

Developing a spatial information system of biomass potential from crop residues over India: A decision support for planning and establishment of biofuel/biomass power plant

As per COP26 commitments, India would reach 500 GW non-fossil energy capacity by 2030 and achieve net zero emission by 2070.

Agriculture residues are an important source of renewable energy. Besides sugar based ethanol generation, residues from different crops rich in cellulose and hemi-cellulose are also useful to produce 2-G ethanol through enzymatic process.

With gross cropped area of 195 M ha covering multiple crops, a huge pool of residue biomass is available across India. Effective utilization of such biomass leads to sustainable, secure and economically-stronger future in terms of providing domestic clean energy, reduction in fossil fuel imports, besides creating new employment opportunities to rural India.

National Policy on Biofuel-2018 aims 20% ethanol-blended petrol by 2025. Mission SAMARTH also encourages 5-10% co-firing of biomass pellets in thermal power plants.

However, energy from crop residues has not been effectively utilized in India due to information gaps on its availability causing supply chain issues, land use constraints, policy incentives etc.

NRSC (ISRO) in collaboration with Technology Information Forecasting and Assessment Council (TIFAC), DST has generated a systematic geospatial database on biomass residues from four major crops and created a digital platform to visualize, annotate, delineate and query towards informed decision making.

Satellite based crop maps, primary productivity along with secondary data on crop production estimates and biomass utilization pattern were amalgamated using a data fusion technique in this endeavor. Ultimately, maps of gross and surplus biomass residues and its bioenergy potential were generated at 1 km level. Using these geospatial maps and other thematic and administrative layers, a unique spatial information system called BHUVAN-JAIVOORJA is developed to offer data and information support to different stakeholders of biofuel / biomass-based industries (<https://bhuvan-app1.nrsc.gov.in/bioenergy/home/>).

How to utilize the portal?

The query module of BHUVAN JAIVOORJA provides information on crop residue biomass availability over a location from its fetch area defined by the user. It also provides a lot of ancillary information such as land use composition, nearest railways, road network, petrol pump etc. for decision making. A brief report (three pages) on the proposed site can be exported detailing all the above said information in tabular and pictorial form. Such report provides comprehensive information on biomass availability and associated infrastructure, logistics etc. for decentralized planning and optimal utilization of biomass resources. A video file demonstrating the web-portal and query module is also provided at https://bhuvanapp1.nrsc.gov.in/bioenergy/documents/bhuvan_jaivoorja_tutorial.mp4, enabling user-friendly navigation in to the portal.

Fig. 1 Map of Bioenergy potential (GJ km⁻²) from surplus residues from Rice, wheat, cotton and sugarcane.

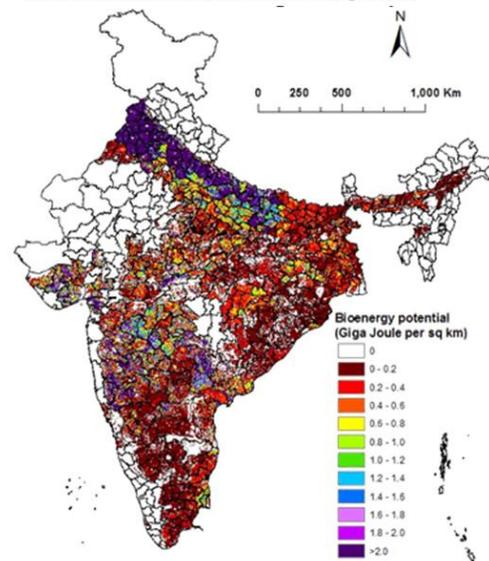
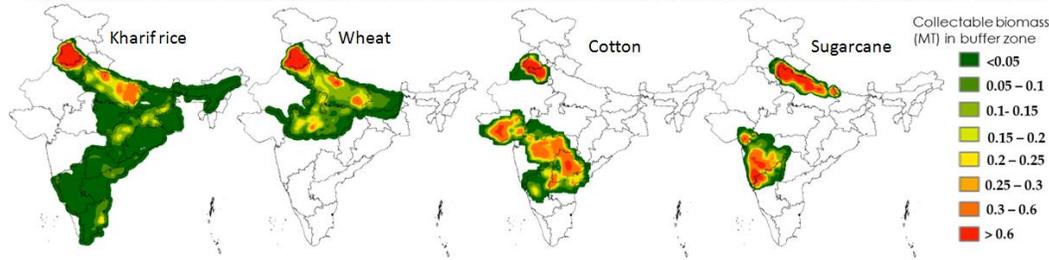


Fig. 2 Prospects of collectable surplus residue potential of the selected crops (kharifrice, wheat, cotton, and sugarcane) over circular buffer zones of 50 km radius.



Outreach and feedback

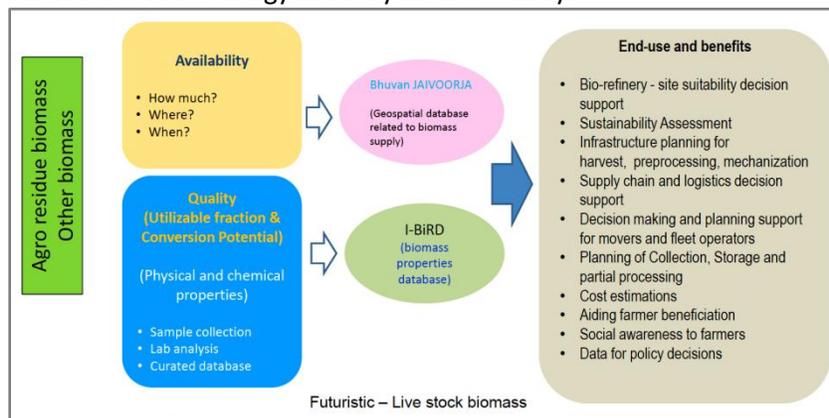
The portal was inaugurated on Jan 2020 at NITI Aayog. The information and decision tools in this portal are now being used by different stakeholders in energy sector providing positive feedback (Shell India, Praj Industry, IOCL, DST, Enertech Fuel Solutions Pvt. Ltd., Green IO Carbon etc). Till date there are more than **3.4 lakhs hits with 3300 unique IP addresses**.

This entire work is peer-reviewed by International experts, leading to its publication in a top-rated journal in energy sector as mentioned below;

Chakraborty, A., Biswal, A., Pandey, V., Shadab, S., Kalyandeeep, K., Murthy, C.S., Seshasai, M.V.R., Rao, P.V.N., Jain, N., Sehgal, V.K., Kaushik, N., Singh S. and Chowdhury, D., 2022. Developing a spatial information system of biomass potential from crop residues over India: A decision support for planning and establishment of biofuel/biomass power plant. *Renewable and Sustainable Energy Reviews*, 165, p.112575. (Impact Factor~15, CiteScore 30.5)

Way forward

- The additional information requirements for efficient use of agric-biomass for energy applications and realizing our bio-economy related goals, are two folds (a) quantum of crop biomass availability from multiple crops in spatial and temporal perspective in each year and (b) biomass quality information in terms of physicochemical properties and composition.
- In this direction, NRSC and CSIR have initiated the phase -II of the Bio-energy project i.e. “I-BiRD – Indian Biomass Resources Database and Decision support for bio-energy applications”. Concept note preparation and presentation to different stakeholders have been completed so far. Funding support is awaited to launch this new project.
- The new project offers wide range of information products and services with customized web tools supporting various needs of bio-energy industry in the country.



Schematic diagram of the proposed phase-II of the bioenergy project