip and sprinklers irrigation systems should be encouraged for vegetable and fruits cultivations. It will help to increase the water use efficiency and productivity of crops.
- There is a need to expand farm mechanization like zero tillage, raised bed planter, seed drill, mulching, drum seeding for crops cultivation.
- Need to construct some water harvesting structures to facilitate irrigation instead of groundwater exploration under the MNREGA scheme.
- Gypsum, FYM (farmyard manure), and Dhaincha should be used to reclaim the sodic and calcareous soils.
- Training to prepare the Vermicomposting and Green manuring should be organized for the farmers.

- Knowledge of ITKs (Indigenous Technical Knowledge) and training should be provided to promote Organic farming to boost soil health.
- The district has a huge scope for medicinal plants and needs some infrastructures for processing units of medicinal crops.
- The district has scope for flower cultivation like Marigold (*Tagetes*) and tuberose (*Polianthes tuberosa L.)*, which should be encouraged.
- There is a need for some processing and canning units of mushroom to proliferate the mushroom cultivation.
- Poly house and greenhouse could be commercially used for the high revenue crops like tomato, cucumber, capsicum for much return to the farmers.
- The farmers are advised for inter-cropping, mainly for turmeric cultivation in mango and litchi orchards.
- There is scope for tobacco cultivation as a cash crop.
- The district needs some infrastructure for Turmeric processing, Soybean processing, Rapeseed & mustard processing, Mango processing, and Litchi processing.
- The district has a scope for beekeeping. It should be encouraged among the farmers.
- The district has scope for fishery and poultry farming. It should be encouraged among the farmers by providing training.
- There is a scope for dairy. It should be encouraged among the farmers by providing them training and market access.
- Farmers should inform and encouraged to follow the crop advisory.

**5.2. Forestry**

- Samastipur District is forest deficient area with only 5.28/% of forest area.
- The district has some popular tourist places. These places can be focused for afforestation drives.
- The trees in the afforestation drive should be fruit yielding or medicinal and aromatic plants. In this way the locals can earn and increase their livelihood options,
- District has 0% very dense category of forest. These forests are important for carbon sequestration and ecological balance in the local area. Local government should focus on dense groves of native trees to balance the flora and fauna. Agro-forestry and afforestation on barren and unused government lands, and land adoption to the local people to increase income and to provide the incentives to the guards and government can be the better option.

**5.2.1. Biodiversity**

- It is recommended to increase afforestation program for the district by providing incentive to local peoples and make them aware about importance of forest.
- To raise awareness, wildlife festivals should be celebrated in local areas.

- Migratory bird poaching has been common in forest areas, so conservation of forest area and making watchtower for tourist attraction is recommended.

**5.3. Tourism**

**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 recommendation 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 sugarcane and tobacco.
- Tobacco producing farmers need to switch to other occupations slowly. As people become aware and health conscious, tobacco demand may slow down with time
- 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 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**

- Awareness about the policies is the key to have a well-developed solar energy sector in the district.
- Since the district is agriculture dependent, Kusum Yojana best suits the district and should be promoted among the people.
- Financial aid for the small scale industries could be the important step in bringing development to this sector.

**5.5.2. Biomass**

- People should be made aware of the biomass energy. They should also be told about the demerits of biomass burning and how using the agricultural waste for producing biomass energy would be useful.
- The district extensively cultivates rice and wheat and hence Biomass based gasifier power project and Biomass based Co-Generation Power Project will be very beneficial for the district.

- The rice mill owners and the other producing biomass energy waste should be encouraged to have a biomass energy plant in the distict.
- Installing biomass plants at the community level, providing special assistance to the district's entrepreneurs should be given importannce.

**5.5.3. Biogas**

- Biogas plants and its benefit should be taught in schools or by conducting programs and local peoples should be aware by making posters or pamphlets.
- Data shows biogas plants have been installed in the district, condition of these biogas plants should be checked.
- Training should be given to operate biogas plants and incentive should be provide to encourage peoples to participate on those event.

**5.5.4. Hydropower**

- It is recommended to identify location on Kalyanpur, Singhia, Bithan and Hasanpur blocks of the district. Making dam or barrage on this location to prevent flood and further use of these reservoir for electricity purpose is recommended.

## 6. Discussion during the Report Presentation

- NYKS volunteers are very active in Patna
- Natural Farming is being promoted among the farmers. Namami Gange will be contacted for the required training.
- Vaishali has a great historical heritage which has a great opportunity to attract tourism.
- Arth Ganga Trails will be explored.
- The suggestions by the Advisor, NMCG were noted
- Officials assured that the reports of the IIM-IIT consortium will be discussed in future DGC meetings.
- Regular Aarti at the Ganga Ghaats will be planned.
- The IIML Report for Arth Ganga should be a regular Agenda item for next 6-8 DGC meetings.
- Hon'ble PM during the post-Budget webinar on Tourism had spoken about market potential of destination weddings. It was suggested that suitable Ashrams in Ganga Basin may be identified for such purpose to promote blissful experience, cost reduction, livelihood opportunities and better upkeep.
- Allocate separate space for Namami Gange Awareness and Jalaj Marketing kiosk in Melas/Congregatios/Fairs for providing better marketing opportunities to the Jalaj products.
- As Dilli Haat Centre – Namami Gange Awareness and Marketing Centre – is being launched soon, it was requested that every district to identify niche products with a creative story and link it with Jalaj in their area.
- To identify Arth Ganga Tourist Trails and organize Ganga Guide training
- Promotion of Natural Farming in Ganga Basin and training workshops should be organized on a regular basis. NMCG is supporting this initiative in coordination with MoA& FW and NCOF.
- Make plans for reuse of treated waste water for agriculture, industrial etc. purpose and also the sludge.
- Training of volunteers for Ganga awareness & Aarti workshops to promote regular aartis on Ghats.

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*Table 2 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 | 466518 | 10 | 1,70,27,90,700 | 1277093025 | 255418605 | 25 | 10216744.2 |
| **Buffalo** | Manure | 241084 | 15 | 1,31,99,34,900 | 989951175 | 197990235 | 25 | 7919609.4 |
| **Sheep** | Manure | 2584 | 1 | 9,43,160 | 707370 | 141474 | 25 | 5658.96 |
| **Goat** | Manure | 386977 | 1 | 14,12,46,605 | 105934953.8 | 21186990.75 | 25 | 847479.63 |
| **Pig** | Manure | 3389 | 2.5 | 30,92,463 | 2319346.875 | 463869.375 | 25 | 18554.775 |
| **Poultry** | manure | 85,488 | 0.1 | 31,20,312 | 2340234 | 468046.8 | 25 | 18721.872 |
| **Total** | | **11,86,040** | | | | | | **19026768.84** |

*Table 3 Biogas potential from agricultural waste.*

| Crop | residue type | Total crop production (tons) (2017-18) | Residue production ratio | Residue amount (tons) | Average collection (70%) | Moisture content | Residue amount after removing moisture (tons) | Biogas potential [m3/(tons of dry matter)] | Overall biogas potential (m3) |
|---|---|---|---|---|---|---|---|---|---|
| **Maize** | straw | 285235 | 1.5 | 427852.5 | 299496.75 | 15 | 254572.2375 | 800 | 203657790 |
| **Wheat** | straw | 167987 | 1.5 | 251980.5 | 176386.35 | 30 | 123470.445 | 800 | 98776356 |
| **sugarcane** | bagasse | 271981 | 0.33 | 89753.73 | 62827.611 | 80 | 12565.5222 | 750 | 9424141.65 |
| **Total** | | **725203** | | | | | | | **311858287.7** |