

The Emergence of Industrial and Environmental Biotechnology as a Rising Segment of New Bioeconomy

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ABSTRACT

Biotechnology pledge, a bunch of progressive methods, has been the focus of public strategy yearnings more than last 20 years. In a call, tempered by sincerity and alertness, Agenda 21, the work programme adopted by the 1992 United Nations Conference on Environment and Development, affirmed that "biotechnology wishes to make a vital commitment to empower the advancement of, for example, better medical care, improved food security through economic rural practises, improved supplies of consumable water, more efficient". Biotechnology has evidently struggled to fulfil its previous guarantees, and this insight is reinforced by flow banter on the well-being of gene-adjusted (GM) food sources. In either case, extensive evaluation shows the advancements of biotechnology in virtually all the major fields of human enterprise. A portion of the remarkable highlights of the emergence of modern and ecological biotechnology as a developing fragment of the new bioeconomy have been seen in this study. Descriptive analysis on various secondary sources data and different articles and research papers have been undertaken to the emerging scope of the bioeconomy.

1. Introduction

The global economy has been witnessing knowledge-intensive use of new technologies such as biotechnology, information and communication technology, renewable energy technology, nano technology for the production of goods and services across all the sectors of the economy. The need for such transformation arises from the fact that there exist major global challenges like population explosion, food security, climate change, resource scarcity, inequality, developed-under development divide between nations, transformation from linear economy to a sustainable circular bioeconomy. The rate of reception seen in the field of biotechnology is steady with past trends in other non-exclusive technologies. The speed of dispersion would be the fastest as biotechnology allows new products that are not subject to existing applications. In the area of medical care, for example, these may include innovative methodological techniques for a wide variety of organic and non-natural articulations. It's been quite few years since the world pioneered on Agenda 21¹. The aim to achieve sustainable development through collective efforts at local, national and global levels was set. The current study discusses the guarantees, opportunities and challenges associated with the incorporation of new and natural biotechnology into the global economy. More specifically, the study is concerned about the capacity of non-industrial(developing) nations to believe a large part of this is clearly a developing area, including the more extensive use of modern biotechnology in regions such as agribusiness, medicine and industry. We are alluding to the latest juncture of biotechnology and the business specialties that they hold as the "new bioeconomy." New modern designs are likely to emerge, powered by mechanical and technical advancement. The new bioeconomy will benefit from advancement in various fields, in particular computer science (precision agricultural practices), and will thrive in nations and local communities that are seeking a way to create an environment of empowerment for their selection. The paper proposes that the promotion of bioeconomy requires the appropriation of a global biotechnological administration structure to put countless non-industrial nations into the global network of trade. Inability to do so would create a "hereditary divide" between nations and would possibly increase public opposition to biotechnology. The components of such a governance system include improvements to market access, enhancement of mechanical capacities, admission to innovation, public biotechnological guidance, and the management of hazards and benefits associated with their use.

2. A Modern Bioeconomy Emergence

Bioeconomy is considered as a biobased economy, an amalgamation of renewable biological resources, effectual biological processes and eco-industrial clusters, which will lead to value-added bioproducts, employments and income generation. Advances in biotech-related fields such as genomics, hereditary design, synthetic design and cell innovation are transforming human lives. Biotechnological changes have brought in great improvements in different sectors like production of drugs, antibiotics, human and plant genetic engineering, bio innovative smart processes. Opportunities for sustainable production of existing and new products and services have been enhanced. Analysis of various researches done, gives different vision to understand the bioeconomy concept

¹It is the "Voluntary" action plan of the United Nations (UN) related to sustainable development

Fig 1. The Bioeconomy Visions²

	The Bio-Technology Vision	The Bio-Resource Vision	The Bio-Ecology Vision
<i>Aims & objectives</i>	Economic growth & job creation	Economic growth & sustainability	Sustainability, biodiversity, conservation of ecosystems, avoiding soil degradation
<i>Value creation</i>	Application of biotechnology, commercialisation of research & technology	Conversion and upgrading of bio-resources (process oriented)	Development of integrated production systems and high-quality products with territorial identity
<i>Drivers & mediators of innovation</i>	R & D, patents, TTOs, Research councils and funders (Science push, linear model)	Interdisciplinary, optimisation of land use, include degraded land in the production of biofuels, use and availability of bio-resources, waste management, engineering, science & market (Interactive & networked production mode)	Identification of favourable organic agro-ecological practices, ethics, risk, transdisciplinary sustainability, ecological interactions, re-use & recycling of waste, land use, (Circular and self-sustained production mode)
<i>Spatial focus</i>	Global clusters/ Central regions	Rural/Peripheral regions	Rural/Peripheral regions

Environmental biotechnology relates to the application of biotechnology in the context of environmental protection to deal with various biotic and abiotic factors influencing environment. Environmental concerns are being dealt through biowaste management, bio monitoring.

The traditional concept of biotechnological strategies makes it conceivable to establish another bioeconomy with more extraordinary possibilities for the commercialization of new biotechnological products and for the wider interest of the agricultural nations. Since its growth, modern biotechnology has been connected to discussions on advantages and hazards. The capacity to alter life itself to build new products and administrations has been described as progressive innovation, with cultural consequences comparable to data and correspondence turmoil. These high expectations have also given rise to fears and concerns that have caught public and policy attention around the world. Hidden in smaller debates about the impact of biotechnology on human well-being and the environment, there are more significant questions about financial factors, which can be turned into consumer divide. Few attentions have been given to the capacity of non-industrial developing nations to make use of similar advances to distinguish their development and become major parts of the new bioeconomy. The debate on the circulation of biotechnological capabilities is evident in the field of agriculture, where only a small number of nations develop GM crops. This small appropriation of capacity is also a major source of global concern and a vital factor in the identification of GM food sources around the world. While rational developments in biotechnology seem to be moving across all accounts in less industrialised nations, there are different elements that would consider more substantial investment by non-industrial nations in the new bioeconomy. A large part of the underlying creative work consumption (R&D) has been effectively borne by the developed nations, and strong global innovation associations are required. Making the most of these opportunities possible, however, will depend on the degree of domestic technical limitations and government policies in non-industrial nations. Many advanced countries have bioeconomy and biotechnology policy framework (Bioeconomy strategy-EU Commission, National Bioeconomy Panel-Denmark, and so on). The developing economies need to focus on such policy adoption to overcome many economic and social concerns. In the era of global trade, restrictions imposed by countries, is one of the fears for economic exploitation of the biotech innovations. The new bioeconomy is represented by the emergence of institutional frameworks, as well as by the laws that allow for an elective approach to innovation participation. In the first place, the latest bioeconomy appeared at the same time as global exchanges agreed to help the business predominance of pioneers, specifically technical fields. These requirements are built up by a more prominent focus on instruments, such as the Agreement on Trade-Related Intellectual Property Rights (TRIPS) under the World Trade Organization (WTO), which could minimise the risk of technical overflows to less-advanced nations. Second, globalisation has increased technical collaboration between nations. Third, the current bioeconomy is primarily powered by the private sector, with less open-ended collaboration. The emerging part of the private sector in the developed nations is calling for a comparative shift in the agricultural nations. Public sector needs to play a pioneering welfare role in increasing investment and research in this field. In general, another innovation management framework is expected to promote technical cooperation, expand business openings for all major players, and widen the potential for more comprehensive recognition of biotechnology products.

3. Global Bio Technology and Policy Trends: Evaluating the Progress of Bio-Tech Economy-

The bioeconomic model is a convergence of different fields like biology, science, engineering and their associated scientific and technological development. Finding a pure economic measure such as GDP is inadequate to estimate its growth and development. Various researchers have given different frameworks to measure the sustainability of bio tech economy. Broadly three aspects can be measured³:

Economic (Traditional): bioeconomy as a share of GDP and Employment; Trade, Gross or Local value added

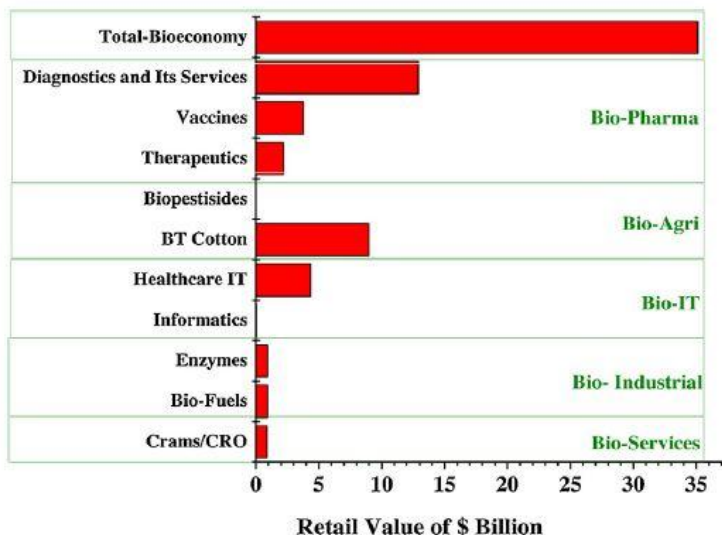
²See: Bugge MM, Hansen T, Klitkou A. What Is the Bioeconomy? A Review of the Literature. *Sustainability*. 2016; 8(7):691. <https://doi.org/10.3390/su8070691>

³Justus Wesseler, Joachim von Braun, 2017, Measuring the Bioeconomy: economics and Policies. *Annu.Rev. Resour.Econ*,2017

Environmental (Physical): share of renewable based content in the country's products and services, GHGs, Fossil Fuel use, soil and water contamination, land use(degradation), biodiversity

Social sustainability (Pervasive): Outcome measures like reduction in carbon emissions, well-being of people (non-price), Equity, Capacity and freedom, People participation Estimates for India indicates that it is a fast-growing bioeconomy at US 35 billion \$ in 2015, powered by biotechnological innovations. Future seems to be full of growth potential and opportunities, with ABLE⁴ predicting the Bioeconomy to cross the \$50 billion in 2018. National Mission on Bioeconomy was launched in Shillong, Meghalaya, by the Institute of Bioresources and Sustainable Development (IBSD). It is subsidiary under the Department of Biotechnology, UnionMinistry of Science and Technology.

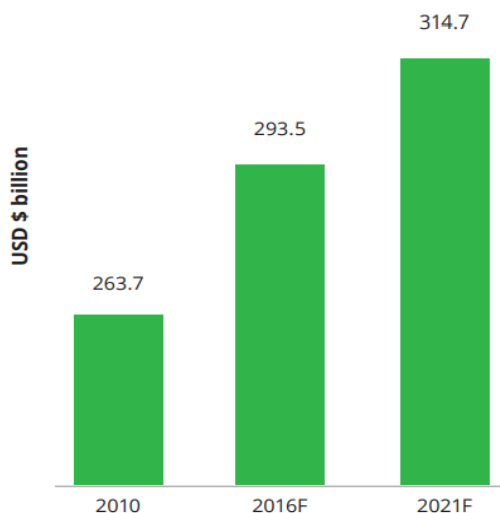
Fig. Bioeconomy growth in Indian context



Source: ABLE India report

Biotechnology industry has been on the growth path. The revenues have been expanding from 1.1 billion US \$ in 2005 to 11.6 billion US \$ in 2017. National Biotechnology Development Strategy was also announced in 2015 by DBT to encourage innovation and R&D in the sector. BIRAC has also initiated various programmes to develop biotech ecosystem. The national policy on biofuels also targets to achieve a blending of fossil fuels with 20% of biofuels by 2030.

New EuropaBio report highlights the increasing potential of Industrial Biotechnology. Its contribution is over 30 billion euros to the European Union economy, and is expected to reach around 100 billion euros by 2030. Its also contributes towards employment generationsubstantially. Generating 4.7% of the gross domestic product (GDP) and employing 8.9% ofthe labour force in the EU-27 in 2017. The figure below shows the revenues generated in global biotechnology industry revenue (USD \$ B), 2011-2016⁵.



Source: IBISWorld Industry Report, "Global Biotechnology," October 2016

Fig. Global Biotechnology: industry revenue (USD \$ B), 2011-2016 industry revenue (USD \$ B), 2011-2016

⁴ Association of Biotechnological led Enterprises (2003)

⁵ <https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Life-Sciences-Health-Care/gx-lshc-2017-life-sciences-outlook.pdf>

In the United States, economic value of the biobased economy is calculated by Biotechnology Innovation Organization (BIO). The calculations include various aspects like renewable chemicals, industrial biotechnology, etc. For the year 2014, employment generated in U.S. biobased products industry was around 4.22 million and the value-addition of \$393 billion was estimated by biobased products industry.

The century is dedicated to opening up new roads to extend the usage of renewable assets in the global economy. These trends would open up new freedoms for investment by non-industrial nations in the new bioeconomy. However, as in previous innovative transitions, current concerns are many. Because of agricultural biotechnology, for example, only a tiny number of non-industrial nations have so far worked out how to become a big part of the global economy. Modern biotechnology spans two distinct territories. The primary zone is the use of inexhaustible raw materials (biomass) to replace raw materials derived from petroleum products. The second is the use of organic structures such as cells or compounds (used as reagents or impulses) to replace regular, non-natural techniques. These biocatalysts are more explicit and precise than their non-organic partners. Subsequently, they provide a more important potential as bioenvironmental cleansers. Overall, biocatalysts produce fewer results and can begin with moderately less purged feedstocks. Moreover, provided that they are self-generating, they can be used in applications such as waste management. Despite these advantages, however, biocatalysts are often fragile (requiring a lot of water) and have a low volume of profitability. With steady advances in biocatalysts and the emergence of new plan concepts, the potential of biotechnology to diffuse in the real world will grow. This possibility is strengthened by recent advances in the natural sciences, as well as related fields such as research and informatics. Biomass use for energy has been on the agenda of various administrations. A major part of the interest arose from the oil emergencies of the 1970s. Despite the fact that interest has been diminished due to a decline in energy prices, development in the organic sciences has continued to boost the possibilities for innovative change and more comprehensive application. In terms of electricity, living plants can be used to manufacture synthetic substances such as citrus extract, lysine and lactic corrosive. As protein innovation advances, consideration is being given to moving towards different bioprocessing strategies by tapping the world's microbial life wonder capability. Emergence of DNA sequencing will prove to be a major breakthrough in science and technology. As a result, the field of genomics is likely to broaden its influence from medicines and agriculture to environmental engineering.

Biotech Innovations in recent times; transition towards sustainable bioeconomy

ECOVATIVE (mushroom technology)	Developed biodegradable plastic called "mushroom materials"; fully degradable new bioplastic.
IMPOSSIBLE FOODS (plant-based meat substitute)	In 2017, the company announced to produce plant-based burger meat.
AMSilk, ADIDAS (biodegradable shoes)	In 2016, Adidas introduced biodegradable shoes. Biotech company, AMSilk provided engineered bacteria protein having similar building blocks as that of spider silk protein.
LANZATECH (low-carbon ethanol)	A carbon recycling company; uses micro-organisms to convert industrial waste into low-cost ethanol. In 2017, Indianoil has collaborated with the company to construct refinery off gas-to-bioethanol production facility.
Liquid biopsies	annual sales of this cancer test are forecast to be \$10 billion
Microbiome	microbiome for developing new diagnostics, therapies, and "probiotic" products

Technological developments will lead to new ages of synthetics and polymers(biofuels) that will compete directly with mass petrochemicals. Next generation industrial biotechnology is an innovation which is energy and fresh water saving. The selectivity of chemicals, proteins, nucleic acids and carbohydrates has become the focal point of exploration to identify harmful gases in mines and life forms in the environment. For some time, companies have been doing various things with the "life science" business model, trying to put together different applications in the fields of medical care, agribusiness and industry under one umbrella venture and a traditional stage of innovation. Data sharing (IPRs) is another critical aspect of these new improvements.

4. Conclusion

The investigation has highlighted some of the remarkable development of industrial and ecological biotechnology as an emerging section of the new bioeconomy. More comprehensive dissemination of these technologies would typically depend on financial assistance and scope provided the State. The capacity of developing agro-based nations, to harness from bioeconomy advancements, is of particular importance. The study focused on the importance of a more open market access framework; more extensive innovation to be undertaken through corporate collusion; motivating administrative conditions, especially those that advance the shift towards modern sustainable bioeconomy. Major concerns relating to high production costs, Intellectual Property Rights, quality standards, need to be addressed. It could be a mean to achieve SDGs especially relating to food security, health and well-being, affordable clean energy. The future looks forward to international cooperation in emerging bioinnovations in biopharmaceuticals, biofuels, biorefineries, bio innovation agriculture, artificial photosynthesis, DNA computers, biobatteries, biomining, biomimicry, Green infrastructure, "Green" Industrial Revolution and so on.

References

1. Bugge, M. M., Hansen, T., & Klitkou, A. (2016). What is the bioeconomy? A review of the literature. *Sustainability*, 8(7), 691.
2. De Besi, M., & McCormick, K. (2015). Towards a bioeconomy in Europe: National, regional and industrial strategies. *Sustainability*, 7(8), 10461-10478.
3. El-Chichakli, B., von Braun, J., Lang, C., Barben, D., & Philp, J. (2016). Policy: Five cornerstones of a global bioeconomy. *Nature News*, 535(7611), 221.
4. Kleinschmit, D., Arts, B., Giurca, A., Mustalahti, I., Sergent, A., & Pülzl, H. (2017). Environmental concerns in political bioeconomy discourses. *International Forestry Review*, 19(1), 41-55.
5. Maciejczak, M. (2017). Bioeconomy as a complex adaptive system of sustainable development. *Marketing*, 2(2), 7-10.
6. McCormick, K., & Kautto, N. (2013). The bioeconomy in Europe: An overview. *Sustainability*, 5(6), 2589-2608.
7. Morganti, P., Palombo, M., Carezzi, F., Nunziata, M. L., Morganti, G., Cardillo, M., & Chianese, A. (2016). Green nanotechnology serving the bioeconomy: Natural beauty masks to save the environment. *Cosmetics*, 3(4), 41.
8. Morrison, B., & Golden, J. S. (2015). An empirical analysis of the industrial bioeconomy: implications for renewable resources and the environment. *BioResources*, 10(3), 4411-4440.
9. Pfau, S. F., Hagens, J. E., Dankbaar, B., & Smits, A. J. (2014). Visions of sustainability in bioeconomy research. *Sustainability*, 6(3), 1222-1249.
10. Scarlet, N., Dallemand, J. F., Monforti-Ferrario, F., & Nita, V. (2015). The role of biomass and bioenergy in a future bioeconomy: Policies and facts. *Environmental Development*, 15, 3-34.
11. Staffas, L., Gustavsson, M., & McCormick, K. (2013). Strategies and policies for the bioeconomy and bio-based economy: An analysis of official national approaches. *Sustainability*, 5(6), 2751-2769.
12. Zilberman, D., Kim, E., Kirschner, S., Kaplan, S., & Reeves, J. (2013). Technology and the future bioeconomy. *Agricultural Economics*, 44(s1), 95-102.
13. <https://www.indianmirror.com/indian-industries/2017/biotechnology-2017.html>
14. India is second largest market for pharma, biotech workforce: Report | Business Standard News (business-standard.com)
15. <https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Life-Sciences-Health-Care/gx-lshc-2017-life-sciences-outlook.pdf>
16. <https://www.lanzatech.com/2017/07/10/indianoil-lanzatech-sign-statement-intent-construct-worlds-first-refinery-gas-bioethanol-production-facility-india/>
17. <https://explorebiotech.com/8-biotechnology-breakthroughs-2017/>