

# Geospatial Information System for Assessment of Bioenergy Potential in India



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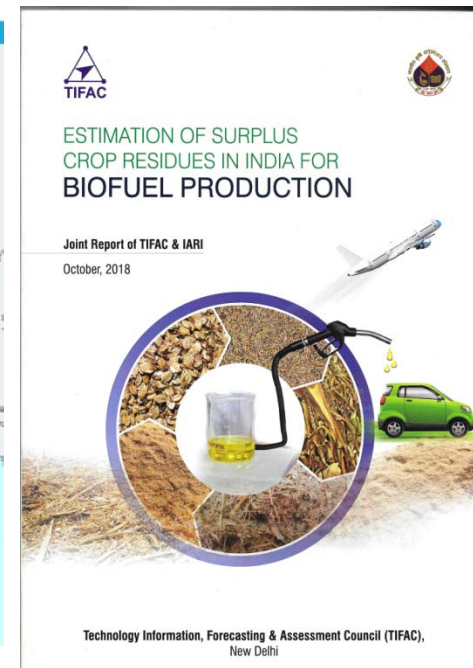
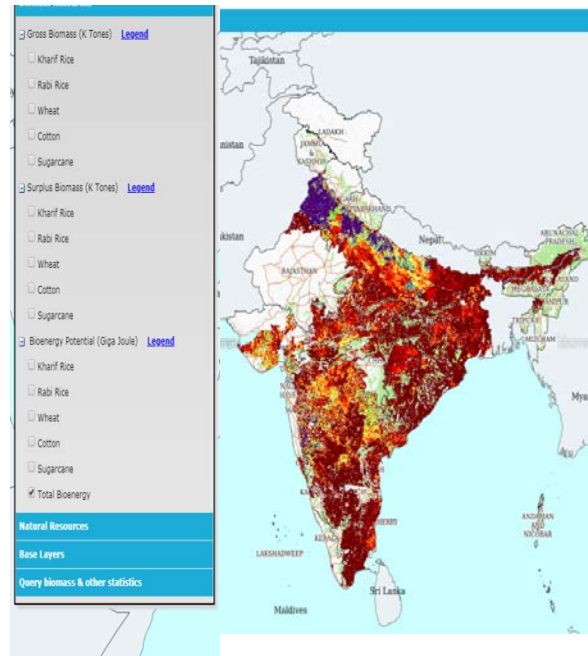
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# Major Objectives

- To estimate amount of biomass generated from identified crops in **different districts** of India.
- To assess amount of **surplus crop residues** from identified crops.

To assess feasibility of identified crop residues for **bio-fuel/bioenergy** production.





# Amount of crop biomass generated

Collection of State/district wise /season wise crop area and production data for last 4-6 years ( 2010-2015) from MoA/ State Governments

QA/QC checks for data obtained from MoA/ State Governments

Compilation of crop harvest index and moisture content

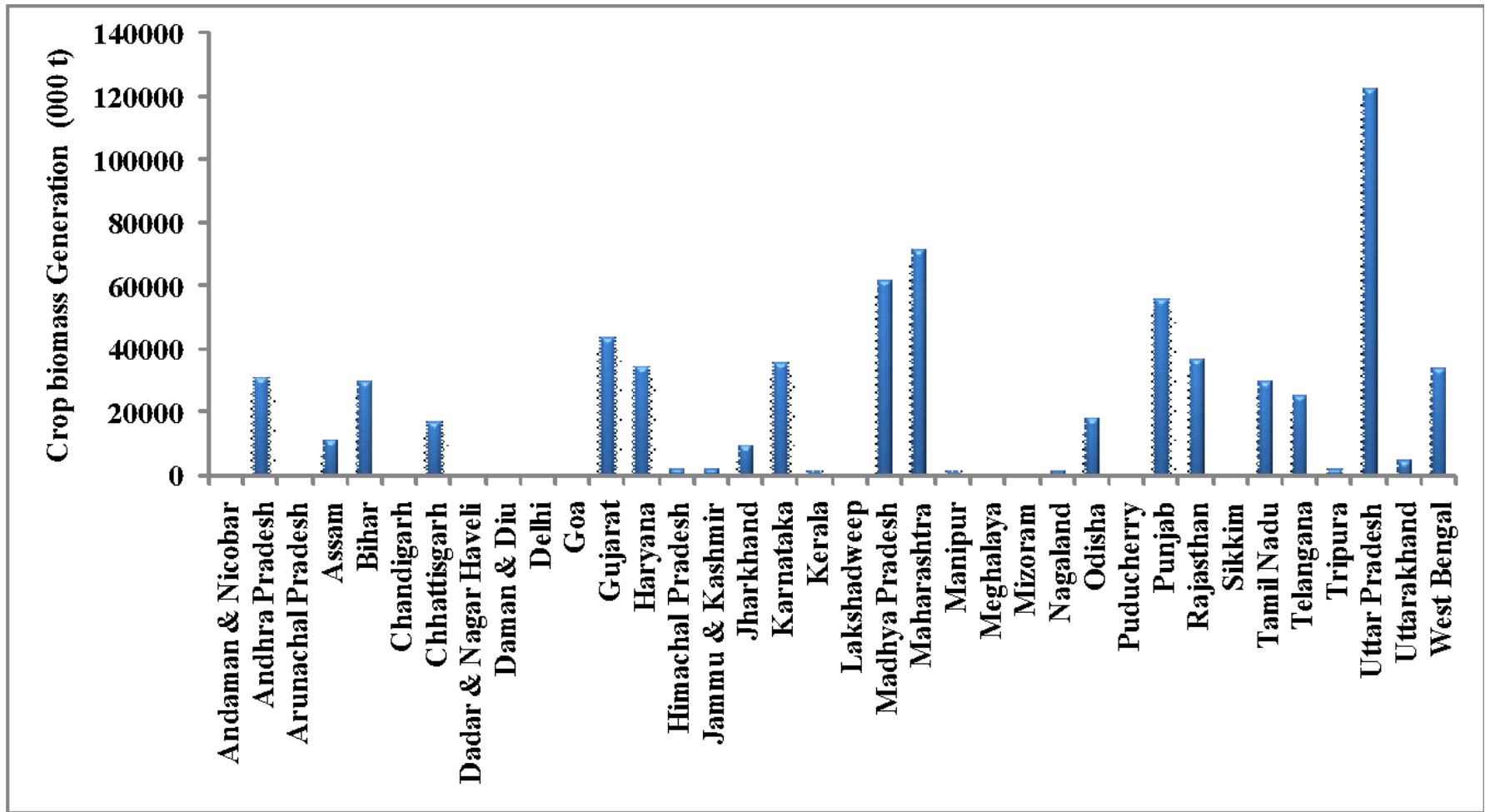
Calculation of **Residue to crop ratio (RCR)**

Estimation of State/district/season wise average **crop biomass generated on dry weight basis**

Mapping of State/district/season wise average crop biomass generated

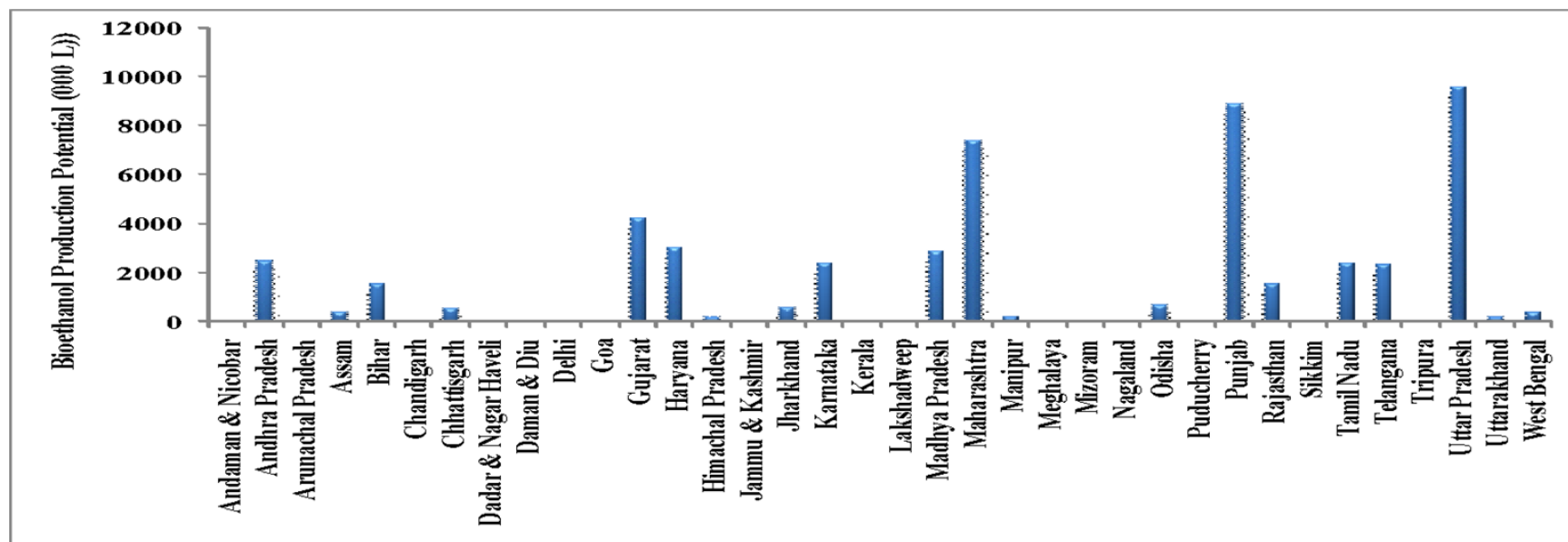


# State-wise total annual crop dry Biomass



**Uttar Pradesh (17.99%) followed by Maharashtra (10.52%), Punjab (8.15%) and Gujarat (6.4%) top 4 states in residue generation**

# State-wise bioethanol potential for crops residues



**Total annual BE production potential of country is 51.35 Billion Litres from 178 MT of surplus crop biomass .**

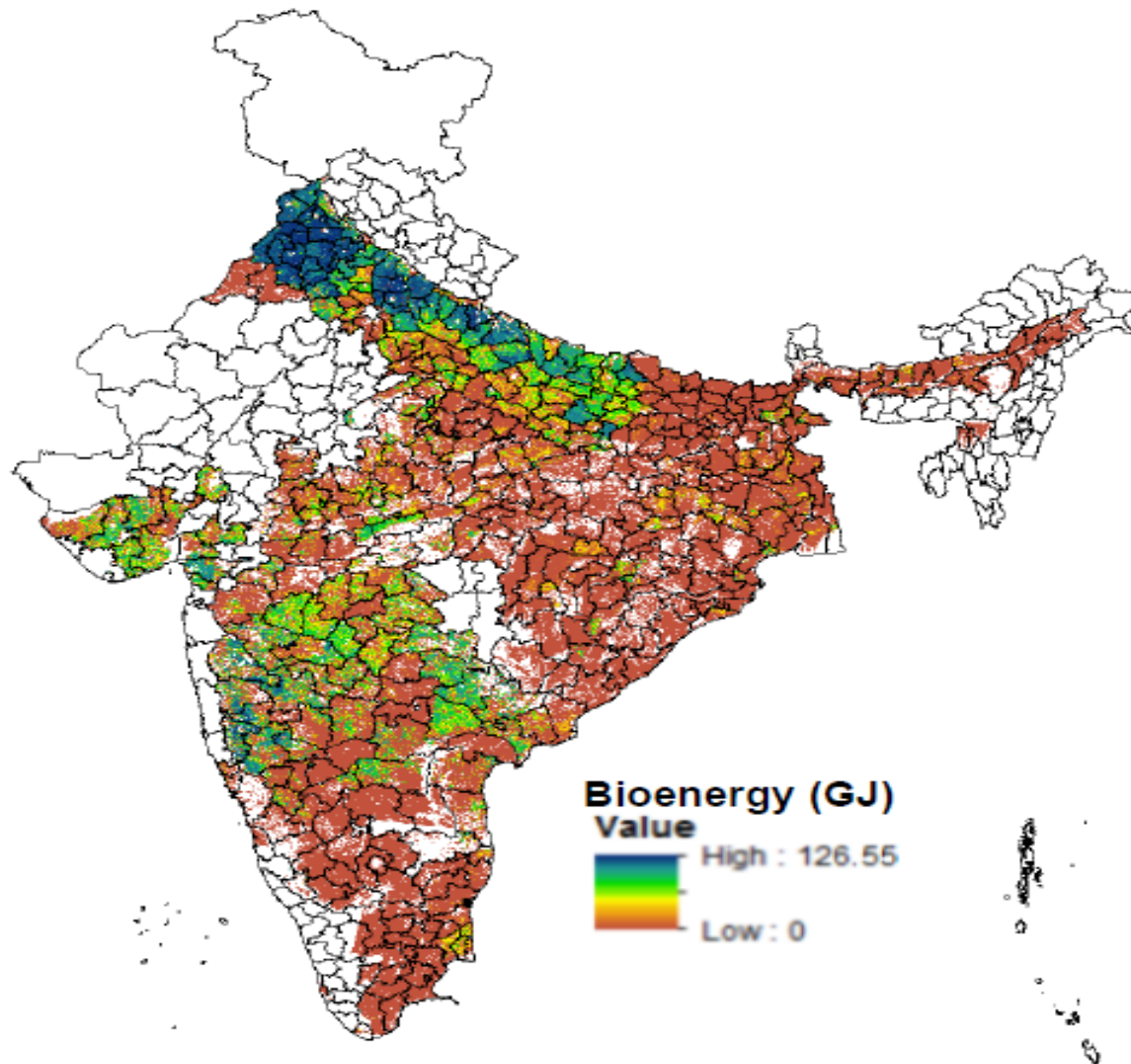
**Maximum potential found in Uttar Pradesh (9588 kL) followed by Punjab (8899 kL), Maharashtra (7406 kL), Gujarat (4205 kL) and Haryana (3034 kL) states.**

Crop/Season		Area (Mha)	Dry Biomass (Mt)	Surplus biomass (Mt) (% of dry biomass)	Bio-ethanol Potential (BL)
<b>Rice -</b>	Kharif	28.64	142.76	35.99 (25.21)	10.08
	Rabi	13.33	66.51	7.27 (10.93)	2.04
	Summer	2.37	15.73	0.6 (3.79)	0.17
	<b>Total</b>	<b>44.34</b>	<b>225.00</b>	<b>43.86 (19.49)</b>	<b>12.28</b>
<b>Wheat-</b>	Rabi	30.92	145.45	25.07 (17.24)	7.27
<b>Maize-</b>	Kharif	7.59	21.49	4.98 (23.17)	1.47
	Rabi	1.19	6.39	1.06 (16.54)	0.31
	<b>Total</b>	<b>8.78</b>	<b>27.88</b>	<b>6.03 (21.65)</b>	<b>1.78</b>
<b>Sugarcane</b>		<b>5.04</b>	<b>119.17</b>	<b>41.56 (34.87)</b>	<b>13.30</b>
<b>Gram</b>	Rabi	8.48	26.51	8.72 (32.90)	2.53
<b>Tur -</b>	Kharif	4.04	8.94	1.7 (19.06)	0.43
	Rabi	0.07	0.22	0.05 (22.80)	0.01
	<b>Total</b>	<b>4.11</b>	<b>9.17</b>	<b>1.76 (19.15)</b>	<b>0.44</b>
<b>Soybean-</b>	Kharif	10.69	27.78	9.95 (35.82)	2.09
<b>Rapeseed &amp; Mustard</b>	Rabi	5.87	17.09	5.16 (30.18)	1.60
<b>Cotton-</b>	Kharif	11.98	66.09	29.55 (44.72)	9.16
	Rabi	0.12	0.48	0.18 (37.17)	0.06
	Summer	0.00	0.02	0.01 (39.34)	0.00
	<b>Total</b>	<b>12.10</b>	<b>66.58</b>	<b>29.74 (44.67)</b>	<b>9.22</b>
<b>Groundnut-</b>	Kharif	4.40	9.45	2.65 (28.03)	0.56
	Rabi	0.56	2.15	0.96 (44.80)	0.20
	Summer	0.52	1.30	0.26 (20.18)	0.06
	<b>Total</b>	<b>5.48</b>	<b>12.90</b>	<b>3.87 (30.02)</b>	<b>0.81</b>
<b>Castor-</b>	Kharif	1.14	4.59	3.01 (65.66)	1.08
	Rabi	0.01	0.02	0	0.00
	<b>Total</b>	<b>1.15</b>	<b>4.60</b>	<b>3.02 (65.53)</b>	<b>1.09</b>
<b>All crops</b>		<b>136.97</b>	<b>682.13</b>	<b>178.74 (26.20)</b>	<b>52.40</b>



# Spatial Information System on Bioenergy

**Geospatial map of bio-energy potential combining rice, wheat, cotton and sugarcane crop over India**

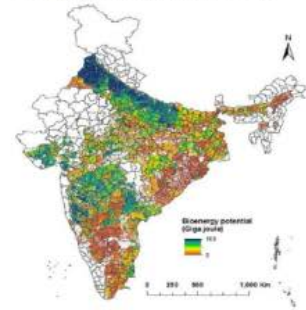


# Webpage of भुवन जैवऊर्जा

## Spatial Information System of Biomass Potential from Crop Residues (Bhuvan - JAIVOORJA)

Bhuvan

Bioenergy potential from surplus residue of crops  
(rice, wheat, cotton and sugarcane) over India



### Introduction

India ranks as one of the top energy consumers. However, its per capita energy consumption is significantly lower than the world average, with wide disparity between urban and rural areas. With India's growing population and increasing GDP, significant growth is expected in the energy demand. Contrary to the demand, native energy reserves of India are not adequate, making the country fairly dependent on foreign imports of oil. For instance, against the consumption of 213.93 MT crude oil in 2017-18, indigenous production was only 35.7 MT. India imports more than 80% of its required crude oil.

Growing energy demand coupled with limited conventional fuel options, geo-politics of oil and environmental concern has compelled India to search for renewable and sustainable energy options. Bioenergy has the potential to be a possible answer to today's energy challenge. The abundantly available biomass resources in India can contribute towards sustainable, secure and economically stronger future in terms of providing domestic clean energy, reduction in fossil fuel imports, employment generation and improving rural economy.

The Union Cabinet of India has approved a new National Policy on Biofuels in 2018, promoting production and use of biofuels in the country. The policy document also recognizes crop residues as a potential source of biofuel/bioenergy. Crop residues are bio-resources with significant spatial and temporal variability. For viable commissioning of a biomass power plant, precise database of residue distribution, including seasonal fluctuation (peak and lean period of availability) are a pre-requisite. Logistics such as residue harvest, collection, storage, and transportation are spatially interlinked and need meticulous planning.

To resolve these constraints, high resolution spatial map of surplus biomass potential from the crop residues (rice, wheat, cotton and sugarcane) over India have been prepared and supplemented with required geospatial layers to facilitate informed decision making.

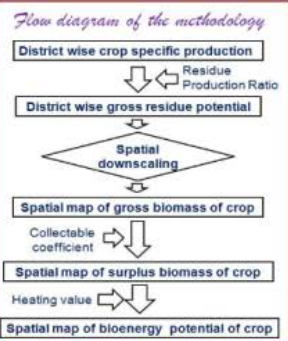
### About

Biomass potential was calculated from district-level crop production statistics. The grain production data were converted into gross residue potential using residue production ratio. The gross crop residue was further converted into surplus crop residue using collectable coefficient at district level. Surplus crop residue was then converted to district wise bioenergy potential using calorific values.

To generate spatial maps of surplus residue potential of the selected four crops over India, potential crop masks were prepared using multi-temporal satellite data and converted into crop fraction at 1 km grid level. MODIS Gross Primary Production (GPP) data was used as a proxy parameter of biomass abundance and disaggregated district level gross biomass potential to 1 km grid level. It was further converted to surplus biomass and bioenergy potential using suitable coefficient as discussed earlier. A spatial decision support tool is developed with all the relevant thematic layers and user friendly query module. The tool would benefit the policymakers & industry developers to assess the availability of biomass resources from user defined fetch area and facilitate planning/establishment of tailored made biofuel plants.

### Features

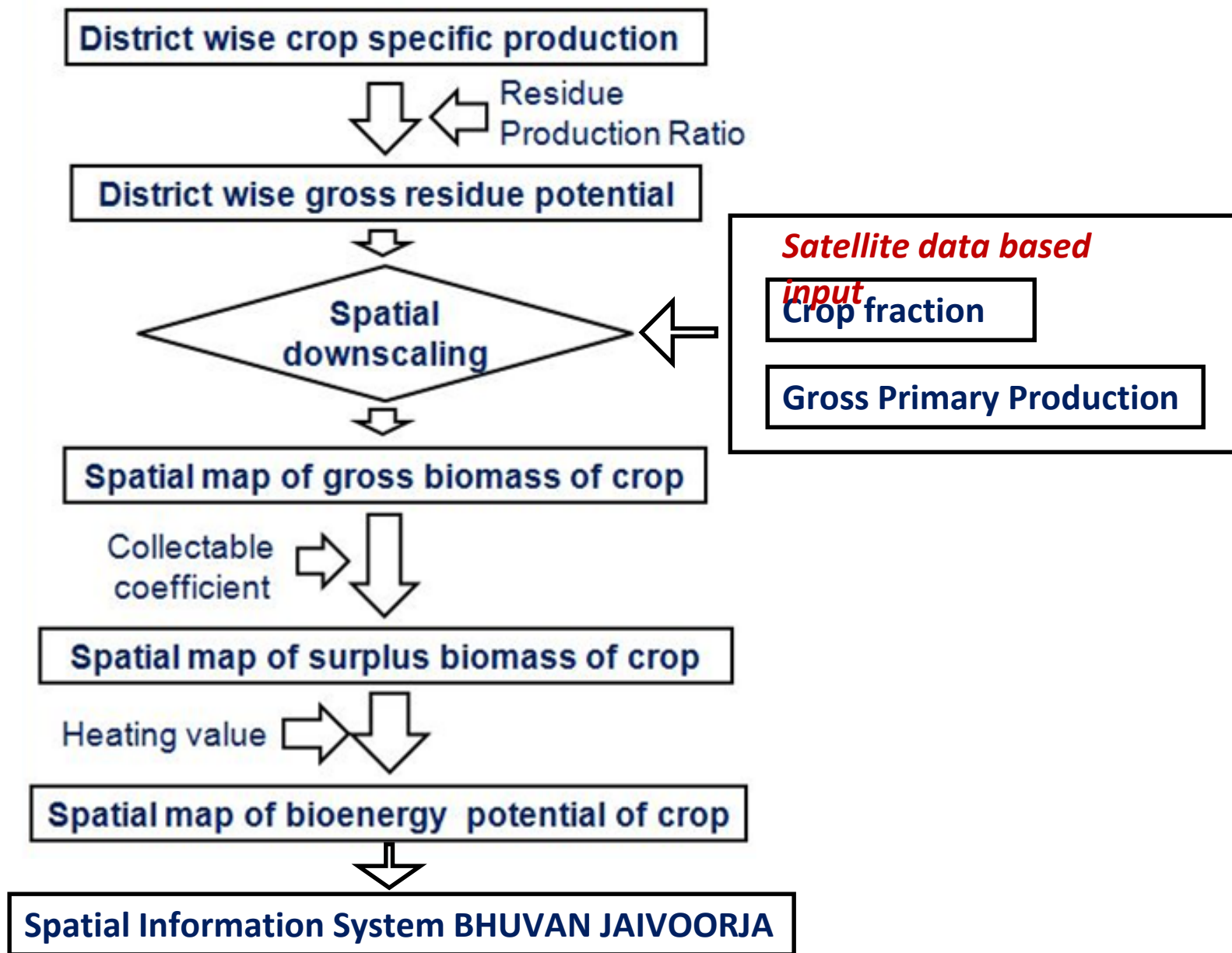
- Spatial maps of gross and surplus biomass of four crop residues (rice, wheat, cotton and sugarcane)
- Bioenergy potential maps of the selected crops
- Land Use Land Cover (LULC) map
- Administrative boundaries and road network
- A spatial query module allowing to draw a Point of Interest (POI) over the map, delineate a fetch area and calculate how much and what type of biomass would be available.
- Geographical location, district, state, nearest town, nearest railway station, nearest petrol pump of POI
- Map and statistics of LULC over the fetch area.



[Visit the site](#)

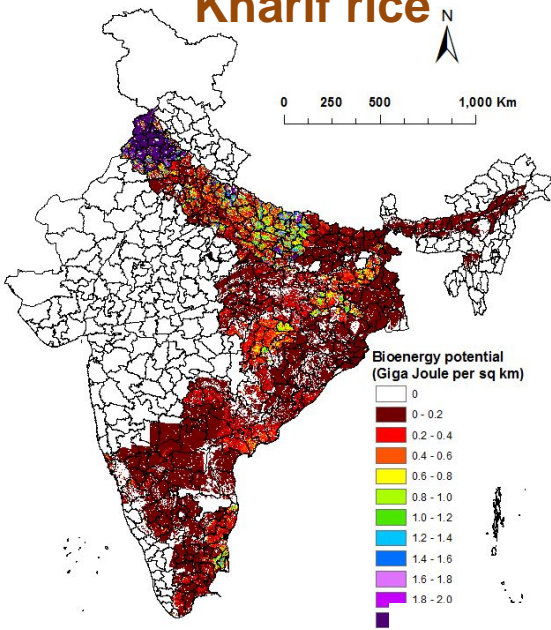


# Schematic diagram of methodology followed for spatial downscaling of district level biomass to 1 km grid level

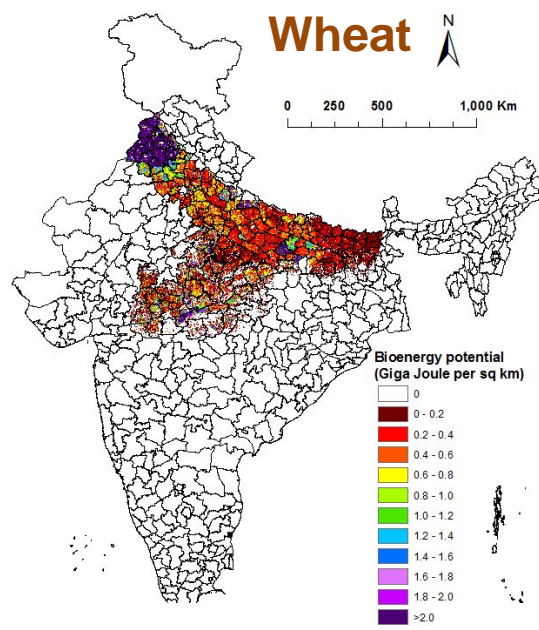


# Geospatial map of bio-energy potential from different crop residue over India

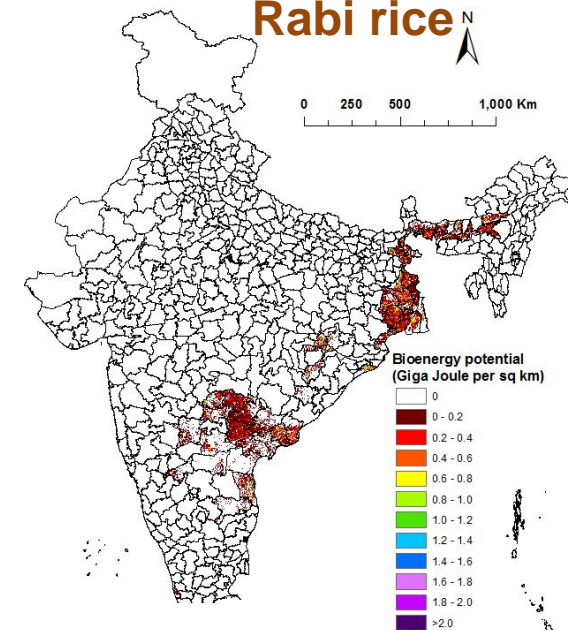
## Kharif rice



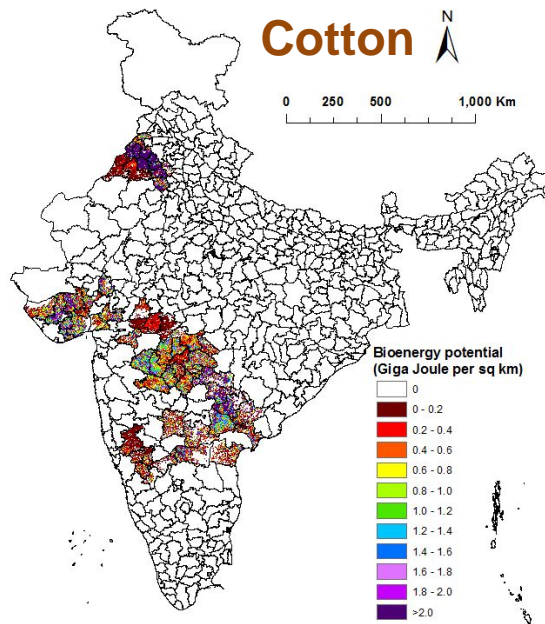
## Wheat



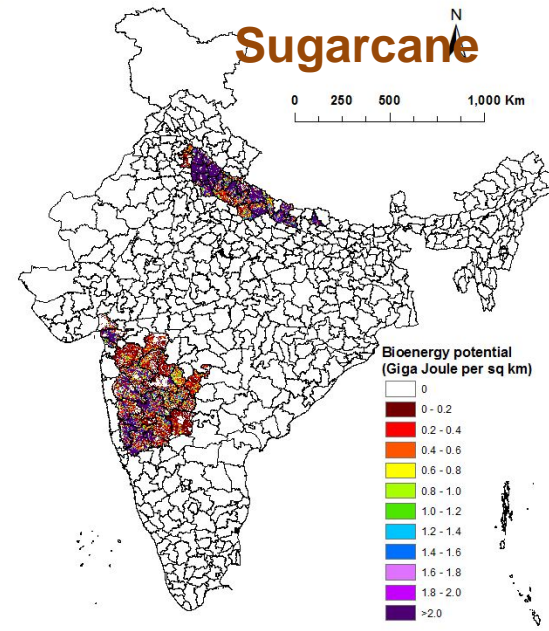
## Rabi rice



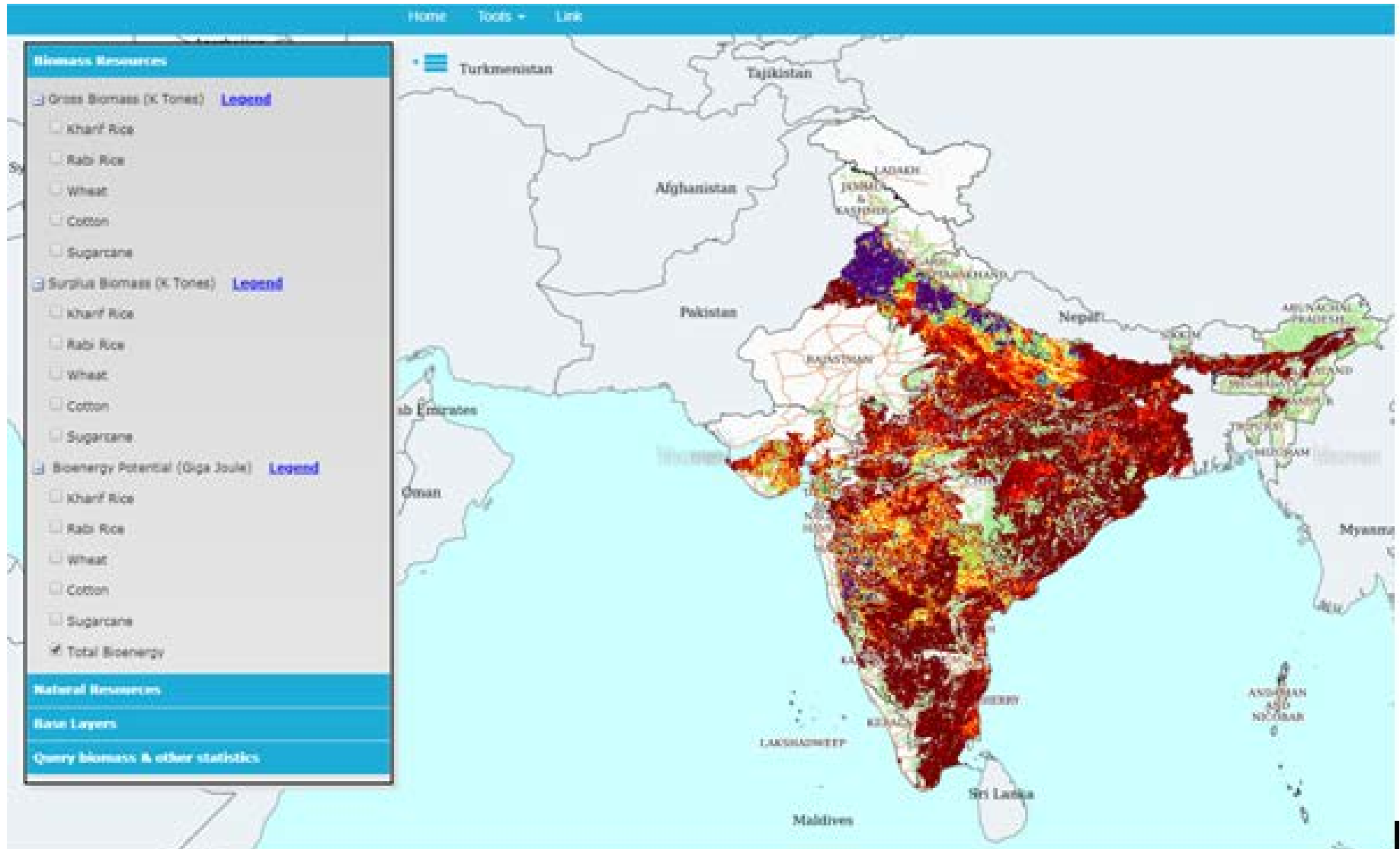
## Cotton



## Sugarcane



# Different geospatial layers of BHUVAN JAI VOORJA



# Major river courses and surface water bodies in BHUVAN JAIVOORJA

## Spatial Information System of Biomass Potential from Crop Residues (Bhuvan - JAIVOORJA)

Home Tools ▾ Link

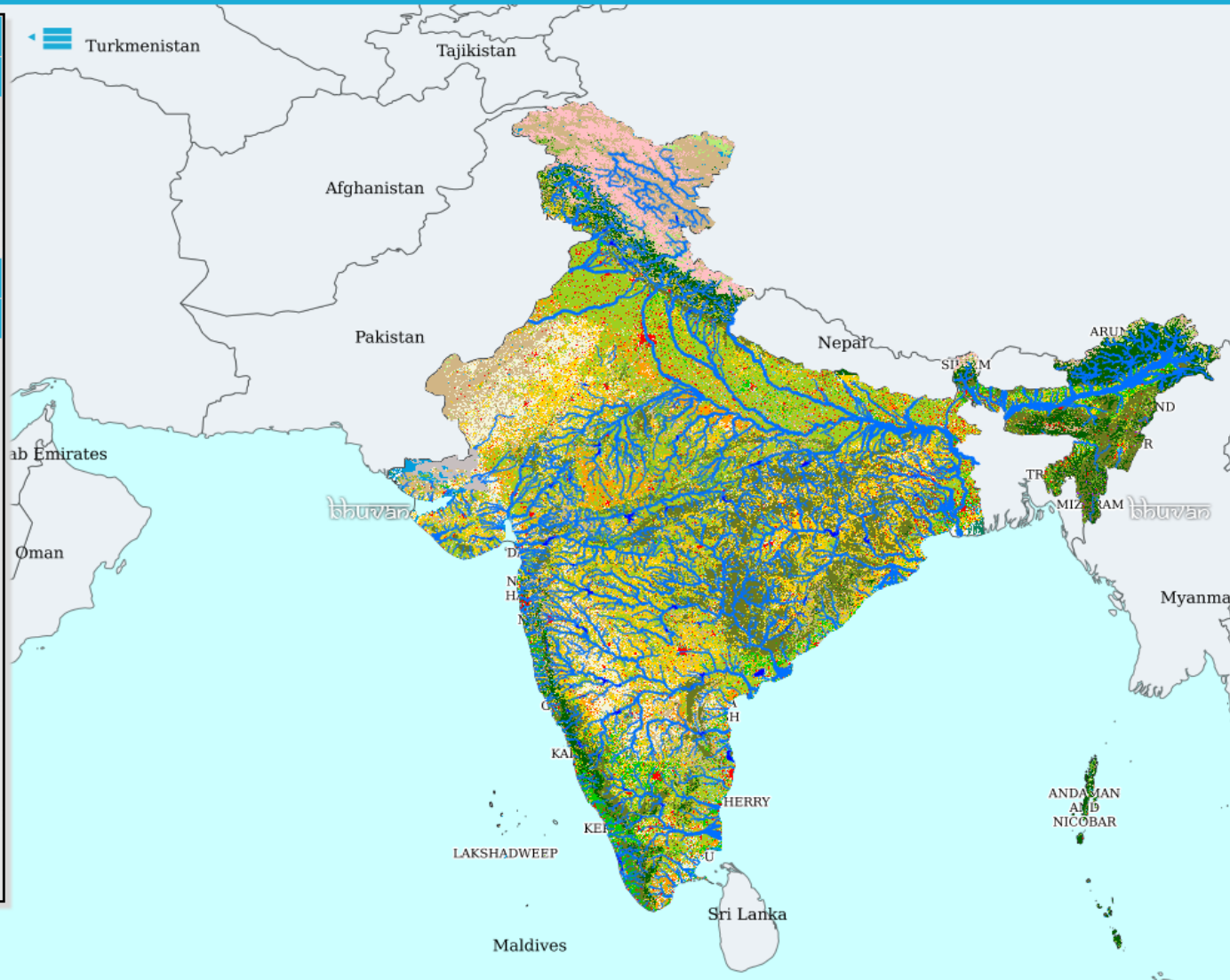
**Biomass Resources**

**Natural Resources**

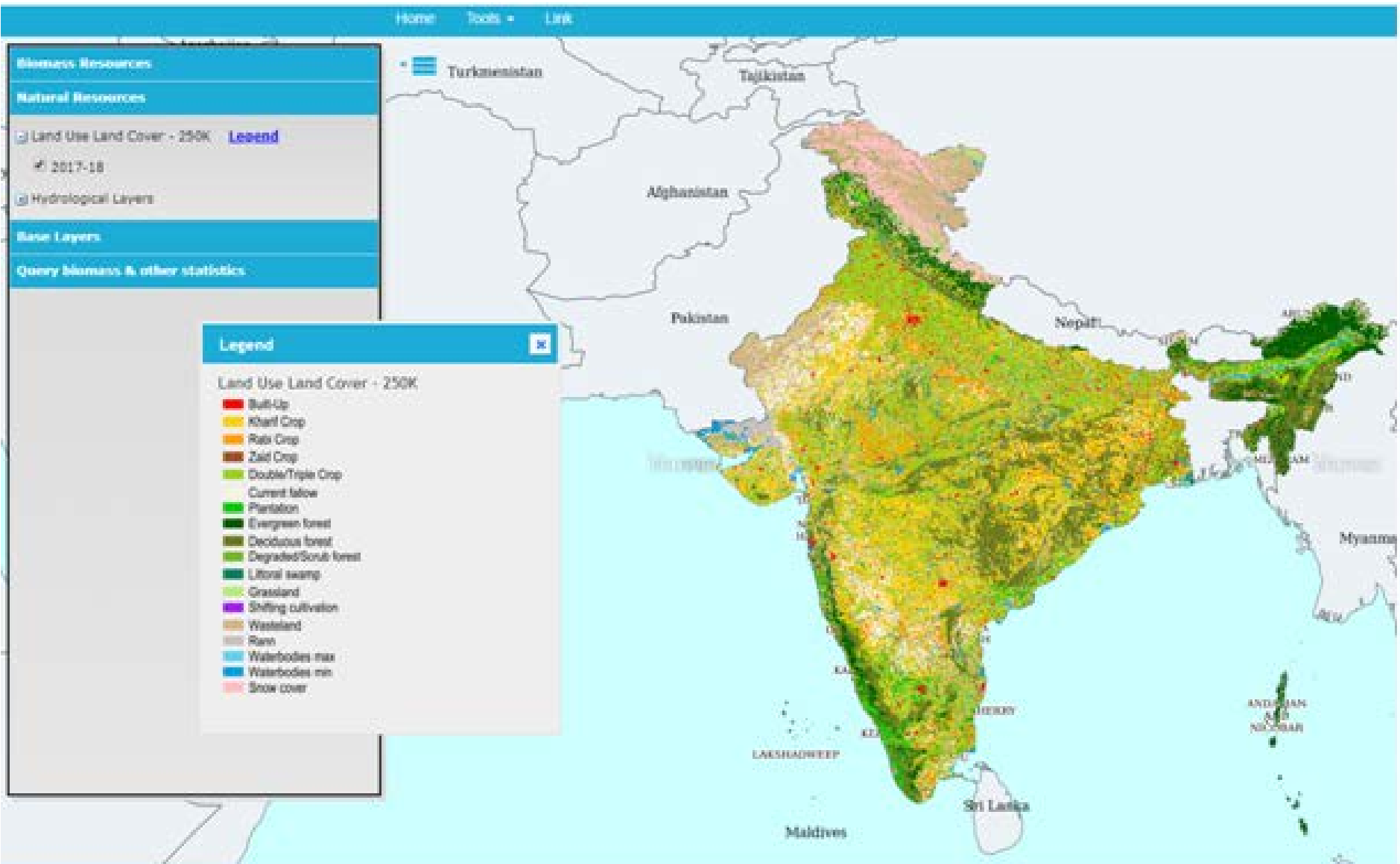
- Land Use Land Cover - 250K
- Hydrological Layers
  - Main River Courses
  - Surface Waterbodies

**Base Layers**

**Query biomass & other statistics**



# Land Use Land Cover in BHUVAN JAIV OORJA



# Spatial Query Module in BHUVAN JAIVOORJA

The screenshot displays the BHUVAN Spatial Query Module interface. The main map area shows a colorful satellite-style map with a red polygon overlaid, indicating a query area. A red location pin is visible within the polygon. The sidebar on the left contains the following sections:

- Biomass Resources**
- Natural Resources**
- Base Layers**
- Query Biomass & other statistics**

Under the 'Query Biomass & other statistics' section, there is a description: "Query the biomass availability over the fetch area along with other resources".

- 1. Point of Interest (POI)**  
(Provide the proposed site of biofuel plant)
  - Draw on map  Enter lat/lon
  - Start to identify proposed site
- 2. Fetch area**  
(Area from which crop residues would be collected)
  - Draw on map  Enter buffer radius
  - Start to identify fetch area
- 3. Analyse the statistics**

At the bottom of the map, there are labels for "Taranagar" and "Raigarh". A compass rose in the bottom right corner indicates North, South, East, and West directions. The text "DEE" is also visible near the compass.

# Demonstration- Web Portal

<https://bhuvan-app1.nrsc.gov.in/bioenergy/home>

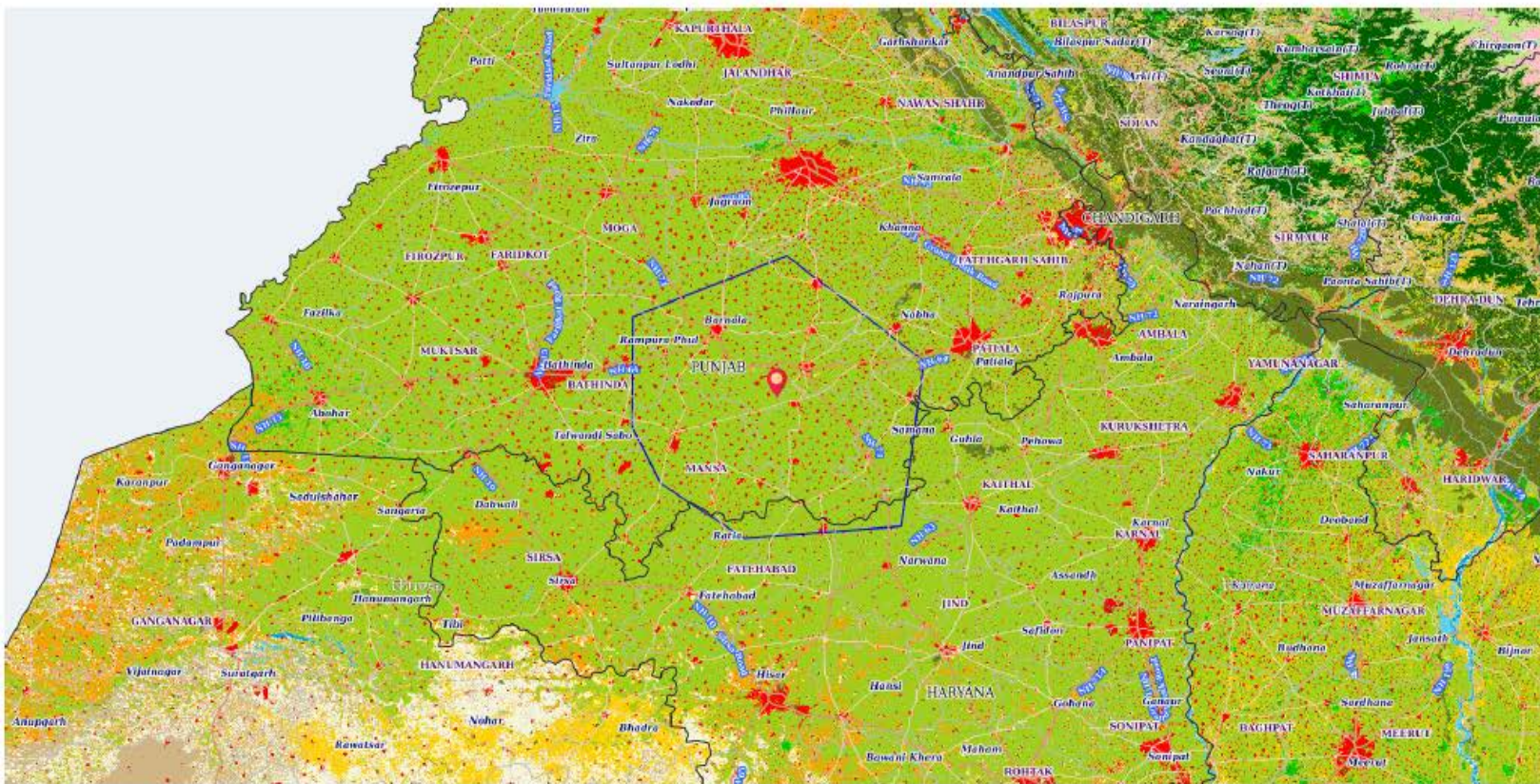
# Land Use Land Cover- Report



## BHUVAN-JAIVOORJA: Report on Available Biomass from Crop Residues (Based on Users Spatial Query)



Land Use Land Cover Map of the Fetch Area



### Legend

- Built-Up
- Kharif Crop
- Rabi Crop
- Zaid Crop
- Double/Triple Crop
- Current fallow
- Plantation
- Evergreen forest
- Deciduous forest
- Degraded/Scrub forest
- Littoral swamp
- Grassland
- Shifting cultivation
- Wasteland
- Rann
- Waterbodies max
- Waterbodies min
- Snow cover



Prepared by  
 Agro-ecosystem and Modeling Division  
 Agricultural Sciences and Applications Group  
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In collaboration with  
 Technology Information Forecasting and Assessment Council  
 Department of Science & Technology, Govt. of India  
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## Basic Information of the Site Location & Fetch Area

1	Fetch Area (in Sq. Km.)	7458.86
2	Coordinate of Site Location	Latitude : 30.11902, Longitude : 75.74799
3	State of Site Location	Punjab
4	District of Site Location	Sangrur
5	City of Site Location	Sangrur
6	Nearest Railway Station	Sunam Railway Station, 5.907 Kms away
7	Nearest Petrol/Gas Station	Indian Oil Petrol Pump, 2.588 Kms away

## Information of the available Biomass/Bioenergy Resources

	Kharif Rice	Rabi Rice	Wheat	Cotton	Sugarcane	Total
Gross Biomass over fetch area (K Tonnes)	3672.77	0.00	4128.45	802.27	0.00	NA
Surplus biomass over fetch area (K Tonnes)	2669.83	0.00	1318.38	677.63	0.00	NA
Bioenergy potential over fetch area (GJ)	41382.38	0.00	22939.86	11790.8	0.00	76113.04



# Biomass Characterisation

- 'Characterization of major agro-residues biomass in India' with major objective of collating information from secondary sources on defined parameters for all identified crops from each of different agro-climatic zones of our country.
- Data would be catalogued; statistics would be analyzed and organized into a searchable database for each parameter.

# *Thank you*



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