



The SAHYOG project: Strengthening Networking on Biomass Research and Bio-waste Conversion – Biotechnology for Europe India Integration

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The main aim of the project SAHYOG is to bring together leading organisations in the field of **biomass production and bio-waste conversion research** carried out within EU research programmes and related programmes by Indian national institutions.

Inventories of biomass and bio-waste potentials and research projects/programs elaborated and analysed within SAHYOG are the basis for the joint **Strategic Research Agenda (SRA)** finally leading to a **Roadmap for policymakers and researchers**. SAHYOG ensures wide-range networking of relevant industries and scientific communities and establishes linkages between on-going research and innovation projects from EU and India.

Please see www.sahyog-europa-india.eu for more information.

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Project News

In this sixth and final newsletter issue, we would like to present to our readers final results of the SAHYOG project, the SAHYOG EU-India Strategic Research Agenda (SRA) on Biomass and Bio-waste, and the SAHYOG RTD Roadmap for policymakers and researchers. Furthermore, information is presented on a "Manifesto for International Cooperation on Biobased Development", the final SAHYOG meeting and workshop on 18-19 November 2014 in Brussels, the Workshop on Biomass and Territory on 12 November 2014 in Italy, and the SAHYOG Interactive Meeting at GBPUAT, Pantnagar, India on 10-13 December 2014.

Joint Europe-India Endeavor towards Sustainable Bio-economy Development: SAHYOG activities and Main Results

Under the main objective of the project SAHYOG (Strengthening Networking on Biomass Research and Bio-waste Conversion – Biotechnology for Europe India Integration), a major coordination approach was planned to support the setting up of the sustainable bio-economy.

As a first step in this project, the work was focused on the elaboration of inventories to document biomass production and bio-waste availability in both regions. These were then complemented with the comprehensive inventories of research activities in Europe and India to identify common areas of interest and cooperation opportunities along with the knowledge gaps in various fields related to the bio-based economy.

During the first year of the project, the most up-to-date data on biomass production and availability from three major sectors: forestry, agriculture and wastes in Europe and India, was collected and analysed at the state level through an intensive consultation of existing databases and reports in Europe and India. An analysis of the EU and Indian inventories demonstrated similarities as well as differences in the availability and usage of renewable biomass for energy, chemicals and materials. Being an agriculture-based country, India derives most part of its potential biomass from agricultural by-products, which is converted to energy through pyrolysis (57%), gasification (29%) and combustion/anaerobic digestion (14%). In the EU, 76% of biomass potential comes from forestry, while the agriculture sector contributes only 13% of biomass. A common feature is that in both EU and India, a great part of the available biomass from all the three major categories remains unexploited. Under the framework of SAHYOG project plan, the work on ongoing research on new data was continued throughout the project duration to update the inventories. The updated biomass and bio-waste resources inventory database for both EU and India, is available at the web-site (<http://www.sahyog-biomass-database.eu>).

The second inventory on European and Indian bio-based projects and programs provides an overview of about 924 projects in the EU and 280 in India, searchable with respect to the categories

Upstream/Downstream/Whole chain, Type of Biomass, Production and pre-treatment, Biomass conversion technology, End Products, Type of research, Organisation type, Drivers, and Sectors. The overall analyses of the data reveals that the Bio-based Research in the EU covers the complete area and the projects funded by both national and EU programmes contribute to the development of the bio-based economy that could be achieved in good cooperation with other countries, and also in collaboration with India. The categorization of the projects, available at the fully searchable database at the website (<http://www.sahyog-projects-database.eu>) enables the collaboration in specific areas.

Based on the state-of-the-art technology and the two inventories, a Roadmap and a Strategic Research Agenda (SRA) were prepared to help paving the way for a bio-based industry and economy in Europe and India. The SRA was prepared taking into account comments and concerns of the different stakeholders. The structure of the SRA consists of three main chapters describing each the strategic research needs in the collaboration between Europe and India in specific domains. The first one is focused on feedstock including wastes and its production (biomass production), the second one on biorefineries (or alternatively biomass/waste valorisation and technologies), and the third one on products, markets and policies (but with a focus on the research needs related to these topics).

The SAHYOG SRA was built upon the vision document put forward by the Public Private Partnership on Biobased Industries – BRIDGE 2020 (Biobased and Renewable Industries for Development and Growth in Europe). The vision foresees the use of renewable resources, bio-waste and side streams as the major input source for materials, food and feed ingredients, fuels and chemicals, maximizing the added value along the value chains. At the centre of this vision, bio-refineries will gradually replace oil-refineries, by sustainably processing biomass into a spectrum of marketable products and energy.

The RTD Roadmap, defining the different implementation steps, was developed at the last phase of the project. The Upstream/Downstream Roadmap compiled the needs and challenges, and the shared vision for the EU and India on the latest developments in the bio-based economy in line with the SRA. It provides a list of recommendations that might be of extreme importance for future concerted actions planning between the two regions.

Within the knowledge-based bioeconomy, information sharing is an important issue. The program on the wide-range networking of relevant industries and scientific communities and linkages between on-going research and innovation projects from EU and India has been accurately organised in the SAHYOG project. The dissemination activities of the project have been an integral part of all work packages of the SAHYOG work program. Further specific dissemination activities included project twinning, short-term exchanges of researchers, stakeholder workshops, and summer schools. All these activities are expected to have a significant socio-economic impact in India and Europe.

The SAHYOG website for the dissemination of project activities and results was created under www.sahyog-europa-india.eu. The newsletter issues inform readers about all the activities and events realised in the framework of the SAHYOG project focusing on EU-India research cooperation in the fields of biomass production and bio-waste conversion biotechnologies.

The organization of expert meetings to provide opportunities to explore the opinions and perspectives of European and Indian scientists and R&D program managers and a final SAHYOG conference and bioeconomy event to ensure widespread communication, were also organized successfully. The results of the project activities performed during the project were presented and discussed with the key experts from both regions including industries, present at the meetings.

The two inventories of biomass and bio-waste potentials and research projects/programs, elaborated and analyzed within SAHYOG, and the joint

Strategic Research Agenda (SRA) are the main highlights of the project. The SRA, aimed to facilitate concerted planning of future EU-India research initiatives, led to define an RTD Roadmap for policy-makers, researchers and other stakeholders related to the field of bio-based economy, identifying key targets to further scale up the EU - India collaborations.

The work conducted under this EU-India project, was accomplished thanks to the support of all the SAHYOG team. The results of the activities conducted under this project will assist both the sponsors of this project to have insights on current status on biomass and bio-waste valorisation research and to strategize the research priorities in the important field of bioeconomy.

I believe that the results achieved during this coordination activity will be of great importance to systematically bridge the on-going respective activities from India and Europe that might help in providing the basis for novel applications in a sustainable bio-economy of the future - the so-called knowledge based bio-economy (KBBE).

Finally, I am pleased to present you the final issue of the SAHYOG Newsletter. All articles in this issue provide a short overview of the main activities of the project.

Thank you and Happy Reading!



A Manifesto for International Cooperation on Biobased Development

The presentation by Prof. Emmanuel Koukios, National Technical University of Athens (NTUA), Greece at the final SAHYOG workshop and meeting in Brussels was based on a broader work, which has the form of a Manifesto and is co-authored by scientists and engineers from several EU countries presently experiencing deep and complex systemic crises.

This Manifesto advocates the adoption of a new development model, focusing on the target of sustainable bioeconomy, around which other themes and topics will crystallize. Implementing this model will act as a locomotive to get the concerned economies and societies efficiently out of their crises, and smoothly into greener post-crisis pastures. The proposal is articulated in ten critical steps or theses for immediate action by the policy- and decision-makers, as well as other key actors. Cooperation at all levels - regional, national and global - on green bioeconomy themes constitutes one of the “ten commandments” for sustainable change.

Bioeconomic systems are usually open ones, communicating, trading and exchanging goods and services with each other. Today, this communication and exchange might involve any of the essential flows (molecular, cellular, energy, information, financial, and human) present in all bio-systems. Overall, inter-regional and international cooperation have become key ingredients of the proposed new bioeconomic strategies. However, in the last period, with the trend of “globalization” affecting a large part of the world, the basic conditions of collaboration have significantly changed. So, in putting together a new bio-based development strategy, such as the one by SAHYOG, we must take into account the rules of the new innovation and technological cooperation landscape for regional and national bioeconomies to network and link with each other. These new major trends concern both the form and content of the linking, bridging and bonding actions, and include goals and issues, tools and approaches, and research agendas.

In further investigating these issues, NTUA researchers have analysed the typology of EU bioeconomies and came up with the following four types shown in the map (in parenthesis, a typical example of each type): “Green West” (e.g. France); “Industrial North” (e.g. The Netherlands); “Rural South” (e.g. Greece); “Emerging East” (e.g. Poland).

For more information on the Manifesto for International Cooperation on Biobased Development, please contact Prof. Emmanuel Koukios, National Technical University of Athens (NTUA), Greece (koukios@chemeng.ntua.gr).



Four types of EU Bioeconomy

The recently published EU-India Strategic Research Agenda (SRA) compiles a shared vision for the EU and India on the latest developments in the bio-based economy, and the research needs in this context. Based on a thorough assessment of the availability of biomass and bio-waste resources, and existing research projects and programmes in both India and Europe, this important document defines specific needs, scientific expertise, research tools required, and the size of demonstration and pilot plants necessary, in order to pave the way towards a future sustainable bio-based economy.

The SRA follows the whole value chain, from (a) biomass production to (b) conversion into bio-refineries and (c) utilisation in markets. For each part of the value chain the present status and strategic research needs for efficient collaboration between Europe and India in the specific domains are described. This work has resulted in a set of comprehensive research recommendations for the bio-based economy and further cooperation between India and Europe. These research recommendations address the areas of biomass and bio-waste resources, their conversion technologies, and bio-refinery systems, as well as markets, products and policies.

With respect to biomass and bio-waste resources significant differences were identified between India and Europe. While the dominant resource in Europe is biomass from forestry, followed by domestic and industrial organic waste, sewage, and cereal residues, in India the most abundant and available feedstock are domestic and industrial organic and bio-degradable waste fractions, and cereal residues; this is due to India's important agricultural sector. Priority research areas for EU-India cooperation include the development of uniform biomass resource databases, low input and intensified (biomass) production, harvesting and logistics (of residues), waste collection, separation and treatment, as well as sustainable algae production systems.

Research priorities in the area of conversion technologies and bio-refinery systems identified for both India and Europe include lignocellulosic bio-refineries, anaerobic digestion, and the demonstration of bio-refinery concepts. Specific research activities of common interest include the development of enzymes, micro-organisms, and processing equipment, efficiency improvements for anaerobic digestion and thermal conversion by gasification and pyrolysis, as well as the development of full bio-based value chains for energy and chemicals production.

With respect to markets, products and policies it was found that in India food security (excluding the use of food crops for energy production) and energy production from biomass resources are of the highest priority number. In Europe, on the other hand, stronger emphasis is placed on the development of new markets (e.g. for bio-based chemicals) within a bio-based economy.

Both continents do acknowledge the need for increased valorisation of biomass and bio-waste resources and an integrated bio-refinery approach in the future. Joint EU-India activities in this field include the development of a common political framework, stimulating a global bio-based economy, the elaboration of standards for performance criteria of bio-based products, as well as well-targeted public awareness programmes and training and education initiatives for researchers and engineers. It is clear that by using the specific strengths from both Europe and India, it is possible to carry out more effective and efficient research, and thereby enhance the bio-based economy as a whole.

The SAHYOG Strategic Research Agenda is available at:
www.sahyog-europa-india.eu/rtd-roadmaps-a-sra/

For further information on the SRA, please contact Rebecca van Leeuwen, Netherlands Enterprise Agency (RVO), The Netherlands (Rebecca.vanleeuwen@rvo.nl) and Reeta Goel, GB Pant University of Agriculture & Technology, Pantnagar, India (rg55@rediffmail.com).

As one of its key goals SAHYOG developed an RTD roadmap that defines the intermediate steps that are needed to tackle the common challenges of the EU and India for the transition to a bio-based economy. This Upstream/Downstream Roadmap addresses the common needs and challenges and gives the shared EU-Indian vision on the bio-based economy.

Starting from the research recommendations developed in the Strategic Research Agenda, the key areas of common research have been selected by consulting European and Indian stakeholders in a targeted way through a recommendation survey. Feedback was received from approximately 250 stakeholders, from academia, government and industry, and active in the various sectors of the bio-economy including energy, agriculture, and chemistry.

In this way, a very thorough view on the common R&D needs of the EU and India was obtained, and following topics were found to be key for the EU-India collaboration in the various parts of the chain of the bio-economy:

Biomass production

- Optimization of agricultural practices through breeding, modelling, monitoring. Providing regionalized solutions. Development of accurate biomass mapping methodology.
- Development of new (energy) crops, including phenotyping, suitable for marginal and abandoned lands and/or low nutrient/water supply and allowing agricultural intensification.
- Research and development on micro- and macro algae as future biomass source.

Reduction and full valorization of waste and by-products

- Set up of surveys to monitor the amounts and compositions of the different types of residues and wastes (municipal, agricultural and process residues and wastes).
- Proper databases on the available biomass potential allowing future predictions considering climate change.
- Improving the collection of municipal waste (segregation) and sustainable agricultural residues harvesting.
- Development of new technologies to convert the different types of solid wastes and residues (agro-forestry, municipal and industrial).

Biomass conversion through biorefineries

- Development of biorefineries based on lignocellulosic biomass towards fuel and chemicals.
- Linked to waste: further development of anaerobic digestion to convert organic wastes into biogas (and in a later stage to chemicals or biofuels).

For these common R&D needs, the short-term, mid-term and long-term subjects for collaboration have been selected and discussed in the RTD Roadmap.

The SAHYOG RTD Roadmap is available at:
www.sahyog-europa-india.eu/rtd-roadmaps-a-sra/

For further information on the RTD Roadmap, please contact Kathy Elst (kathy.elst@vito.be), Deepak Pant (deepak.pant@vito.be) or Ludo Diels (ludo.diels@vito.be), Flemish Institute of Technological Research (VITO), Belgium.

Final SAHYOG Meeting and Workshop

18-19 November 2014, Brussels, Belgium

An additional stakeholder workshop was organized on the occasion of the final SAHYOG project meeting taking place at the ENEA Liaison office in Brussels on 18-19 November 2014.

The main aim of this workshop was to present and discuss pre-final versions of the SAHYOG Strategic Research Agenda (SRA) and the Roadmap for

policymakers and researchers. Comments received by stakeholders were included in the final revision of these important project outcomes.

All presentations are available at the project website:

<http://www.sahyog-europa-india.eu/news-a-events/events>.



Participants of the SAHYOG Meeting and Workshop in Brussels

Workshop on Biomass and Territory: Made in Italy experiences for the new international markets, at Bologna Trade Fair in Italy, 12 November 2014

In collaboration with FederUnacoma and Nuova Energia magazine, ITABIA – Italian Biomass Association – organized an international workshop hosting the delegations of foreign countries present at EIMA International and interested in the issue of the exploitation of the biomass resource. The idea was born from the intent, already experienced in the early stages of the ASSO BIOENERGY FederUnacoma, to promote initiatives that encourage the internationalization of “made in Italy” passing through the transfer of know-how of the national biomass bioproducts and bioenergy systems.

On this occasion Dr. Neeta Sharma, the SAHYOG project Coordinator, was invited to give a talk on the

international cooperation for the transfer of know-how and good practices: the EU-India Project – SAHYOG (Strengthening Networking on Biomass Research and Biowaste Conversion - Biotechnology for Europe India Integration).



Panellists of the Workshop on Biomass and Territory in Italy

The SAHYOG interactive meeting was organized at GB Pant University of Agriculture & Technology, Pantnagar, India in December 2014 by SAHYOG partner Prof. Reeta Goel, GBPUAT College of Basic Sciences and Humanities.

Highlights of this visit to GBPUAT included a meeting with Dr. Aziz Qureshi, Governor, Uttarakhand and Vice-chancellor Dr. HS Dhami on 11 December 2014, where the SAHYOG Strategic Research Agenda (SRA) and RTD Roadmap were presented and opportunities for future INDO-EU collaborations discussed.



SAHYOG visit to GBPUAT research centres, Pantnagar, India

Furthermore, several GBPUAT research centres (Norman E. Borlaug Crop Research Centre, Vegetable Research Centre, Dairy and Poultry Farm, Nagla, Floriculture Research Centre) were visited by Dr. Neeta Sharma and Dr. Neera Bhalla Sarin (see pictures). Dr. Neeta Sharma, ENEA, SAHYOG coordinator, also visited Kumaun university, Nainital on 12 December 2014 and had a meeting with the Vice-chancellor to explore future opportunities for research cooperation. Press conferences were organised at GBPUAT and at Kumaun University. The news on the results of the meeting was published in a number of local and national newspapers.



News in one of the local newspapers in Uttarakhand & UP State in India

SAHYOG team members will participate at the 23rd European Biomass Conference and Exhibition (EUBCE) in Vienna and present activities conducted under the SAHYOG project such as:

- Results and achievements of the SAHYOG project – Future EU-India cooperation for the transition to a bio-based economy
- SAHYOG EU-India Strategic Research Agenda (SRA) on Biomass and Bio-waste
- SAHYOG RTD Roadmap for policymakers and researchers

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