



Regenerative agriculture should not shy away from technological innovations, including vertical farms that occupy a very small amount of land and use water sparingly. Photo: Imago / NurPhoto

# The future of agriculture

## Modern farming must balance environmental impact and nutritional value

It seems as if the transition towards animal-free protein is gaining speed. This shift is beneficial for the environment, human health, and animal welfare. Going forward, the impact of food on health and the environment will determine consumer choices. For the younger generation, the environmental impact will be as important as taste, nutritional values and health effects.

By Henk Hoogenkamp

The food industry has an important role to play in helping consumers shift to a diet of more plant-based foods. This includes the necessity to increase the intake of micronutrients such as zinc, calcium, iodine and vitamin B<sub>12</sub> that are often difficult to get from plants. Nutrient inadequacy is usually the result of people not consuming a sufficient variety of foods. Plant-based foods are higher in essential nutrients like fiber, polyunsaturated fatty acids (PUFAs), folate, vitamin C, vitamin E and magnesium, while protein quality and quantity are typically lower. These lower levels of nutrition need to be taken into account when comparing them to animal protein.

Rising demand for meat requires an increase in the production of livestock, a scaleup that is highly questionable due to limited global resources. Ultimately, there will be a clash between the ever-expanding world population and the rapidly growing need for agricultural land.

Even though most European and North-American countries consistently increased their plant-based meat consumption, 2021 had the highest global meat consumption on record. This global trend will likely continue showing stark increased meat consumption in Sub-Saharan Africa, Asia, China, and South America, not only causing green house gas emissions to rise substantially, but also enforcing another steep upscale of animal production for the world's meat supply.

It is questionable if limited global resources, such as fresh water, animal feed, and fertile soil will be sufficient as the world's population continues to grow to an expected ten billion inhabitants by 2050. As resources become scarce and animal diseases and feed requirements continue to grow, alternatives to conventional livestock farming will be necessary.

### Change the process, not the food

Plainly put, the 4<sup>th</sup> Industrial Revolution can either cause socioeconomic insecurity or benefit the global population. As seen in the past, industrial revolutions can only succeed in economic and ecological measurements if consumers embrace the change.

In times of food democracy, society has the privilege to question the status quo and to listen to more than one perspective. Therefore, the question that needs to be answered is what the primary purpose of modern food research is. Is it to improve health most effectively and efficiently, or is it to maximize the financial return on investment, boosted by the pervasive web of deep financial entanglements between food industry, pharma, and government health agencies?

### Maximizing potential

One of the main objectives to maximize the positive impact of cellular biology is reducing or even removing animals from the meat and dairy protein supply chain. These noble objectives harness the disruptive nature of cellular and/or molecular agriculture, making food more accessible, cost-efficient, and healthier for future generations.

However, environmental issues can vary across the globe. For example, in Asia and Latin America, air pollution and clean water shortages are of significant concern, while the primary issue in Indonesia is waste management. In Europe, there is growing awareness about the ill effects of plastic waste and ocean pollution.

### Precision fermentation

Food companies ultimately need to democratize ownership of cellular agriculture to maximize its potential by facilitating (emerging) technologies, such as meat, dairy and eggs from cultured cells, fungi, and genetically-modified yeast.

Digital platforms, artificial intelligence, bio-engineering technologies such as precision fermentation serve to orchestrate political-economic participation to reduce ecological and environmental harms.

There is relatively low consumer awareness of genome-edited (GE) foods. Genome editing is the collective term to describe a wide range of technologies used to alter the DNA by modifying DNA sequences. Obviously, small changes to the DNA can lead to an enhanced shelf life, improved taste and nutritional value, as well as disease resistance. Using genome-editing technology allows faster and more precise change that will ultimately increase crop yield significantly.

These sociotechnical pathways synergize tissue engineering, molecular agriculture, computer science, and ideally open-source licensing to benefit smallholder farmers.

There is no doubt that cellular agriculture can reduce water, land-use, and chemical inputs, improve food safety, as well as reduce greenhouse gas emissions. However, socioeconomic and ethical questions need to be addressed, including displacing farmers, fishermen and adjacent industries that are considered the first entry point for further food processing.

### Power grab or democratizing

In agriculture, artificial intelligence significantly reduces the use of labor. Drones, sensors, and

automated equipment contribute and accelerate crop-yield efficiency. For some, there is a good reason to be skeptical of technological breakthroughs. The concentration of ownership and wealth could lead to a power centralization in favor of large conglomerate agri-food companies. It will be essential for the success of these technological innovations to engage all stakeholders, including farmers and consumers in a transparent and open dialogue.

A sustainable food production needs to include a non-industrial point of view. Therefore, it will be imperative that inclusive public policies, democratic principles and pathways are governed by multi-stakeholder interests.

Climate-smart farming includes regenerative agriculture. One approach in farming is topsoil regeneration to absorb carbon dioxide. This method also improves water retention, as well as provides a habitat for beneficial microbes and less need of fertilizers.

Animals play a vital role in soil health, not only safeguarding land against drought but also sequestering carbon and erosion. Regenerative farming can play a part in a holistic ecosystem. Industrial farming typically services monocultures. In addition, frequent ploughing increases topsoil erosion.

### Vertical farming

To secure global food supply, a compromise between intensive and extensive agriculture is needed. Regenerative agriculture should not shy away from technological innovations, including vertical farms that occupy a very small amount of land and use water sparingly. Vertical farms use artificial lighting and growth media for food production. Growing pressure on the supply chain will make farming in the proximity of bigger cities more appealing, which means that consumers get food with minimal storage time.

The net-effect of vertical farming is savings in energy, transportation, irrigation water, and chemical fertilizers. These advantages will help lower the carbon footprint while producing foods year-round in or close to urban areas.

### A multidisciplinary approach

For an increasing number of people, farming is not a career choice. It is important for farming to embrace modern agriculture methods to improve living conditions, including higher profit margins.

Climate change is causing land degradation, especially triggered by topsoil erosion and depletion of essential crop growth nutrients. A multidisciplinary approach will be needed to tackle soil degradation. A major component of the possible solutions will be financially incentivizing sustainable farming practices so that farmers can tackle the root causes of pollution and apply environmentally sustainable and profitable agriculture systems to feed a growing global population.

Extreme weather conditions, heavy rainfalls, as well as prolonged drought contribute to more pollution and farmland degradation. Topsoil regeneration is one of the key elements and the frequent use of cover crops is one proven method of successfully preventing soil erosion, aside from assisting to sequester carbon in the soil via their deep roots.

### The new normal

It is critical to engage in an honest and open communication on climate change. Slowly but surely, planetary health might be on the same level as personal health as the main driver of the consumer decision making. It is important that people receive trustworthy information on how agriculture, and the food industry impact the planet, as well as pinpoint solutions to accelerate the journey towards net-zero emissions.



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## Taiyo Allergen-free minced meat alternative from granulated pea protein

At Fi/Hi Europe, Taiyo GmbH (Gevelsberg, Germany) introduced a new natural meat alternative for minced meat dishes. The granulated pea protein targets consumers not wanting to miss out on a minced meat-like texture. It is especially suitable for people on a vegan or low-meat diet who suffer from intolerances and thus pay close attention to ingredients. Taiyo GmbH is the representative of the group for the EMEA region.

Consumers on the lookout for plant-based meat alternatives will

find a broad variety of products with a large array of ingredients, flavors and textures. Soy- or seitan-based products are among the most popular, but consumers suffering from allergies or those with thyroid diseases avoid these ingredients. Meat substitutes made from pea protein can fill the gap in the offer for this group of buyers. Thanks to the gentle production process, Taiyo's newly developed Vegemeat boasts excellent taste as well as a convincing meat-like texture, making a big

difference compared to many other meat alternatives based on pulses.

Vegemeat is a 100% natural, vegan pea protein granulate with no typical inherent flavor, so no off-notes need to be covered with special masking flavors. The production of the meat imitation with a minced meat-like texture succeeds thanks to a sophisticated recipe and a special production process. Vegemeat promises vegan enjoyment and is ideal for popular dishes such as bolognese

or lasagne. From a nutritional point of view, Vegemeat scores with a high protein content, which at 78 g per 100 g of product is far above that of soy, and a fat content of only 0.3 g/100g. Since no sugar is added, the carbohydrate value is also pleasingly low at 5.5 g. In total, Vegemeat contains only four ingredients: Pea protein, strawberry juice concentrate, salt and glucomannan (konjac root powder).