AGROECOLOGY AT THE HEART OF THE BIOECONOMY

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The bioeconomy, at its most fundamental level, aims to generate value from photosynthesis. It seeks to transform biomass into a resource for everyday applications in modern society: food production, of course, but also industrial uses or recycling. In this way, agricultural by-products are increasingly being used as renewable raw materials for industrial applications, in particular in the sectors of energy, chemistry and construction.

Finally, the idea of a "bioeconomy" itself, which is currently very in vogue, actually represents a modern take on a long-established dimension of agriculture, one which dates back to the days of rural self-sufficiency. Before the development of trade on a massive scale, local agriculture provided not only food but also the energy required for home life and to drive machinery. Farmers would rear horses for traction and grew cereals to feed them. Agriculture would also provide a significant proportion of the materials required for artisanal or industrial activities. These included flax, hemp, silk and wool for the textile industry and grease or oils for the chemical industry. The same went for various construction materials (wood, straw, etc.).

This new version of an age-old practice establishes, in some ways, a connection between agriculture, forests, the sea and industry: In this way, the European Commission has stated: "the bioeconomy can produce fuel from algae, recycle plastics, transform waste into new furniture or clothing, and develop organic fertilisers from industrial by-products."

The bioeconomy is a system and a cycle, it is extensive, stretching across different sectors, and the idea of recycling lies at its core. It is also a dynamic approach. It has much in common with the idea of a circular economy. Playing a part in the bioeconomy involves studying chains of value directly or indirectly linked to photosynthesis to increase their effectiveness. This often involves hybridisation and synergies between chains of value, which boils down to trying to make the connections between these chains more fluid. The issue of how activities are organised on a territorial level quickly emerges out of these considerations, which raise many questions about the relationships between different sectors.

In this way, the bioeconomy is a very wide-ranging concept. It provides a model for a sustainable economy by using resources provided by biomass, which is to say matter generated through photosynthesis. It is an intrinsically renewable economy and one which is good for the environment insofar as it is produced in an environmentally friendly way.

This concept of a bio-sourced economy or a bioeconomy is rooted in the economy of living things. As such, it overlaps with many other areas of activity which rely on photosynthesis. Most agricultural production falls into this category. Agriculture is involved in the circular bioeconomy

in two opposing directions. On the one hand, it can be used to recycle certain forms of industrial by-products or waste (brewing dregs, skimmings from sugar production, urban sludge, etc.). On the other, industry is able to use agricultural products. This is the case for energy and, in particular, biogas.

What part does agriculture play in the bioeconomy?

The dynamic and systemic vision referred to as the bioeconomy can be approached from three complementary perspectives, when it comes to agriculture.

1) First, there is the bio-resource approach, as we have seen. This corresponds to creating new chains of value based on the use of biological materials all or part of which come from agriculture. From this perspective, agriculture must fit into a typically industrial chain of value. To date, the agricultural sector has relatively little experience of aligning itself with industrial processes in this way.
2) Then, there is a bioecological approach which corresponds to the technical and agronomical perspective of “green” biomass production. That is to say low-energy and low-input with a theoretical agricultural objective of 100% “natural” production.
3) Finally, the biotechnology approach encourages the development of as many technologies as possible, building on research in the life sciences. This relates primarily to industrial processes.

Improving the efficiency of photosynthesis

An important way of developing the bioeconomy involves increasing the production of biomass. Two potential, complementary ways of increasing biomass production per area unit are available. The first would be to try to increase the efficiency of each plant which is grown. At the same time, growers could try to increase production per unit (per hectare for example).

Increasing the efficiency of plants means increasing the yield obtained from the transformation of light into biomass through improving plants. In other words, genetics is used to increase efficiency - the yield of the “photosynthesis factory”.

To increase production of biomass per hectare, the overall efficiency of the system of production for a given area must be determined over the course of an entire year or, better still, a pre-determined succession of years. The aim is therefore to increase the yield for each plant and also the overall efficiency of the system of production. The main objective is to optimise the use of light which arrives on farmlands, in particular through extending the period during which chloroplasts capture light.

In terms of financial performance, efforts are focused on shortening cultivation cycles to fit three cash crop harvests into two years (in tropical zones, it may even be possible to produce up

to two and a half harvests in a year). A complementary relationship between crops and livestock may also increase the value of the biomass produced and better close the cycles of elements such as nitrogen or phosphorus.

An agroecological agriculture for the bioeconomy

The development of the bioeconomy generally goes hand in hand with high expectations of positive environmental outcomes. The aim is to not only produce biomass "in an environmentally-friendly way" but also, more generally, to increase the positive contribution of agriculture to the ecological transition in our societies (green energy, recycling, contributing to a low-carbon economy).

This agricultural and environmental transition requires a reduction in the consumption of chemically synthesised inputs for plant and animal care products as well as mineral fertilisers. To achieve this, they must be used less, and environmental losses must be reduced. They may also be replaced by new organic or biodegradable products such as biostimulants, biocontrol products or products produced through recycling, such as organic fertilisation or composting of urban waste.

On a wider scale, this transformation will also happen through better use of the natural functional processes at work in our environment. Their effects on agricultural production must be optimised. This will involve, for example, the use of soil biodiversity - the micro-organisms present in the microbiota of animals, but also of plants.

It will be possible to derive value from the symbiosis and complementarity of crops within a same area. This is the concept of a "mosaic", according to which crop parcels are organised to better control parasites in space and over time. This may require crop rotations over areas larger than individual farms, which means that alliances between farmers must be negotiated.

Agronomic research will provide support and guidance for this approach to better adapt systems of production to variations in their environment. This is known as "resilience", an increasingly fashionable term borrowed from psychology.

Alongside technological research, agronomic research is therefore a key sector for developing the bioeconomy. The importance of these expectations will probably change the direction and strategies of research bodies.

A challenge for the strategic management of farms

Asking the question of what part agriculture has to play in the bioeconomy boils down to considering agriculture in its three dimensions of sustainability. It also involves examining how agriculture interacts with the rest of the economy and, as such, its integration in society. We must ask ourselves how each farmer will integrate this new dimension into the management of their agricultural business.

The bioeconomy, as well as the movement towards a more sustainable agriculture, will almost certainly lead to greater complexity in agricultural systems. Because of a desire for short-term efficiency, the trend since the end of the second world war was towards greater simplicity. That often translated into technical specialisation at the level of farms, leading to a concentration of basins of production in a limited number of sectors. However, one of the main directions of travel for the future is diversification, which represents a complete U-turn. In this way, rotation patterns will be extended. Now, farmers are even starting to grow several crops on a same plot or section of countryside.

Furthermore, the bioecological approach involves a longer-term view of the agricultural business (not just one or even three years). The aim will no longer necessarily be to optimise a single criterion. Performance will increasingly be measured according to several criteria and will therefore be increasingly complex to assess. Performance will still need to involve turning enough of a profit for the business owner to make a living and for the business to keep going. But effects on biodiversity or soil carbon sequestration, for example, will also be measured.

Necessary social and managerial innovations

The ambitions of the bioeconomy will lead to changes in agricultural techniques but also in ways of managing agricultural production systems. The same will go for processing industries. In reality, the change goes even further. It will affect the entire management of production sectors and territorial activities. Innovations in management and governance will therefore be required. Behind all of this, a crucial development in the entire chain for supporting the agricultural economy, public or private, is taking shape.

A public policy challenge

Public policy must support enhanced cooperation between stakeholders for given territorial areas and the development of long-term strategies. This will involve support for building diverse agricultural and agri-food ecosystems consistent with local contexts. It is clear that the bioeconomy approach will require buy-in and dynamism on a regional level.

Alongside this regional dimension, public policy must also focus on the development of businesses. Tools supporting the growing diversity of products must be designed. Support must be offered as complexity increases within businesses and throughout entire sectors.

The economy will focus more and more on the environmental benefits of agriculture. The beneficial effects of agriculture on biodiversity and restoring environments and ecosystems (in particular through the use of soil as a purification system) will increasingly be highlighted. Indeed, talk of a "regenerative agriculture" is beginning to emerge.

Alongside agricultural production for human food and non-food needs, there is the crucial question of how this new performance will be remunerated - a vital issue for our modern societies. What will be remunerated by the market, and what will be paid for out of public funds?

The bioeconomy suggests interesting opportunities for putting agriculture at the heart of processes within sectors and chains of value, but also at the centre of an approach which cuts across sectors and considers how activities are organised by territory.

It therefore paves the way to a new, systemic approach to processes which had previously been addressed separately, and some of which are actually very old. To do so, the bioeconomy is turning to research and public policy. It asks farmers to consider the development of their practices and the design of their systems of production. In this way, it will modify working conditions for farmers. But more than anything else, it will change society's view of agriculture, and maybe even farmers' understanding of their work, which will no longer be perceived as solely about food production. It will be a transformation which goes to the very heart of what it means to work in the agricultural sector.

Box 1

The French bioeconomy in figures

€300 billion in annual turnover
1.9 million jobs in the regions
940,000 in agricultural production
37,000 in fishing
30,000 in forestry
430,000 in the food industry
150,000 in the bio-sourced industry
300,000 Other sectors

10% of chemicals and materials come from biomass
50% of renewable energy comes from biomass

Source: Ministry of Agriculture

Box 2

The bioeconomy in our everyday objects

Water-soluble plastic made from milk protein

Plastic bags, coffee capsules, disposable cutlery, and cups made from potato or maize starch

Surfboards, skis and snowboards which contain resistant, lightweight hemp fibres

Musical instruments and rackets which contain hemp for its acoustic qualities and ability to absorb vibrations

Cement and insulation materials which contain hemp

Handbags, and shoes made from fish skins collected from fish markets

Cloth and clothing made from flax or hemp

USB keys, glasses, trays and flowerpots made from algae