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Creating Biotechnology Scenarios in Complex Social Systems

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A variety of factors will determine how the globe evolves. Transitioning to renewable energy and decentralised storage, adopting a global policy approach to enable the use of new genomic technologies, patients accepting new treatments, society adopting preventive medicine or demanding transparency about food properties, dietary shifts, the development of new high-tech materials, lifestyle shifts, and advancements in robotics and artificial intelligence are all examples. Following such changes and projecting their long-term influence on how we live may encourage scientists to take a translational step and create biotechnology discovery research routes that would serve as the foundation for future research and innovation (R&I) [1].

Biological research is expanding its horizons of knowledge at a breakneck speed. As our understanding of biological processes improves, so does our ability to generate incremental and differentiated advances in the medical, agricultural, and industrial biotechnology sectors. Because the time it takes to comprehend basic biological processes, come up with an idea, and build a viable product can range from 10 to 25 years, one of the most pressing questions in today's biotechnology discovery research is "innovation for what future world." To that goal, we conducted a first-of-its-kind scenario study with a 2050 time horizon in 2019 to better comprehend the agricultural biotechnology option space. I Fifty-five trends and 22 uncertainties in the agricultural socioeconomic system were examined in order to outline the spectrum of possible future paths and focus down how agricultural biotechnology may best future-proof food, nutrition, and health security. Consumer and demographic trends, farming and technology, politics, economy, and societal developments were all discussed, while identified uncertainties were grouped into three themes: the need for adaptation, value chain priorities, and the role of research.

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By 2050, biotechnology discovery research will likely be at the heart of a slew of new technologies. However, depending on how the future unfolds, today's biotechnology research advancement has a higher or smaller potential to serve as the foundation for future innovation. Furthermore, the lack of a pervasive open innovation culture between business and academics raises the danger of losing out on innovation that will fulfil industry or consumer need in the future. It is apparent, for example, that demand for climate change-related biotechnology innovation will be considerable, and that policymakers will promote it. However, it is still unknown what the unfulfilled demands of various stakeholder groups will be. Associated effects on towns, gardens, parks, lakes, and agriculture fields.

As a result, there is no evident translational step from innovation potential to necessary new knowledge. Similarly, how to infuse innovation into products is unclear. It might be anything from gene editing to unique, societally approved procedures that have yet to be developed. The first action, building climate change expertise, is unlikely to become obsolete. The second, using biotechnology innovation to combat climate change is more risky since it is dependent on how policies evolve throughout the world. For example, whereas a comprehensive replacement of fossil-based synthetic materials by bio-based alternatives is feasible in a bio-innovation world, such a development is less likely to occur in a REJECTech world, even though the know–how to do so exists.

The exploitation of the micro biome is another example. Because bacteria affect most, if not all, complex ecological systems, exploitation of biological know–how is projected to open up new markets and business models in a wide range of biotechnology disciplines. Medicine, health care, food systems, industrial and home processes and materials, resource recycling, and energy capture are some of the possibilities [2]. To make this a reality, wide basic biotechnology discovery research on micro biomes must reach a tipping point, allowing for R&I for smaller and larger possibilities across industries. This demands a large public effort to enhance precompetitive know–how and enablement to a level suitable for sector uptake while maintaining a fair risk profile. A flagship method in medicine, for example, based on on-going big data efforts, such as the human '100K genomes project 'ii, might serve as a vehicle to attain the necessary level of enablement in a 5-year time frame while allowing smaller projects to build on it cost-effectively.

However, an entrepreneurial environment is required for this to occur, meaning that such advances are more likely to emerge under a Bio-innovation scenario or even a Food Emergency scenario, after society begins to prioritise food and health access. A third example is dietary changes that favour alternate protein sources. Taste, texture, palatability, colour, convenience, and price are all factors that influence consumer decision. To make alternative protein products competitive with beef, considerable gains in biological understanding and food source upgrades would be required, among other things. The difficulty is to narrow down the carriers, such as algae, insects, crops, fermentation, and so on, as well as the particular features, so that biotechnology research may be put to use [3].

It's not evident how to do this successfully since it's unclear which

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items and product attributes will meet future market expectations. This underlines the need of comparing learning contexts and identifying scenario-specific indicators to provide early insights into how certain trends are unfolding. These signs might be related to yes/no decision points in policy formation, the timely implementation of important enabling technologies, or the presence of significant consumer demand. Tracking the progress of numerous, scenario-specific indicators can assist to direct emphasis in discovery research and to stress or de-emphasize important elements in a timely way to increase the likelihood of successful innovation [4].

When the founding know–how generated through discovery research is not widely available and accessible in a useful manner, as in the biotechnology instances above, there is a danger of poor innovation output. The implementation of learning scenarios and the assessment of success against indicators for these situations can considerably increase the timely availability of founding know–how. We think that in order to boost the output of innovation, the conversation should move beyond financial tools and creativity. Instead, we advocate examining how the innovation ecosystem works. The present working principles between academics, value chain stakeholders, and society might benefit from an exhaustive examination to maximise the utility of breakthroughs in knowledge. To go from discovery to innovation more quickly, biological research requires continual cross-stakeholder contact. An open innovation governance approach to cope with precompetitive and competitive big data information and activities is a must to better direct biotechnological R&I. Appropriate business models and governance ideas to deal with, among other things, data ownership and intellectual property must be created, and specialised data stewardship teams must be installed to make this feasible and sustainable. Setting this up will very certainly need numerous rounds of optimization to get the greatest balance of stakeholder interests. Yet, in an ever-changing environment, it is ideally positioned to increase the entire flow of innovation to the market and to provide the required flexibility to deal with forthcoming trends [5].

Conflict of Interest

Authors declare no conflict of interest.

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