

Innovation and Sustainable Development: A Bioeconomic Perspective

Manish Anand, The Energy and Resources Institute (TERI), New Delhi¹

Introduction

Sustainability is a relationship, or balancing act, between many factors (social, environmental and economic realities and constraints) that are constantly changing (Munasinghe & McNeely, 1995; Pirages, 1994). Ensuring sustainability over time means maintaining a dynamic balance among a growing human population and its demands, the changing capabilities of the physical environment to absorb the wastes of human activity, the changing possibilities opened up by new knowledge and technological changes and the values, aspirations and institutions that channel human behaviour. Thus, visions of a sustainable world must naturally change in response to shifts in any part of this dynamic relationship (Pirages, 1994).

Bioeconomy – the emerging cross-cutting economic sector that produces, transforms, and uses bio-based materials and products – is at the center of sustainable economic strategies of countries worldwide. The concept of ‘bioeconomy’ revolves around a technology transition, especially biotechnology, which uses bio-resources. Competitiveness in such a system will increasingly depend on innovations around bio-based products and processing technologies.

Bioeconomy and sustainable development goals

Sustainable bioeconomy is synonymous with achieving the sustainable development goals (SDGs) (See, Figure 1). Around half of the 17 SDGs are directly related with bioeconomy. SDG 2 calls for sustainable agriculture, especially for

the fight against hunger. According to the latest edition of the annual UN hunger report (The State of Food Insecurity in the World 2015 - SOFI), roughly 1 in 9 people are suffering from chronic undernourishment. To meet the food requirements of the projected population of around 9 billion people by the middle of this century, the bioeconomy has to provide a reliable food supply system meeting the basic needs of the world population.

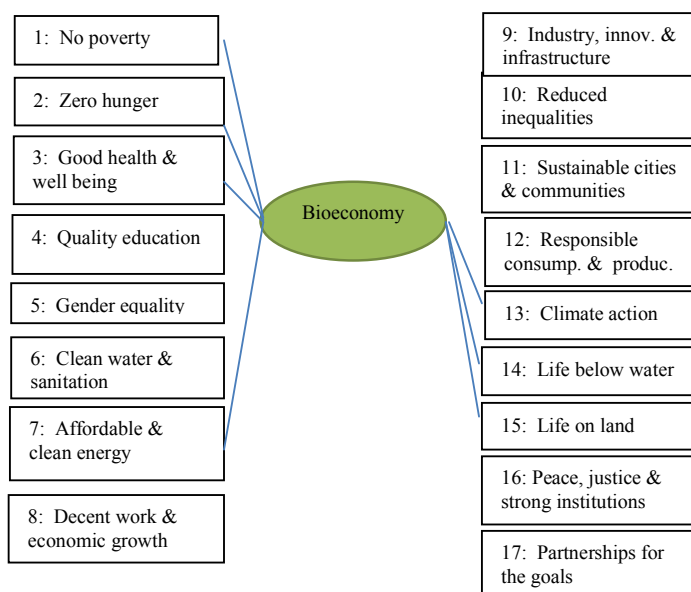


Figure 1: Bioeconomy and SDGs

To end extreme poverty by 2030 as envisaged under SDG 1, a very clear understanding of rural poverty and the pathways to move out of the extreme poverty trap is required. In this regard, the relationship of agriculture to the environmental crisis needs to be understood. Most of the planetary boundaries today are threatened by unsustainable agricultural practices. In the area of biofuels, the SDGs overlap with the bioeconomy. Given all of the

¹ Email: manand@teri.res.in. The views and opinions expressed are the author’s and do not represent those of the Secretariat of the United Nations. Online publication or dissemination does not imply endorsement by the United Nations.

challenges of the food systems, any large scale application of biofuels could deeply compete with food or other ecosystem services. But there could also be applications not competing with the food supply and ecosystem services that the bioeconomy could potentially explore and contribute to, such as to SDG 7 on access to renewable energy services . Another area bioeconomy could potentially contribute to is the domain of human health by providing vital solutions for diseases as well as for healthy ecosystem services.

Technology and bioeconomy – a systems perspective

Solutions to sustainability problems and challenges would critically require knowledge from scientific research and appropriate technologies. In this regard, the traditional single-discipline focus of S&T may not be appropriate, and a more fully integrated S&T system with transdisciplinary orientation would be desirable. To meet the challenges in achieving the complex and intricately intertwined SDGs, , a range of disciplines and expertise needs to be taken into consideration to develop a region-specific bioeconomic agenda that bears in mind the local context, the micro climate, and micro ecological conditions.

Advancements in emerging technologies, such as biotechnology, offer a cornucopia of possibilities to help address some of the development challenges like access to clean drinking water, energy provision, effective health care, food security, and so on. Decentralized technology can to a large extent help meet some of developmental challenges like provision of safe water and clean energy. However, the complex and interdisciplinary nature of emergent technologies would require a major reorientation and organization of R&D practices. This has profound implications for developing countries, which are locked into a path of knowledge generation, development and commercialization within an institutional set up that may be increasingly less relevant with respect to requirements of emerging technologies. In this regard, the need for

institutional changes in building S&T capability would be decisive. Institutions in the above context refer to the sets of common habits, routines, practices, rules or laws that regulate the relationships and interactions between individuals and groups. Since institutions determine to a large extent the interaction pattern, learning behaviours and the sharing of knowledge, their importance in building capabilities assumes a great deal of significance.

Access to clean water, energy and sustainable agricultural production systems are major challenges in developing countries, despite the availability of technologies. This indicates that the solution to these development challenges does not solely lie on the technology front, but also depends to a large extent on the governance framework. Factors influencing the relationship between knowledge, diffusion and outcome in the spheres of agriculture, water and energy mostly revolve around resources, infrastructure, strength of institutions and quality of policies. Also the human element, including cultural and individual behaviour patterns, play a role even where knowledge is diffused and services are available (See, Figure 2).

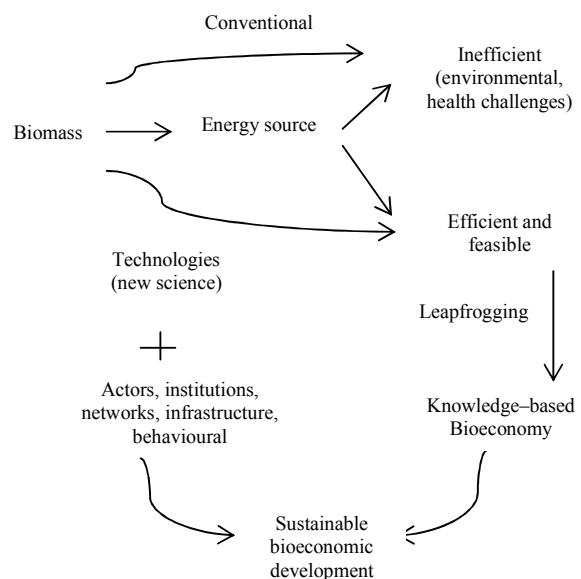


Figure 2: Innovation system for sustainable bioeconomic development

In sum, building functional bioscience innovation system would be important in order to move towards a sustainable bioeconomy. It could be helpful to establish an innovation systems approach, in which drivers of the bioeconomy would respond to changes in systems components, and impacts on growth, distribution and ecology would be derived in the context of policy interventions.

The case of India

In India, bioeconomy has the potential to realize the opportunities to tackle the grand societal challenges concerning food/feed security, water security, energy security, materials development, rural development, and ecology of the environment. Being an agriculture-based country, India derives most part of its potential biomass from agricultural crops and by-products. About 23.5% of the total primary energy used in the country is still generated from biomass, and more than 70% of the country's population depends upon it for its energy needs.

The emerging bioeconomy in the Indian context is changing the feedstock competition on biomass for food, energy and industrial material use. There is therefore a need to increase efficiency in bioeconomy through innovations that would not be in competition with, but enhances food security. Hence, there is a need for innovation policies to address these issues. Some of the pointers for research and innovation strategy for realizing the bioeconomic agenda in India relate to²

- Researching on improvements of agricultural practices to increase biomass production for food and non-food uses.
- Taking into consideration the available leads from on-going projects on diversified agriculture, crop rotation practices, state-wise diversified germplasm demarcation,

improved water and fertilizer management, phenotyping etc.

- Increasing the agricultural biomass potential by investing in high-yields varieties, energy plantation in unexploited waste land, and regional solutions diversified crop selection as per state geographical and agronomical conditions.
- Researching on new crops/plants that have the potential of growing on marginal or waste land or have high productivities and low land use.
- Bioprospecting of the biodiversity, which is expected to lead to new species with improved properties for biomass production, as well as species containing high added value active compounds for instance for medicinal application.
- Coastal areas as production sites for cultivation of large amounts of algae, and especially macroalgae that are rich in proteins, sugars, oils and lipids, and many other compounds as well as energy source.
- The need for research on technical conversion processes allowing the utilization of bamboo in the various sectors of the bio-economy. Bamboo is traditionally applied in paper, pulp, and handicrafts industry, but further implementation as wood substitute, timber replacement, or energy feedstock is envisaged.
- Exploring potential for energy generation from waste, as for instance municipal waste generated in the country comes from various sources and disposed in a local landfill site.
- Researching on waste management systems to handle large amounts and diverse types of industrial, agro-industrial and municipal wastes.

² <http://www.sahyog-europa-india.eu/>

Concluding Remarks

To make the transition to a bio-economy, numerous incremental and radical innovations need to be developed. Bioeconomy draws heavily on basic scientific research, which is most often lacking in developing countries. Current science funding is limited in many low income and emerging economies, and science policy strategies are often not well informed by evidence. To take advantage of opportunities, developing economies need to invest in building their analytical strength to prioritize investments on science and technology, including for biotechnology.

There is very little South-South (between developing countries) collaboration on technologies to promote green innovations, even though there exists a huge potential for expanding green production and trade. Also, there has been very little attention to base-of-pyramid (BoP) innovations that address the needs of the poor. There is much scope for innovation that helps improve the delivery of a wide range of public services. Therefore, building capacity in forging international collaborations with public and private entities, and harnessing the emerging innovative international knowledge networks would be important.

References

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