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Synthetic Biology: Changing the Way You Grow and Eat Your Food!

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By Suraj Nair, Lead (TechSprouts), Ankur Capital

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How do we feed 10 billion people worldwide by 2050? Sounds simple enough? Produce more food, right? Sadly, it isnâ??t as straightforward as it seems. Agriculture is one of the largest contributors to greenhouse gas emissions (GHGs), uses the largest amount of water sources and is one of the highest polluting activities. Simply growing more food is unsustainable. So, letâ??s start answering the question by putting things in perspective:

There is ample evidence to suggest that we are already growing enough food to feed more than 10 billion people. Despite this, hunger exists. The problem is not so much about food production as it is about a lack of efficiency in agri-food systems across the board.

Further, climate change is sending global climatic systems into a state of flux and rapid change. Agriculture is extremely sensitive to shifting weather patterns, droughts, excessive rain and other climatic aberrations, which makes it acutely sensitive to the effects of climate change.

Systemic inefficiencies in agri-food systems are associated with various parts of the value chain, ranging from agri-inputs to crop development and final food production. Traditionally, addressing these inefficiencies has involved the use of digital technologies to collect and distribute data and improve the value chain with data-driven decision making.

However, the last decade has seen the advent of synthetic biology as a new innovative approach towards improving agri-food systems. Furthermore, synthetic biology can not only address inefficiencies, but also make agriculture more climate-resilient.

What is the synthetic biology approach?

Vitamin A deficiency is a major health issue across the world, more so in countries limited to rice as their staple food. Two scientists in the 1990s decided to find a disruptive solution to this. They fortified the rice with beta-carotene, a precursor to vitamin A, by genetically engineering the conventional rice crop. Known as the Golden Rice Project, this is a great example of the synthetic biology approach, wherein natural biological systems are engineered to result in certain desired outcomes.

Using advanced techniques in genetic engineering, systems biology and bioengineering, synthetic biology provides disruptive innovative solutions for the most complex problems in the agri-food value chainâ??developing biological stimulants and pesticides, advanced crop development with climate resistant traits and efficient food production.

While this seemed impossible just a decade ago, synthetic biology has seen a major transformation. DNA sequencing and gene synthesis costs have reduced by more than 100x and faster gene sequencing techniques such as NGS have been developed. All this has led to a significant increase in the data on genomics. This data is being used to develop specific interventions in the agri-food value chain.

How are the investments shaping up?Â

Investments have been on the rise in companies using synthetic biology for disrupting the agri-food systems. According to research from builtwithbiology.com, 2021 saw $4.4 billion invested in these companies which is equivalent to the cumulative funds invested over the last decade. Close to $3.4 billion was invested in startups developing food products including meat analogs and dairy alternatives using synthetic biology.

Impossible Foods, a US-headquartered developing plant-based meat burger patties uses synthetic biology to produce heme which gives the burger patties its beef-like flavour. The company raised $500 million in 2021, bringing its total funding to $2 billion. Future Meat Technologies, a cultured meat company from Israel saw one of the largest investments amounting to $347 million. The company has been able to bring down the cost of cultured chicken to less than $17 per kilogram through years of research and development into engineering microbes and optimisation of their production process.

Company	Description	Latest Funding amount (in $ Million) (2021)
Impossible Foods	Plant-based burger meat, sausage and chicken substitutes	500
Future Meat Technologies	Cultured Chicken	347
The Every Company (formerly Clara Foods)	Chicken free egg proteins	175
New Culture	Cow-free cheese	25
Apeel	Biological fruit coatings	250
Pivot Bio	Nitrogen biofertilisers	430
GreenLight Biosciences	RNA Pesticide	109

More than $900 million was invested into agri-inputs startups with $430 million in Pivot Bio which has launched its PROVEN 40 OS and RETURN OS, the first microbial nitrogen fertilisers in the market. GreenLight Biosciences is developing the worldâ??s first RNA-based pesticides and has received $109 million in funding in 2021. Both are US firms.

Advanced seed development has generally been dominated by large seed companies such as Syngenta. However, a new breed of startups have emerged who are using data and artificial intelligence to speed up the seed development process.

Phytoform Labs with offices in the US and the UK recently raised $5.7 million for scaling up its AI based genome editing platform. Similarly, Indian firm Piatrika Biosystems raised $1.2 million for developing its AI/ML agri-genomics platform.

What does the future hold?

The decade gone by has opened up numerous opportunities for the use of synthetic biology in disrupting the agri-food sector. Several companies in the sector are in the advanced stages of product development and are on the cusp of scaling up and commercialisation. Cultured meat and dairy products are expected to hit the market over the next decade. As more genomic information flows in and newer biochemical pathways are explored, new product lines are expected to emerge as well.

However, there are a few challenges that need to be addressed for the products to become widely available and accepted by the consumers which include reducing the costs, improving the organoleptic properties of the products and scaling up for mass production.