Arth Ganga Project: District Bhojpur

February 2022

Submitted to

National Mission for Clean Ganga (NMCG)

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EXECUTIVE SUMMARY

Bhojpur, an abode to many freedom fighters, is a district subdivision of Patna located in Bihar. Aarah is the administrative headquarter. The district has rivers flowing mainly from North, East and south. River Ganges in the north, river Son in south-eastern, etc, and low lying alluvial rich flats best-known region for growing wheat, all aids into rich physiography of the district.

Agriculture is the main occupation and livelihood of the dwellers. Owing to the adequate precipitation and developed river system the district falls under Agro-climatic Zone III B, with soil varying from heavy clay to sandy clay and highly irrigated lands(74.66%). The land use land cover pattern has been changing only to bring more land to practice agriculture. The growth of Boro Crops, the Package program, etc. provide evidence of intensive agriculture prevalence in the district. Paddy, wheat, maize barley, etc. are the main crops grown. Horticulture, poultry, etc. although not much developed have also been pushed up.

Krishi Vigyan Kendra is actively involved in the betterment of the district had established a distillation unit for Medicinal and Aromatic plants, Solar Energy Park, promoting floriculture, developing Sugarcane industry, seed village for production of oilseeds, cereals, vegetables, etc (Rs 45 million annual turnovers).

The forest deficient region (1.35%) has forests under moderately dense and open forests and lacking very dense forests. Under agro-forestry in the flood-prone and non-flood zone- Eucalyptus, Arjun, Jamun, etc, and Shisham, Gamhar, Melia, Teak, etc. are adapted respectively. To increase biodiversity and sustainable forestry practices like Miyawaki afforestation should be adapted. Wetlands are not in adequate number with natural wetlands more than man-made ones. Monitoring wetlands, promoting eco-tourism, etc. are the steps needed for eco-restoration and economic development. There are many tourist attractions like temples, Qila, historical statues, etc.

The district has a high potential for biomass production as agriculture is the main economy. Thus, the production of biogas is expected to be promising yet there are hardly plans executed. Cow dung is the main used energy source whereas kerosene is the main power source. Although solar energy is promoted in the region, it is inadequate. The presence of the surplus amount of river water hydropower has high potential and should have been the most exploited source of energy yet there are no ongoing projects but four sites are identified for future projects.

High revenue crop plantations, sericulture, adapting to advanced technologies, proper monitoring and maintenance of places and forests, mixed farming, promoting poultry and fisheries, floriculture, drip, and sprinkler irrigation, etc., are a few measures that might be adapted in the district.

1 DISTRICT OVERVIEW

1.1 INTRODUCTION

Bhojpur district is one of the thirty-eight districts of the Indian state of Bihar. Arrah town (also known as Ara) is the administrative headquarters of this district. Bhojpur district is located on a global map between 25°10' and 25°40' North latitude and 83°45' and 84°45'East longitude. The district occupies an area of 2,395 square kilometers. The rank of the district in comparison to other districts of Bihar in terms of area is 20th. The district is bounded on the north by the district of Saran and the State of Uttar Pradesh, on the south by the district of Rohtas, on the west by Buxar, on the east by the districts of Patna and Arwal. A total of 1.35% of the total geographical area is covered by the forests. Administration wise, the district is divided into 14 tehsils namely Agiaon, Arrah, Barhara, Behea, Charpokhari, Garhani, Jagdispur, Koilwar, Piro, Sahar, Tarai, and Udwant Nagar. The district comprises 6 towns and 1217 villages.

The district of Bhojpur has a population of 27,28,407 according to the 2011 Census. Bhojpur has a sex ratio of 907 females for every 1000 males and a literacy rate of 72.79%. The work participation rate (WPR) in the district is 18.77 percent for main workers and 11.38 percent for marginal workers. Proportion of non-workers in the district is 69.85 percent

Agriculture is the main occupation of the people of the district and also the main source of livelihood of the people. Paddy, Wheat, Maize and pulses are the main crops of the district. The important crops of the district other than the Paddy are Barely, Gram, Peas,Arhar, Masuri, Khesari, oil-seeds and sugar-canes. The district has only a few small scale industries and some agro based industries.

Figure 1 Map of the district

1.2 DEMOGRAPHIC PROFILE OF BHOJPUR

Bhojpur district, a part of Patna division is a district of the Bihar state with its administrative headquarters located at Arrah town. Geographically, the district lies at 25047'N latitude, 84052'E longitude.

Geographic area: 2,395 Km^2
Altitude: 193 m
Rainfall: 576.6 mm (2018-19)
Forest area: 32.25 Km^2
Rivers: Ganga, Sone

Administrative Divisions:

District Headquarter	Arrah town
No. of subdivision	3
No. of Blocks	14

No. of Villages	1217

Table 2 demographic overview

Demographic and Socio-economic Parameters:

Population	27,28,407
Population Density	1139 / Km^2
Sex Ratio	907
Literacy	70.47%
Occupation/Livelihood	Agriculture

1.3 AGRO CLIMATIC PROFILE OF THE DISTRICT

1.4 ECONOMIC PROFILE OF BHOJPUR

2 QUANTITATIVE DATA ANALYSIS

2.1 Agriculture and Allied Activities

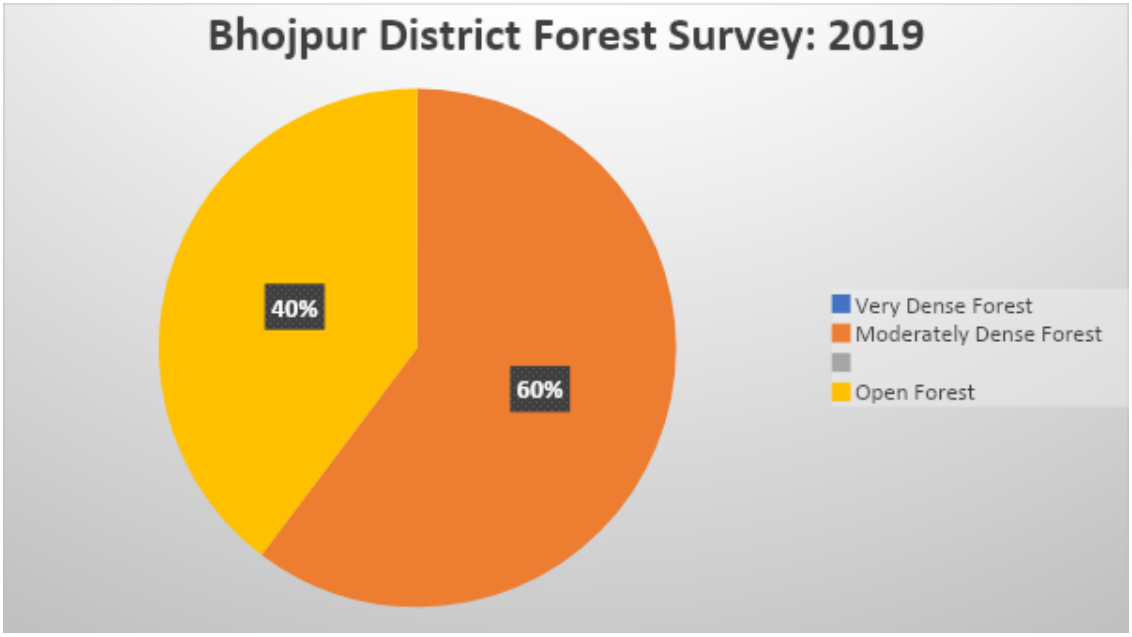
2.2 Trends in Livestock

2.3 Forestry

District of Bhojpur has 2395 Km^2 total geographic area. Forest cover area as per 2019 forest survey assessment is only 32.25 Km^2. This is 1.35% of the total area which makes the district a severely

forest deficient area. The state has a total 7305.99 Km^2 forest area which is 7.75% of the total geographic area of the state.

Bhojpur district does not have forest under the category of Very Dense Forest (VDF), 19.44 Km^2 of area comes under the category of Moderately Dense Forest (MDF) and 12.81 Km^2 is open forest (OF) as per 2019 assessment (Figure).



Forest Survey of India 2019 Bihar State vs Bhojpur Comparative Assessment						
Area	Geographical Area	Very Dense Forest	Moderately Dense Forest	Open Forest	Total	%of Geographical Area
Bhojpur	2395	0	19.44	12.81	32.25	1.35
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 32.25 square km, in which 60% area is mid-dense forest, and 40% area is open forest.

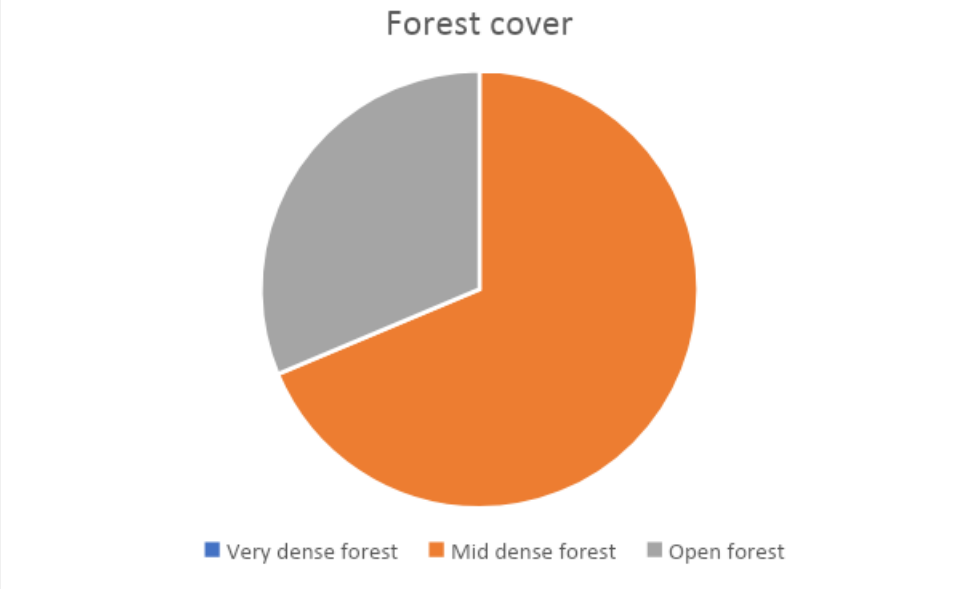
Table 1 Bird species recorded in the district.

Number of species	319

Number of rare/accidental species	7
https://avibase.bsceoc.org/checklist.jsp?lang=EN&p2=1&list=clements&synlang=&region=INggbrbj&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
2395	0	19.44	12.81	32.25	1.89	-3.75	0.00



2.4 Tourism

2.5 Wetlands

The district doesn't consist of a large number of wetlands. Table 1 shows the number of wetlands and their area representation in the district. There are around 34 wetlands sized greater than 2.25 Ha and 104 less than 2.25 Ha areas. The region consists of small wetlands, generally less than 20 Ha in the area but 2 are greater than 20 Ha.

Table 1: Wetland Data of Bhojpur 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	0	1	1	0	0	0	0	0	0	0	0	0	0
Ox-bow lakes/cut off meanders	3	4	1	0	0	1	0	0	1	1	0	0	2
High altitude Wetlands	0	0	0	0	0	0	0	0	0	0	0	0	0
Riverine Wetlands	3	4	1	0	2	1	0	0	0	0	0	0	3
Waterlogged	3	3	0	0	3	0	0	0	0	0	0	0	2
River/Stream	0	10	10	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	1	12	11	0	0	1	0	0	0	0	0	0	9
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 (138)	10	34	24	104	5	3	0	0	1	1	0	0	16

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

- The district comprises 138 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. Biogas:

Either the biogas data is not available for the district, or no plants exist in the district. Biogas potential has been evaluated by average livestock and agricultural waste production. Biogas potential from animal waste is calculated approximately as one crore m^3/year and fourteen crores m^3/year from agricultural waste. This amount of biogas generation can efficiently complete the energy demand of the district.

2.6.2. Hydro Power:

Rivers run practically three sides of the district—north, east, and a portion of the southern boundary. The Ganges marks the district's northern boundary. The Ganges River is responsible for the fertility of the low-lying lush alluvial plains in north-eastern India. The rivers Chher and Banas merge to form the Ganges.

The Sone is another significant river in the area. The Sone enters Bihar near the junction of Palamu (Jharkhand), Mirzapur (Uttar Pradesh), and Rohtas (Bihar). It travels through the southern and eastern limits of the Bhojpur district till it joins the Ganges at Maner in the Patna district. No hydropower plant exists in the district; however, four new project sites have been identified for small hydropower projects.

Table 2 Identified sites in the district.

Name of project	Category of project	Name of river/canal	Capacity in kW	Head in meter	Discharge in m^3/sec	Remarks
Chauri	Canal	Arrah BC	500	5	12	Site identified
Dellia	Canal	Arrah BC	350	4	9	Site identified
Harpur	Canal	Arrah BC	750	2	42	Site identified
Pawna	Canal	Arrah BC	600	2	23	Site identified

2.6.3. Biomass

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.

Agriculture is the main occupation of the people of the district and also the main source of livelihood of the people. The net sown area of the district is 175100 ha and the area sown more than twice a year is 73200 ha; hence a total of 248300 ha of the gross cropped area. Table 1 lists the major crops grown in the district and their productivity.

CROP	PRODUCTIVITY (kg/ha)
Rice	1885
Maize	2088
Pigeonpea	1114
Wheat	3499
Chickpea	1265
Lentil	1026
Mustard	1272
Potato	16500
Onion	15850

The pie chart in figure 1, depicts the type of fuel used by households for cooking. 53% households use cowgung cake, followed by 25% using firewood, 12% using crop residue cake and only 11% using LPG/PNG as the fuel for cooking.

The district has a good potential of biomass potential. According to Pugazenthi et. al. (2016), the total biomass power potential available in the district Bhojpur is 0.4329.

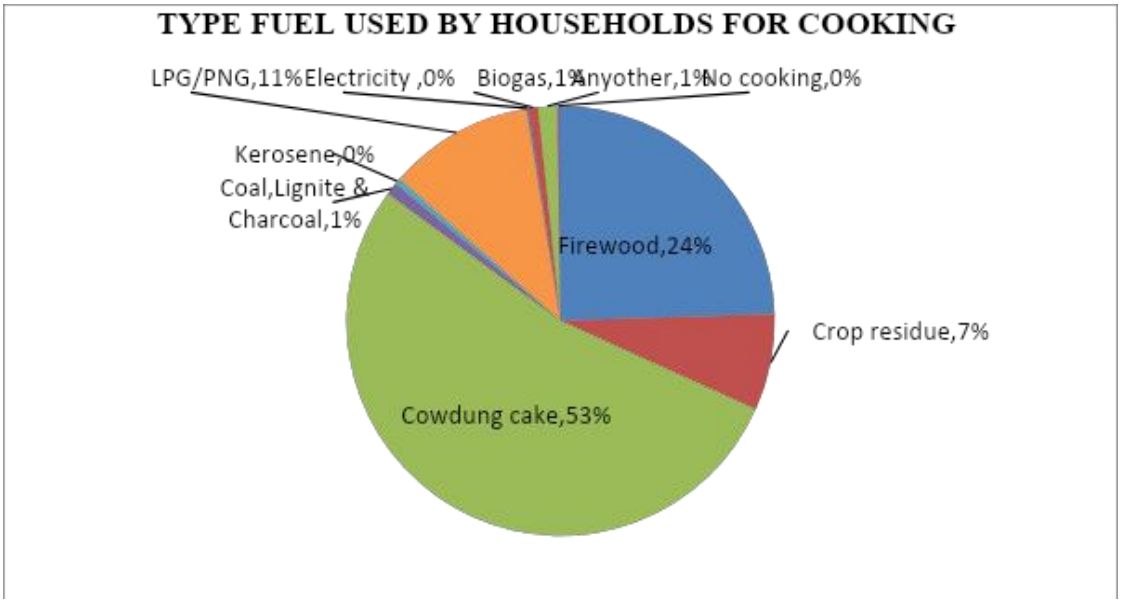


Fig. 1

Not much data is available about the progress of the biomass district of Bhojpur.

2.6.4. Solar

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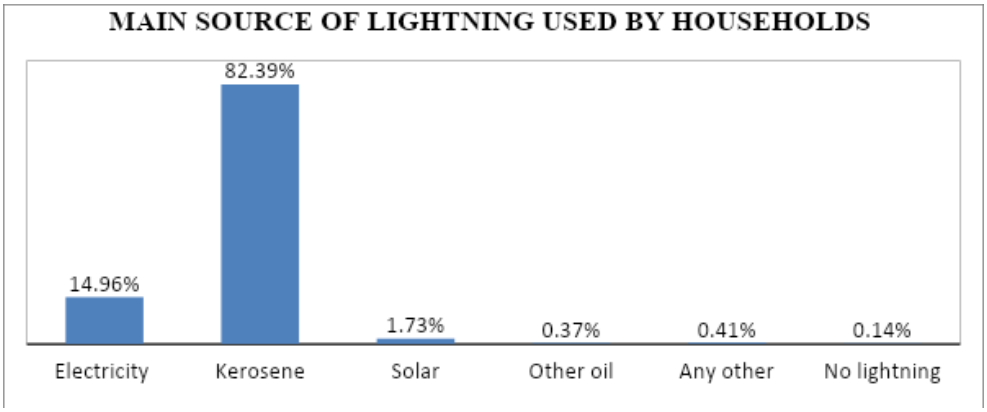


Fig. 1

According to the 2011 census, the main source of lightning used by households in the district Bhojpur is kerosene, about 83 households use it. Other than these are the 14.96% households using electricity and only 1.73% households using solar as the main source of lightning (Fig. 1)
The district has a good energy potential. According to Pugazenthi et. al. (2016), the total solar energy potential available in the district Bhojpur is 0.0419.
There is not sufficient data available giving the account of the solar power units in the district.

3 QUALITATIVE DATA ANALYSIS

3.1 AGRICULTURE, ALLIED ACTIVITIES, FORESTRY

3.2 ENERGY

3.2.1. Biogas:

The district has no biogas plant installation data at the household level and industrial level. No data of gaushala was found for the district.

3.2.1. Hydropower:

Four sites have been identified for future small hydropower projects in the district. All of these projects are planned to install on the Arrah BC canal with the capacity of 0.5, 0.35, 0.75, and 0.6 MW capacity.

3.2.2. Biomass:

The district Bhojpur has a good potential to develop its biomass energy sector, but has not witnessed much development. A new article in The Times of India, with the heading 'Biomass energy units can boost industrial growth' reads- Bihar has a good potential for setting up biomass-based energy generation plants as paddy husk and other biomass are available in plenty in the state. Setting up of these plants, in turn, could give a boost to establishment of industries in the state. According to figures provided by the Bihar Renewable Energy Development Corporation (BREDA), Bihar could very well generate about 200MW power through biomass-based units. Bihar Industries Association (BIA) president KPS Keshri and its former secretary general Sanjay Goenka shared the minister's view. They said the industries coming to Bihar would have the option of setting up their own captive biomass energy generation plants, for which the state government

is providing subsidy.
Keshri said the grant of special status would set in motion the process of industrialization in Bihar and the BIA was already in dialogue with the state government for formulating a plan for setting up of private industrial areas with the state government's support for creation of infrastructure. Goenka said a 3MW biomass energy plant using paddy husk has already been set up by a new paper unit near Giddha industrial area in Bhojpur district. The industries minister added that many rice and sugar mills had set up biomass energy generation plants of two to three MW capacity.
The district also faces the problem of stubble burning and this is evident from a news article in , Hindustan Times. According to this article, In a bid to discourage the practice of stubble burning during the upcoming harvesting season for kharif crops, the Bihar government has decided to "name and shame" violators and has made it mandatory for farmers hiring combine harvestor machines to furnish an affidavit that they would not burn crop residue in their fields, officials familiar with the matter said. In Bihar, stubble burning in districts of Kaimur, Rohtas, Bhojpur, Buxar, Nawada and parts of north Bihar has become common over the last few years owing to large-scale use of combine harvestors, the machines that harvest grains in a fast manner, leaving high density of crop residue.

3.2.3. Solar:

The concerned authorities in the district have been constantly trying to establish the solar energy sector in the district but still much can be done in the district Bhojpur in this sector. According to a news article in The Times of India Power-starved Bihar is yet to take off in solar energy. Although, of late, the Bihar government is serious about solar energy as an alternative source of energy. Less than a percent of the total population has access to solar power. The situation in the remaining districts is even worse. There are only 13 solar street lights in Nawada, Patna has 27, Bhojpur 14, Samastipur 15, Vaishali 11, Kaimur 34, Jamui 14, Muzaffarpur 18, Gaya 84 and Nalanda 32. The cost of each 74 watt solar street light is Rs 28,240 which includes the maintenance cost for five years.
Another article in Energetica India, with the heading 'RK Singh Dedicates NHPC, PFC Projects worth Rs 9 Cr including Solar Lights to Bihar' reads The Union Minister of Power and New & Renewable Energy RK Singh have dedicated various projects worth Rs 9 crore to Bihar through video conferencing. These projects will be implemented under the Corporate Social Responsibility (CSR) activities of NHPC and PFC in Shahpur and Bihiya block of Bhojpur district in Bihar.

3.3. FORESTRY

Forest Survey 2019 assessment reported a variety of native trees in rural and urban areas across the state. These common species are Mangifera indica, Bombax ceiba, Psidium guyava, Dalbergia

sissoo (FSI, 2019). Currently, the State government forest department runs 'Krishi Vaniki Yojana', a scheme which primarily focuses on motivating farmers to plant trees and other crops on a large scale along with traditional crops on their land. This scheme is aimed to improve the income of farmers in the event of crop loss and to contribute towards agricultural produce by growing 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 nurseries at the rate of Rs 10 / seedling. If farmers maintain 50 percent of the plants purchased from the forest department in their lands for 3 years, then for this, the farmers will be given an incentive of Rs 60 per plant. Moreover, the Rs 10 they spent for purchasing the seedling is also given back to the farmers (Krishi Yojana).

Recently, The United States Agency for International Development and Bihar's Department of Environment, Forest and Climate Change jointly launched a 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).

3.3.1. Biodiversity

To save Ganges dolphins, awareness programs were conducted on dolphins' day, and hundreds of fishermen and local people took pledges to protect the river and environment. The officials told the fisherman that action would be taken against those who kill small fish (less than 1 kg) and the shopkeepers who make such nets. As compared to 2017, forest data had decreased by 3.75% in 2019.

3.4. 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 the land of many famous personalities, who have contributed to freedom, literature and culture. 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:

- Different types of small & cottage industries other than some agro-based industries are set up in the district
- Some of the large ponds and "Jhils" exist in the district, which are presented de-watered and put to crop and grows "Boro crops"
- Paddy, wheat, maize, barley, gram, peas are main crops grown in the district

- Khesari, oil seeds, spices, fruits and sugar cane are also grown in the district in small quantities.

3.5. TOURISM

4 ACTION PLAN DEVELOPMENT

4.1 AGRICULTURE

4.2 FORESTRY

Bhojpur 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 Bhojpur 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 Bhojpur 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).

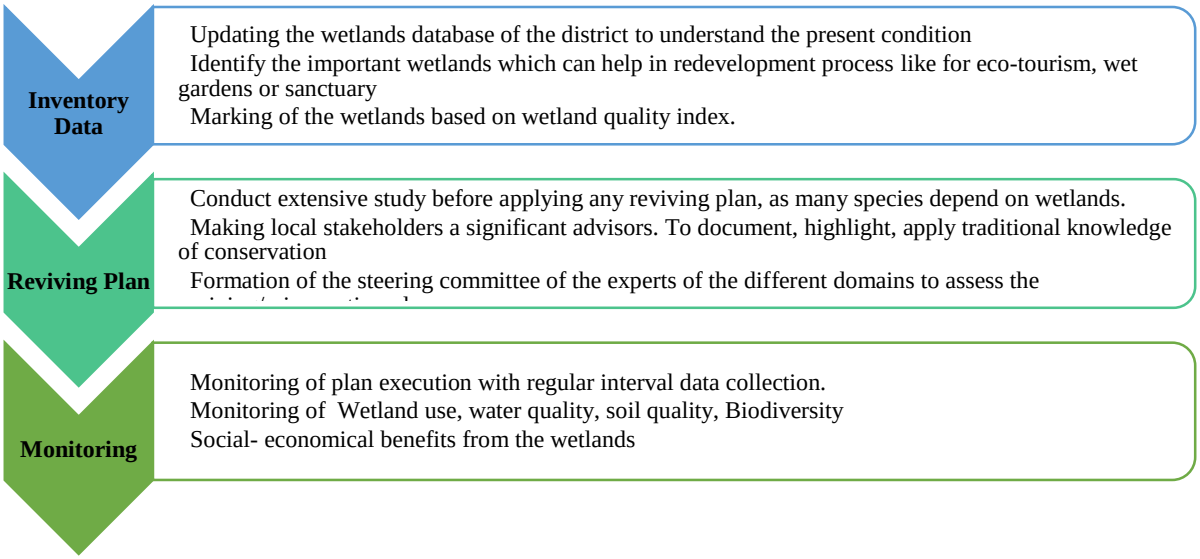
4.2.1. Biodiversity

Forests are a source of pride in the district's ecology, not only because of the sheer size of the territory they cover but also because of the diversity of vegetation. Only 1.89 percent of the geographical area is under forest; therefore, an afforestation or reforestation program should be taken to increase forest area.

4.3 TOURISM

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. Biogas:

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

4.5.2. Hydropower:

More small hydropower plants sites should be investigated in the district. The local population benefits from the building of these facilities in the form of increased job opportunities and the fulfillment of their electricity needs. As a result, building small hydropower projects is crucial to meeting the state's energy needs and promoting economic development.

4.5.3. Biomass:

The people of the district Bhojpur are probably not very aware about biomass energy, which can be the reason why the district still lags behind in the biomass energy sector. The district also deals with the problem of stubble burning. So in order to speed up the development of the district in a sustainable manner and to reduce the population causing stubble burning, biomass energy should be popularized among the people of the district. A district wide survey should be conducted so that the appropriate lands could be figured out for setting up biomass plants. This is important so that the biomass energy production units could get easy supply of biomass wastes from all the possible producers. Also a well-connected transportation system should be planned. There is also a need to encourage the local people to set up community based biomass plants. This will not only give employment opportunities to its people but also the wastes produced could be managed well. To make the installation of the biomass plants cost and space effective, it is important that research should be encouraged in this field.

PROJECTION AND MONITORING MATRIX

Firstly, people should be made aware about the biomass energy and how can they utilize the biomass waste in energy production. The farmers should be made familiar with the demerits of stubble burning.

Secondly, a proper curriculum should be added in schools and colleges which mainly educates the students about the energy resources of their state and moreover of their district specifically. Research should be done to decrease the cost and size of these biomass based plants.
Thirdly, a district oriented survey should be conducted to figure out the lands available for setting up biomass energy plants.
Fourthly, Biomass based gasifier power project and Biomass based Co-Generation Power Project should be promoted as these suit best to the district. There should be provision for rice mills and other biomass waste generating industries to set their own biomass plants.
Fifthly, a well-connected system of roads along with the storage centres should also be planned and constructed in the district.
Lastly, government should try to establish such norms that the local people of the district can set up community biomass based biomass plants at low costs.

4.5.4. Solar:

The district has a good potential in the solar energy sector. So in order to establish solar energy in a full-fledged manner the people of the district should be made aware of the solar energy like the ways in which it can be used- photovoltaic or thermal etc. Also the policies and the schemes of the central as well as the state government should be brought into familiarity with the people. Next to this should be setting up of solar feeder segregation units under Kusum Yojana, so that farmers get uninterrupted electricity supply. This will incline farmers to use advanced technology requiring power to carry out various farm activities. The industrial sector should also be provided with some benefit of subsidy, net metering etc. This will help them get returns faster as compared to when no benefit is provided. Also the National solar Mission should be popularized among the residents of the district. People should be encouraged to install solar rooftops at their homes. The area where there is no power supply or the infrastructure is not sufficiently developed to support the grid connected solar panels, those installing off grid panels should be provided with some kind of benefit in form of financial assistance, etc.

PROJECTION AND MONITORING MATRIX

Firstly, make more and more people aware about solar energy. People should be made familiar with the policies the government has made for them.
Secondly, the main economic activity that is agriculture and solar energy should be brought together, as in Kusum Yojana. This will accelerate the development of both the agriculture sector as well as the solar energy sector.
Thirdly, the National Solar Mission should be popularized among the residents of the district and the infrastructure required for the penetration of solar energy should be developed.
Fourthly, the remote areas where utility supply has not yet properly reached should be provided with the financial aid for the off-grid connections.
Lastly the industrial sector should be provided with the facility of net metering. Alongwith, solar thermal energy should also be given importance.

5 RECOMMENDATIONS

5.1 AGRICULTURE AND ALLIED SECTORS

Recommendation to Developed Agriculture Activities and Allied Activities

- There is a need for an infrastructure of quality rice mill units to boost the farmers income from rice cultivation.
- Commercialization of mentha crop under the adverse climatic condition and development of some infrastructure for mentha processing units will provide much return to the farmers.
- The district has ample scope for the expansion of Drip and Sprinkler irrigation for vegetable and fruits cultivations, which also increase the water use efficiency and productivity of crops.
- Near the Ganga river, organic farming is commonly practiced. There is a need for training, certification and government assistance to promote organic farming and boost soil health.
- A few areas of the district have a minor salt problem, which can be reclaimed through the application of gypsum and leaching methods.
- The district has the scope to develop some infrastructure for agro-based (Mango, guava) small and medium scale processing units to promote fruits cultivation.
- High revenue crops such as capsicum, strawberry, mushroom and vegetable pea cultivation should be encouraged for much return to the farmers.
- There is a need to built-up for mushroom processing units to provide good market access.
- The district has the scope for commercial greenhouse and poly houses cultivation for roses, Gerbera, muskmelon, and cucumbers for much return, which should be encouraged.
- Tulsi (*Ocimum tenuiflorum*), Kalmegh (*Andrographis paniculata*), ashwagandha (*Withania somnifera*), Aloe vera and mentha cultivation should be encouraged among the farmers.
- The district has a huge scope for pearl and prawn farming. It should be encouraged through proper training.
- Integrated farming or mixed farming could generate more income for the farmers of the district.

- The district has a huge scope for fishery and poultry farming. It should be encouraged among the farmers by providing training.
- Farmers should be informed and encouraged to follow the crop advisory.
- There is a huge scope for floriculture. Marigold, cherry and Balsam flower cultivation could generate more income for the farmers.

5.2 FORESTRY

- Bhojpur District is forest deficient with only 1.35% 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 governments 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 incentives to the guards and government can be the better option..

5.3 WETLAND

The wetlands need to be intact, but at the same time, they need to be planned wisely to support the district economically, socially and environmentally, which will lead to indirectly relieving of stress from the Ganga River to a large extent. It will also lower the local people's dependence on the Ganga River for their small-scale industry or basic daily needs. The following 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 sugarcane.
- 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 abundant lakes and jhil.
- It is recommended to develop flower gardens around the wetlands area and biodiversity by creating a market for selling handicrafts nearby.
- Development of water bodies near bhojpur temple and veer Kunwar singh park to promote eco-tourism.

5.4 TOURISM

5.5 ENERGY

5.5.1. Biogas

- Biogas plants and their benefits should be taught in schools, and local people should make posters or pamphlets.
- Biodegradable Garbage Management is a major component of solid and liquid waste management, and the Gobardhan Scheme tries to manage cow dung and other biodegradable waste in rural regions. These schemes should be applied to the district level.

5.5.2. Hydropower

- It is recommended to install the small hydropower plants on investigated sites and investigate the new location near Sahjauli, Ara sadar, Barhara, Sahar, Sandesh, and Bihiya village of the district of 1-2 MW capacity.

5.5.3. Biomass

- People should be made aware about biomass energy.
- Biomass based gasifier power project and Biomass based Co-Generation Power Project should be popularized in the district.
- Research in making the biomass plants smaller and less costly should be done.
- The local people should be encouraged to establish biomass based plants.

5.5.4. Biomass

- Making more and more people aware of solar energy and its benefits by arranging awareness campaigns.
- Agriculture should be backed by solar energy under the Kusum Yojana and farmers should be made familiar with each of the details of the Kusum yojana.
- The National Solar Mission should be popularized among the people of the district.

6. Discussion during the Report Presentation

- Recently a Natural Farming Training has been organized in Bhojpur.
- Organic Farming is being promoted and Natural Farming is being taken up.
- The points suggested by Advisor, NMCG about the utilization of the Ashrams was appreciated by the DMs and the opportunity will be explored.
- 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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7 APPENDICES

Table 3 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	204271	10	74,55,89,150	559191862.5	111838372.5	25	4473534.9
Buffalo	Manure	201760	15	1,10,46,36,000	828477000	165695400	25	6627816
Sheep	Manure	18935	1	69,11,275	5183456.25	1036691.25	25	41467.65
Goat	Manure	115425	1	4,21,30,125	31597593.75	6319518.75	25	252780.75
Pig	Manure	131375	2.5	11,98,79,688	89909765.63	17981953.13	25	719278.125
Poultry	manure	72,019	0.1	26,28,694	1971520.125	394304.025	25	15772.161
Total		**7,43,785**						**12130649.59**

Table 4 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	5177	1.5	7765.5	5435.85	15	4620.4725	800	3696378
Wheat	straw	244432	1.5	366648	256653.6	30	179657.52	800	143726016

sugarcane	bagasse	61	0.33	20.13	14.091	80	2.8182	750	2113.65
Total		**249670**							**147424507.7**