FOR A LOW-CARBON, RESILIENT, AND PROSPEROUS AGRICULTURE

Final report - November 2024

AS PART OF THE PROGRAMME
DÉCARBONONS LA FRANCE !

Planning an ambitious transformation of the sector is essential

Context

The French agricultural sector stands at a crossroads in the face of environmental, energy, and climate challenges. Representing **18% of national greenhouse gas** (GHG) emissions, agriculture must undergo a profound transformation to contribute to decarbonisation objectives (-46% by 2050 compared to 2015, according to "Stratégie Nationale Bas Carbone" (SNBC2), French low-carbon strategy), while also ensuring biodiversity preservation.

Inherently highly vulnerable to climate change, the agricultural sector is also heavily dependent on fossil resources and on imports for crop fertilisation and animal feed. This transition therefore aims to **enhance resilience and national agricultural sovereignty, safeguarding the sector's ability to feed the population while ensuring the economic viability of farms.**

Finally, the agricultural sector has a unique potential to preserve biodiversity and sequester carbon, a significant asset that must be leveraged.

A collaborative project that invites to a debate

Conducted over 18 months, this project aims to outline perspectives that will enable the agricultural sector to face these challenges by 2050.
It comprehensively addresses the sector's issues, reflecting the current state of research and debates.

To achieve this, **the team relied throughout the process on a scientific advisory board and a panel of farmers,** ensuring that the perspectives of all agricultural stakeholders were considered. **More than 150 organisations took part in the consultation process** (trade associations, technical institutes, associations, etc.), alongside numerous farmers and other professionals. In total, **nearly 300 people contributed to this work,** either professionally or personally.

At this stage, the project has focused on the agricultural sector, but it will be expanded in the coming months to include the broader food system.

Four reports to discover

To ensure that this work reflects the realities faced by farmers across France, The Shift Project and the Shifters, its network of volunteers, conducted a six-month survey, gathering over 7,700 responses, "la Grande Consultation" (GCA). Produced insights have directly contributed to the separately published report "For a Low-Carbon, Resilient, and Prosperous Agriculture".

Additionally, two working groups conducted parallel research to explore:
- The related employment and skills challenges;
- The related role of technology.

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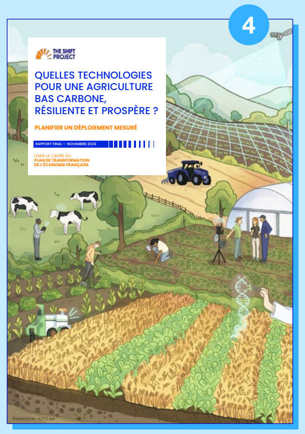
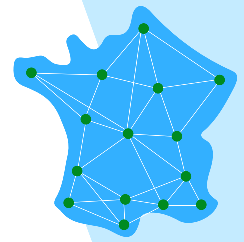
4 

A complex agricultural system, constrained by energy, climate, and ecosystem limits

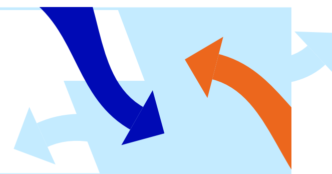
A diverse agriculture, shaped by a determining socio-economic context

1 **The French agricultural system is complex and highly diverse, combining animal and plant-based sectors with interdependent production methods.** It underpins the production of the increasingly sought-after agricultural biomass resource, which serves multiple purposes, including food, energy (combustibles, biogas, biofuels), industry, and biomaterials.
Although agricultural land still covers half of the French territory, it has been in constant decline for a century, giving way to afforested areas and urbanisation.



2 **Today's agricultural systems are highly specialised and geographically polarised,** with a spatial separation between crop production and livestock farming. **Farms are becoming larger but fewer in number, and farm succession is emerging as a critical challenge:** With an aging agricultural workforce, half of the 390,000 farms will need to be taken over within the next decade.

3 **The French agricultural system** is integrated into international trade flows. France is a major exporter of cereals and wine (6th largest worldwide), yet it increasingly depends on food imports, particularly fruits, vegetables, and poultry.

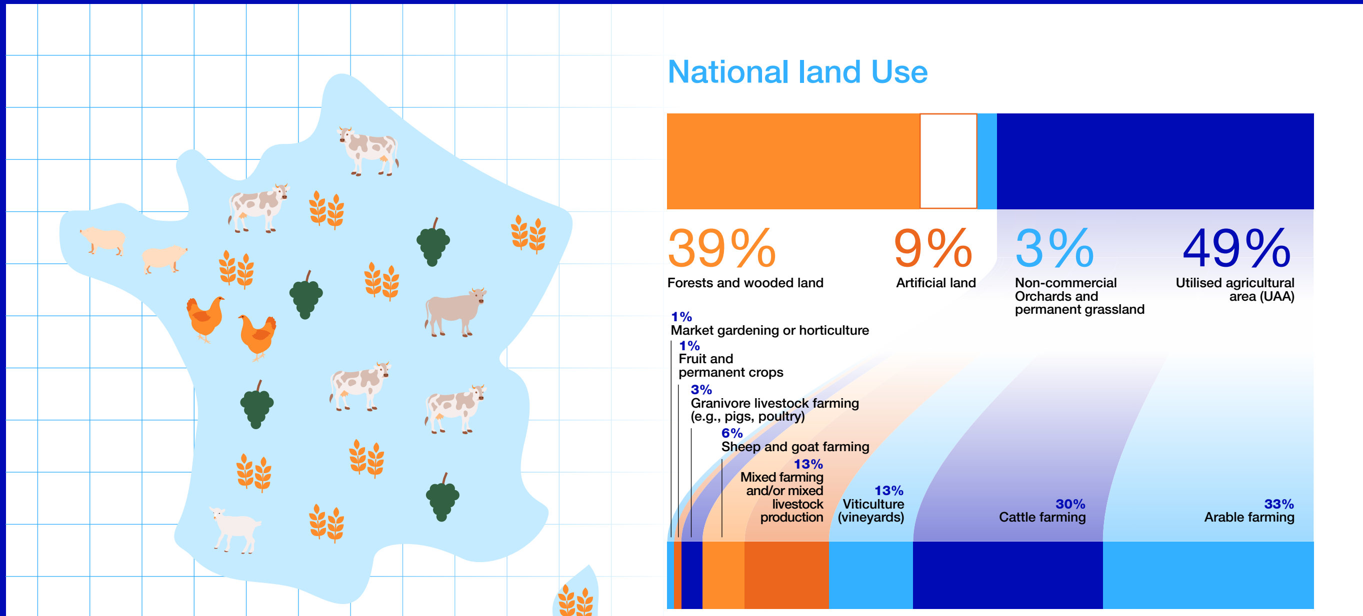


4 Beyond the physical context, particularly soils and climate, **agricultural production systems are constrained by major socio-economic factors, notably the *European Common Agricultural Policy (CAP)*,** which was launched in the 1960s to regulate the sector.

5 In a context of high international competition, including within the European Union, and despite European support and public spending on agricultural crisis management, **most farmers' incomes remain irregular and often insufficient. This limits their capacity for transformation and strategic decision-making.** The simultaneous pursuit of multiple conflicting objectives through agricultural public policies places farmers at the heart of contradictory injunctions. This significantly undermines their economic and professional well-being.

6 Alongside the remarkable increase in physical productivity in the agricultural sector, which has now plateaued, **farmer's added value and income in constant currency has declined since the 1970s.** This has led to growing inequalities among farmers, to a decreasing number of farms and agricultural jobs—now less attractive—and to a simplification of agroecosystems.

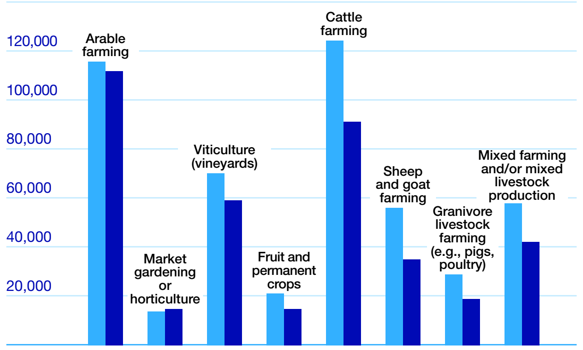
French farming today



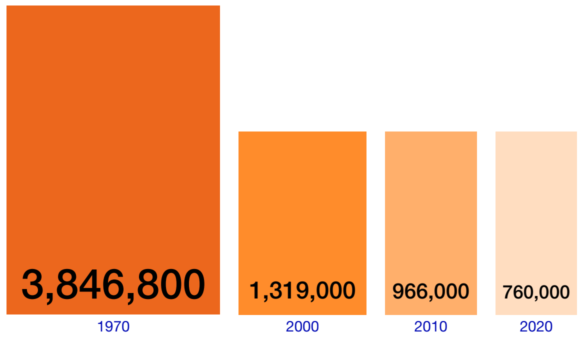
Breakdown of activities as a percentage of Utilised Agricultural Area (UAA)

Significant decline in the number of farms and workers

Change in the number of farms by activity



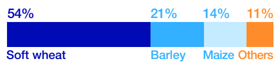
Change in the number of agricultural workers



Foreign trade

A strong export capacity

Cereals
31 Mt on average over the period 2018-2023
6th world's largest exporter

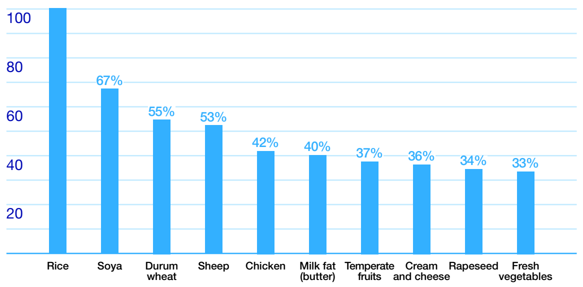


Wines and spirits
19.3 Mt
1st world's largest exporter

Milk and dairy products
19.3 Mt
4th world's largest exporter

Agri-food products
3.2 Mt en 2022
6th world's largest exporter

Dependence on imports for many products

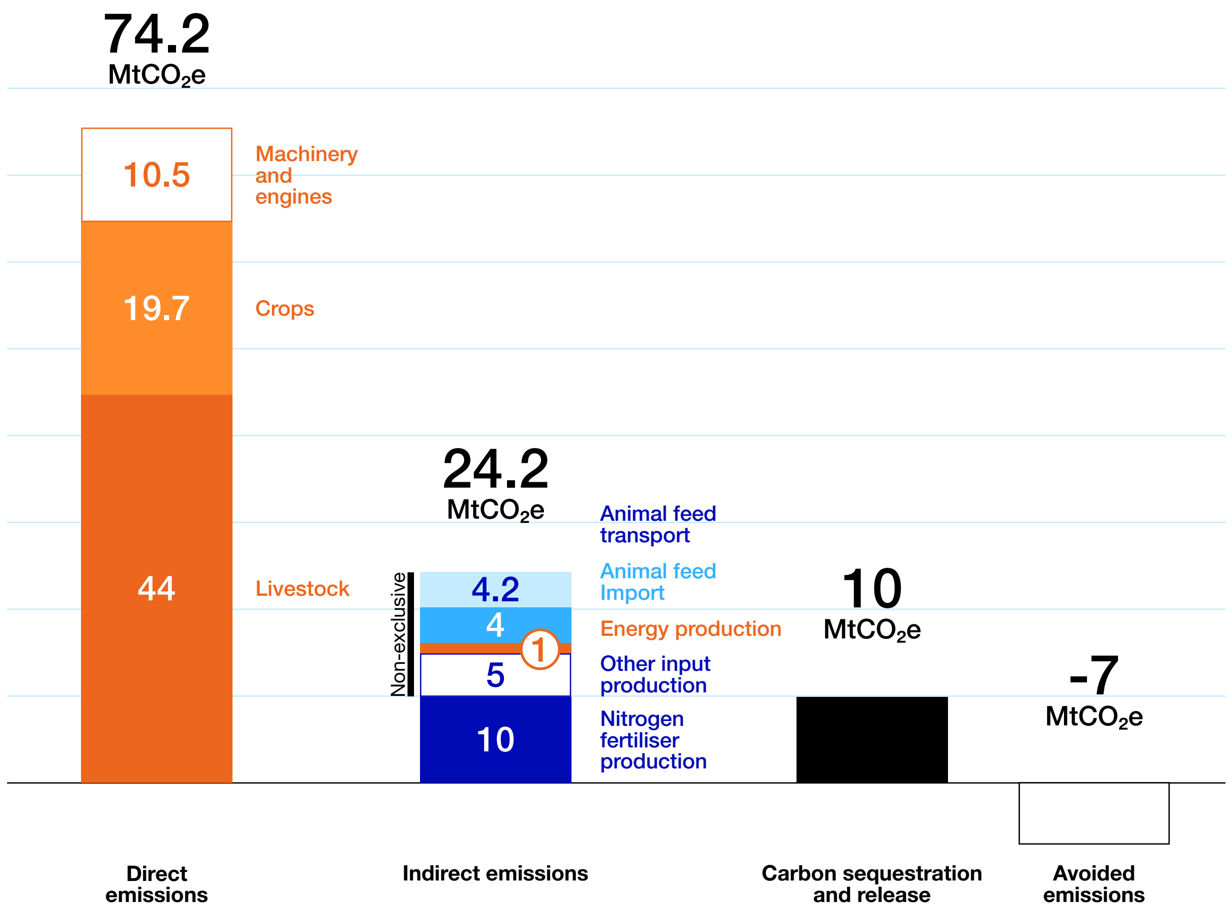


Significant direct and indirect climate impacts

Agricultural activity operates within a system that is a major emitter of GHG, both directly and indirectly: methane (CH_4) from grazing livestock, nitrous oxide (N_2O) from the fertilisers it consumes, and carbon dioxide (CO_2) from the machinery and transport it relies on. **Unlike other sectors, agricultural emissions are predominantly non-energy-related.** They are controlled by biological processes that are of diffuse nature and complex, making sometimes their quantification challenging.

The sector's territorial GHG emissions have decreased by 16% since 1990, primarily due to a declining cattle population and a reduced use of synthetic nitrogen fertilisers. The current average annual reduction stands at approximately -1.8% per year, in line with the targets set in the SNBC2 for 2030. The reduction objectives assigned to the agricultural sector are adapted to its specificities and are less stringent than those imposed on other sectors, as a portion of its emissions remains unavoidable. However, these targets do not yet account for the sector's significant indirect emissions, which should be considered.

GHG emissions from the agricultural sector (indicative figures, 2021-2022, $MtCO_2e$)



THE SHIFT PROJECT

Growing dependencies and vulnerabilities

1 **Modern agriculture is increasingly dependent on fossil fuels,** for powering tractors and machinery and for producing synthetic nitrogen fertilisers derived from fossil gas as well as for transporting inputs and agricultural products. This dependence makes the agricultural system highly vulnerable to energy shocks and poses risks to productivity, nitrogen fertilisation being a key determinant in current yield levels.

2 **French agriculture is also heavily reliant on imported inputs,** particularly from countries not always in line with its values (soy from Brazil for livestock, nitrogen fertilisers from Russia for crops), **raising geopolitical concerns and a critical sovereignty issue:** French must choose its agricultural model, its level of dependence, and its trade partners. Additionally, the current system is highly dependent on exports of certain products.

3 **Rooted in specific soil and climate conditions, agricultural production systems are particularly vulnerable to climate change.** Its impacts—combining acute events *(droughts, excessive rainfall, thermal stress)* with long-term shifts in climatic parameters *(rising average temperatures, altered precipitation patterns)*—are already compromising yields, quality and stability of crops while complicating storage. Strengthening the resilience of the agricultural system is essential to prevent maladaptation risks and safeguard food security.

4 **These disruptions will impact both livestock and crop systems,** with varying effects depending on agricultural models, geographic areas, and time horizons. They will drive changes in livestock productivity, yield potential and crop distribution areas. This shift in biogeographical zones is a major challenge for perennial crops (such as vineyards and fruit trees) and permanent grasslands, but it can also be an opportunity for new crops. It requires creating or reorganising supply chains and securing seed production areas, a strategic link in national and international agricultural production...

5 **Water management and soil preservation, both strategic resources, are becoming increasingly critical due to climate change.** Crop irrigation accounts for 58% of total water consumption, particularly in summer when water resources are most scarce. Although irrigation applies today only to 10% of total agricultural land, its part is increasing in all production systems and already covers half of vegetable, horticultural, and orchard crops. The availability of water resources by 2050 is a major challenge and requires ways of ensuring effective and legitimate governance to prevent conflicts of use.

6 **The modernisation of agricultural techniques—*including excessive mechanical soil work and the reduction in the use of organic fertilisers*—has weakened soil health and quality, making it more vulnerable, particularly to physical erosion, with the reduction in its organic content.** Systems ensuring permanent soil cover (permanent grasslands, grass-covered vineyards and orchards, intercropping plant cover and direct seeding techniques) help to mitigate these risks. Preventing soil artificialisation and conserving soil resources are essential for resilience, as they support water absorption during heavy rainfall, carbon storage, biodiversity preservation, and guarantee the national agronomic potential.

7 **Contemporary agriculture relies on a limited number of cultivated plant species and animal breeds,** a legacy of intensive genetic selection that has enabled massive productivity gains but has also weakened the sector's resilience and adaptability to global changes, which sometimes occur simultaneously (e.g., pathogens, shifting climatic conditions). **Additionally, agricultural modernisation has led to a simplification of farming systems, reducing their resilience** by separating animal and crop production, productive and non-productive spaces, and trees from crops.

8 Current agricultural yields in France are **highly dependent on** pesticides, which have harmful effects on both human health and biodiversity.

Impacts on ecosystems

Agricultural systems have shaped French landscapes and foster a great diversity of agroecosystems and biodiversity. However, modern farming techniques have disrupted the biological balance of these environments, despite biodiversity being a key factor in the resilience and productivity of agroecosystems.

Agricultural activities **impact water quality,** as groundwater and surface water can be contaminated by agricultural pollutants, such as nitrates and pesticides. They also affect air quality due to ammonia (NH_3) emissions and phytosanitary residues.

When it comes to environmental impact, the technical alternatives present trade-offs: non-polluting mechanical soil work contributes to soil erosion, affects soil fauna, and consumes more fuel, while the use of chemicals, which consumes less energy, presents risks of toxicity for the user and biodiversity and of contamination of the ecosystems and agricultural products. The ideal of conservation-based organic farming is challenging to implement, even impossible for some crops.

A significant but threatened contribution to national decarbonisation

1

While the agricultural sector is a source of greenhouse gas emissions, it is also one of the few sectors capable of naturally storing carbon in soils and in woody biomass through photosynthesis, provided that the soils are preserved to maintain existing carbon stocks and that appropriate practices are developed to increase carbon sinks. This contribution to decarbonisation is highly dependent on land-use decisions and agricultural practices.

Converting cropland to grassland allows carbon storage, while the reverse massively releases it, as does soil artificialisation. Today, additional carbon storage in grasslands and orchards does not offset the sector's overall land-use emissions, which remain at 9.5 $MtCO_2e$.

2

The agricultural sector must simultaneously contribute to national mitigation targets while anticipating changes in other sectors. The ongoing energy transition will create new demands and intensify competition for key resources such as electricity, biomass, and land. Many energy-intensive sectors are relying on bioenergy as a substitute for their fossil fuels. **However, this resource partly competes with other essential uses (food and feed, returning organic matter to the soil) and will not be sufficient to meet demand, against a backdrop of uncertainty about future yields.** A cross-sectoral and cooperative approach is essential to effectively plan for decarbonisation and, more broadly, the transition of the whole economy. This will require making strategic trade-offs regarding biomass allocation, growing electricity demand, and land artificialisation driven by other economic activities.

Deploying physical levers at a massive scale: the essential reconfiguration of the sector

Various transformation levers can help adapt the agricultural sector to new climatic conditions, reduce its dependence on fossil fuels, lower its greenhouse gas emissions, and contribute to biodiversity preservation and carbon storage. They vary in their scale of implementation —*national, regional, or at farm-level*— as well as in their nature, ranging from "optimisation" (improving efficiency within an existing system) to "transformation" (a fundamental system reconfiguration).

The necessary transition cannot rely solely on optimisation measures: it will require substantial changes to agricultural systems. It is also crucial to prioritise the most effective levers with proven impacts while avoiding harmful choices. This means steering clear of measures that could worsen the sector's environmental footprint or reduce its adaptability (e.g., maladaptation, socio-technical barriers) and ensuring that any mitigation or resilience strategies deliver tangible, reliable benefits.

A. Decarbonising and transforming fertilisation practices

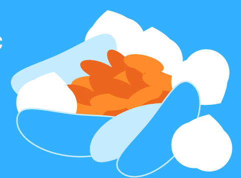
Mineral nitrogen fertilisers have significantly boosted agricultural yields, but their current use conflicts with decarbonisation and resilience objectives. Reducing emissions and dependency related to fertilisation practices will require both the relocation and decarbonisation of fertiliser production and a reduction in overall consumption.

Beyond optimising fertiliser application (through improved formulations, machinery, and decision-making support tools), there is considerable potential for substitution by developing legume crops, either as standalone crops or as cover crops. These plants naturally introduce nitrogen into farming systems through symbiotic nitrogen fixation, alongside nitrogen recycling from livestock excreta and the use of natural fertilisers.

However, these alternatives bear significant challenges in terms of:

- Maturity of production systems (e.g. increasing legume production at scale);
- Changes in farming practices (e.g. widespread adoption of cover crops);
- Availability of organic inputs (e.g., supply of manure from decreasing herd numbers, hygiene constraints on using bio-waste and human excreta).

The potential for symbiotic nitrogen fixation varies according to the type of legume, in relation to their biomass productivity:



ranging from 50 to 200 kgN/ha depending on the legumes

Avoided nitrogen (following the substitution of a cereal, rapeseed, or other crop):

indicative value of 200 kgN/ha

B. Reducing GHG emissions and enhancing the resilience of livestock systems

A major transformation of both ruminant and monogastric livestock systems is essential to reduce their direct and indirect GHG emissions, enhance their resilience, preserve some induced benefits (such as carbon storage, biodiversity, soil fertility transfer, and resource or land valorisation…), and mitigate negative externalities (such as ecosystem capacity to absorb effluents, competition over biomass use…).

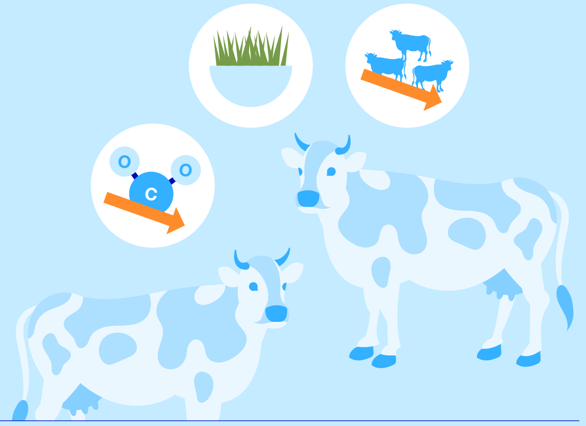
Since carbon accounting alone tends to favour more intensive production systems, it is too limited a methodology for assessing the overall environmental performance and resilience of livestock farming.

Given that livestock systems are biomass converters and more vulnerable to energy supply constraints than crop systems, it is crucial to prioritise the most self-sufficient and input-efficient systems.

A balanced approach must be found across different types of livestock farming, reconciling a reduction in animal numbers with the preservation of ecosystem services provided by certain systems while also limiting imported emissions. The decline in livestock numbers must be carefully planned and accompanied by a proportional reduction in demand, to prevent compensation through increased imports and associated emissions.

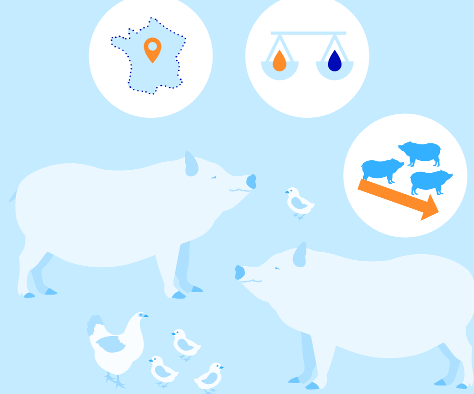
Ruminant farming generates significant direct GHG emissions, requiring a focus on mitigation while preserving the environmental benefits of grasslands. Key strategies include:

- reducing enteric fermentation emissions per animal through improved feed autonomy, optimised herd management, better synergies between livestock groups, improved effluent management, and animal selection;
- preserving grassland-based and mixed crop-livestock systems: they require less inputs, generate less emissions, and are more resilient; permanent grasslands — key carbon and biodiversity reservoirs that do not compete with food production — should be safeguarded as much as possible;
- gradual and controlled herd size reductions, potentially at a slower pace than the current trend.



Monogastric livestock farming relies highly on imported feed and, in some cases, misaligned with the local environment's ability to absorb livestock effluents. The priorities are to reduce indirect emissions and balance these farms territorial distribution by:

- decarbonising animal feed using deforestation-free, locally sourced raw materials and agricultural co-products, while improving farm effluents and energy management;
- balancing spatial distribution of livestock production, aligning it with local capacities for waste absorption, feed production, and fertilisation needs;
- controlling herd reductions to lower N_2O emissions (linked to crop fertilisation for animal feed) and reduce competition for cereals between animal and human food supply chains.



While sector actors are investing in short-term technical mitigation strategies (by 2030), their approaches mainly focus on reducing direct GHG emissions and lack the transformative scope needed to achieve broader sustainability objectives. **It is critical to set an ambition for 2050 that goes beyond mere mitigation to include reductions in indirect emissions, energy objectives, resilience-building, and biodiversity preservation.**

C. Reduce energy demand and decarbonise the energy used

Reducing CO_2 emissions in the agricultural sector relies on a combination of energy-saving measures and the substitution of fossil fuels with low-carbon energy sources, both for fuel and combustion-based consumption.

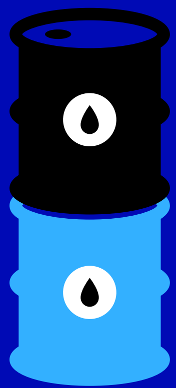
By 2050, agricultural machinery could be decarbonised. It involves improving the energy efficiency of equipment and exploring decarbonised energy (electricity, biogas, biofuels) depending on the required power and the way the machinery is used. Farms can aim for energy autonomy using renewables (photovoltaics and agrivoltaics, biomass-sourced methane, biofuels), lowering exposure to energy price fluctuations, and potentially increasing their income. However, we need to factor in other sectors, also aiming for decarbonation, that will compete for the same energy resources, and future necessary investments.

We also need to rethink farming energy use to reduce demand: systematically implementing energy efficiency practices, promoting less energy-intensive agroecological practices (particularly reducing tillage), avoiding over-investment, properly sizing and powering machinery, pooling part of the fleet, and planning its use in an evolving context.

Fuel savings associated to conservation agriculture:

Up to 50% reduction

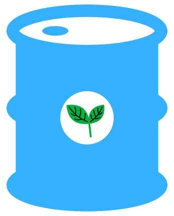
in fuel demand for the most efficient farmers



A full decarbonisation of machinery seems

achievable by 2050

is considered achievable, especially via biofuels for functions unsuitable for electrification or biogas



D. Activating resilience and biodiversity preservation levers

The overlapping impacts of climate, energy, and ecosystem disruptions require the activation of mitigation, adaptation, and resilience levers:

- Adapting crops and farming techniques to new soil and climate conditions (varietal selection, anticipation of shifting production zones, use of bio-stimulants and biocontrol methods, intercropping, and varietal mixtures);
- Expanding biodiversity preservation strategies, which generally align with resilience objectives (diverse and extended crop rotations, pasture-based livestock systems, hedgerows and agroforestry, reduced tillage, increased agricultural landscape complexity and associated ecosystem services);
- Implementing water management measures (enhanced soil and landscape resilience to improve water infiltration and reduce evaporation, drought-resistant crops deployment through genetic selection or crop substitution, "resilience irrigation" by improving irrigation efficiency and implementing water retention systems prioritised for essential crops or vulnerable crop growth stages).

The transition to "autonomous and resource-efficient" systems, both in livestock and arable farming, also serves as a significant socio-economic resilience lever, as it enhances farm-level value creation. In market gardening, micro-farms structured around permaculture principles, which rely on minimal mechanisation and high crop diversity, benefit biodiversity while demonstrating strong resilience.

E. Maintaining and increasing carbon storage in agriculture

Carbon storage in soils and woody biomass is potentially reversible and temporary, making it essential to prioritise. This is particularly important as it aligns with practices that improve soil fertility, biodiversity in cultivated areas, and strengthen overall system resilience. The two main priorities are:

- Maintaining existing carbon stocks by preventing soil artificialisation through the preservation of permanent grasslands, ground cover in perennial crops, hedgerows, and isolated trees on farmland preservation;
- Enhancing agricultural carbon sinks by scaling up cover cropping and conservation agriculture, by expanding agroforestry (planting woody vegetation, trees, and hedges), by increasing orchard plantations, by boosting the use of organic fertilisers, and by introducing temporary grasslands into annual crop rotations.

With forest carbon sinks in decline, **the agricultural sector presents a significant carbon storage potential,** estimated by research at between 29.9 Mt and 53.5 $MtCO_2e$ over 30 years. Achieving this potential requires widespread adoption of agroforestry, cover crops, and temporary grasslands. However, regional variability must be considered, particularly regarding water availability.

F. Enabling the agricultural system circularity and the biogeochemical cycles looping

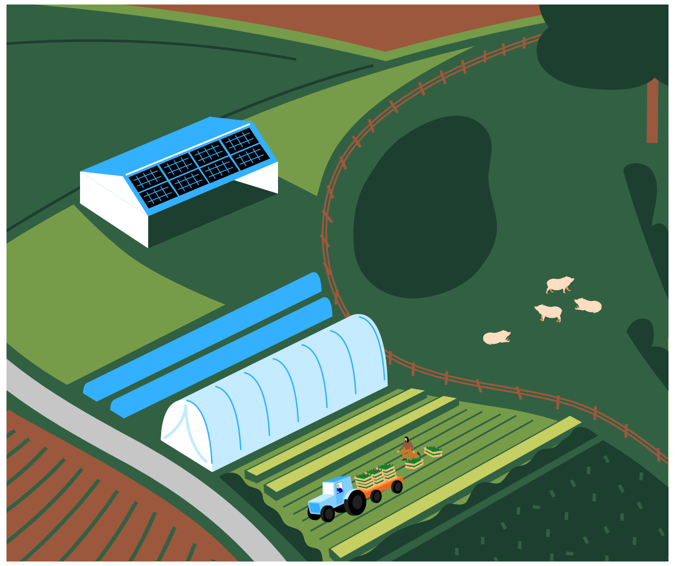
The specialisation of agricultural regions, the decline of mixed crop-livestock farming, and the increasing distance between production and consumption have disrupted nutrient flows related to feed and food production and to crop fertilisation. To restore more natural and resilient biogeochemical cycles, implementation at the territorial level is required through:

- Re-localising feed production, to improve nitrogen cycle efficiency. French livestock farming could eliminate its dependence on imported soy by increasing domestic soy cultivation, restricting this soy exclusively for poultry farming, and expanding pasture-based legume cultivation for cattle.
- Balancing livestock farming across regions to re-transfer organic matter flows, ensuring better use of manure in cereal-growing areas while reducing their environmental impacts in highly specialised regions that lack sufficient spreading areas to sustainably absorb animal waste, particularly in vulnerable zones.
- Improving nutrient and organic matter recycling, including human excreta (90% of mineral nitrogen is currently lost) and urban bio-waste, to close nutrient cycles and help maintain agricultural productivity.

G. Rethinking logistics for a greater resilience

The agricultural system, closely linked to the broader food system, is extremely reliant on domestic and international transport. Beyond decarbonisation, it is crucial to reconfigure flows by redistributing activities across territories and relocating production where feasible.

Additionally, both imports and exports rely heavily on the availability of cheap oil. Given the prospect of decreasing accessibility and increasing cost of energy, these dependencies must be reassessed and adapted.



Transforming the agricultural system by 2050: choosing between scenarios and planning ahead

Building on the transition levers outlined above, **this project has explored potential pathways for transforming the agricultural system by 2050. These projections do not assume an optimal diet or a precise allocation of agricultural biomass, but rather aim to support the achievement of the following objectives:**

- Ensuring food production meets national needs while maximising the autonomy of French agricultural supply chains;
- Reducing GHG emissions from the agricultural sector;
- Strengthening the sector's resilience to climate, energy, and geopolitical crises, and reducing its dependency on fossil fuels;
- Contributing to the overall resilience of society and the preservation of ecosystems.

Each priority involves difficult trade-offs

The consequences of three major strategic priorities that could shape the French agricultural system by 2050 have been explored:

Greater national agricultural and food autonomy	Reduced national energy dependency	Maintaining export capacity

The strategic priorities initially considered in these scenarios cannot be fully achieved when an additional climate objective is introduced. This particularly impacts livestock reduction and, assuming a consistent diet, the overall food production potential. **This analysis highlights the need for pragmatism and compromise between strategic priorities. As a result, a fourth "conciliation" scenario was developed,** primarily based on physical, climate, energy objectives, and with a strong emphasis on resilience. This scenario provides a balanced perspective on how to navigate the trade-offs between different strategic objectives.

Summary of scenarios

Consistent principle across all four scenarios: compliance with the agricultural sector decarbonisation targets as defined by SNBC2: **48 $MtCO_2eq$ by 2050 (direct emissions)**

Three test scenarios with deliberately contrasting objectives

1 — Enhanced national agricultural and food autonomy

Fulfilment of total protein and caloric requirements

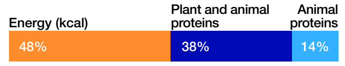
Elimination of imported animal feed

2 — Improved national energy independence

303,314 GWh of bioenergy produced, equivalent to five times current output

3 — Contribution to global food security

A remarkable nutritional performance



TRADE-OFFS IN SCENARIO 1 & 2

Significant reduction in ruminant herds

TRADE-OFFS IN SCENARIO 3

Sharp reduction in ruminant and monogastric herds (risk of shifting to imports)

Proposal of a conciliatory scenario 4: a potential pathway for decarbonisation and resilience in the agricultural sector

Objectives

Reducing indirect emissions and increasing storage capacity to match residual direct emissions

Move away from fossil fuels and achieve energy self-sufficiency

Contribution to societal resilience (including support for extra-sectoral decarbonisation, biodiversity and water resource conservation)

Structuring assumptions

Strong increase in legume cultivation areas, particularly soya

Extensification of livestock farming coupled with a herd size reductions

- -20% Monogastrics
- -25% Beef cattle
- -30% Dairy cattle
- -20% Sheep and goats

Proposed conciliatory scenario

- Carbon neutrality
- Lowest level of indirect emissions (-82% reduction in GHG emissions linked to fertiliser synthesis)
- Significant decline in energy demand (both direct and indirect)
- Threefold increase in bioenergy production
- Coverage of domestic nutritional requirements (marked increase in plant-based protein supply)
- Preservation of export capacity (particularly for cereal crops)

Key insights from the conciliatory scenario

Mobilising systemic transition levers at scale:

- Transforming fertilisation practices
- Reshaping livestock systems
- Reducing and decarbonising energy demand, while contributing to other sectors
- Sustaining and enhancing carbon storage in soils and biomass

Recommandations

For a planned, coherent, and effective transition

- Plan and clarify objectives
- Ensure the economic security of farmers
- Anticipate needs in skills, research, and knowledge
- Engage territorial stakeholders: supply chains and local authorities
- Promote the dissemination of agroecological practices

THE SHIFT PROJECT

Towards a balance between physical constraints and strategic objectives

While our conciliation scenario is meant to be debated and refined, it nevertheless provides valuable insights and indication of orders of magnitude:

- A significant reduction in direct agricultural GHG emissions, aligned with SNBC2 objectives (48 $MtCO_2e$ by 2050), is achievable by prioritising the following levers:
  - Livestock systems, contributing approximately -12 $MtCO_2e$, through a combination of reducing enteric fermentation emissions per animal, evolving livestock systems, and a 27% average reduction in herd sizes;
  - Reduction of synthetic nitrogen fertilisation by approximately -11 $MtCO_2e$: cutting synthetic fertiliser use by around 70%, offset by tripling legume cultivation areas, generalising cover cropping, and increasing the use of digestates from anaerobic digestion.
- A significant potential for reducing indirect emissions: decarbonising synthetic fertiliser production alone could yield savings of approximately -7 $MtCO_2e$.
- An energy efficiency improvement (20% energy savings) and decarbonising energy use in agricultural machinery and buildings (1/3 electrification, 1/3 biogas, 1/3 biofuels for remaining uses) could achieve reductions of around -7 $MtCO_2e$.
- A better management and valorisation of livestock effluents could provide additional reductions of around -4 $MtCO_2e$.
- Offsetting residual emissions will require preserving carbon-storing agricultural land and massively expanding carbon sequestration practices, particularly cover cropping and agroforestry.

A strong need for planning by 2050

This exercise does not claim to exhaust the subject, but it demonstrates that trade-offs are complex and that each choice comes with significant consequences, regardless of the path taken.

Our conclusion is that it is urgent to make a societal choice today and determine what kind of agriculture we want by 2050. This will allow us to:

- Initiate the necessary changes now,
- Provide stakeholders with a clear and reliable trajectory,
- Support the actors who will face the greatest challenges in adapting.

The stakes are too high, and delaying decisions is a luxury we can no longer afford. This view is also shared by farmers themselves, with 86% calling for clearer national objectives for the French agricultural sector (Source: GCA).

Recommandations

The agriculture transition objectives cannot be sustainably achieved without ensuring the economic viability and prosperity of farms. **Farmers cannot be expected to shoulder alone the triple burden of the consequences of past political choices, adapting their practices to climate changeand the financial risks associated with these changes, without guaranteeing sufficient incomes and protecting them from international competition.**

More than 90% of surveyed farmers are willing to accelerate or initiate their transition to agroecological practices (Source: GCA), yet the main barriers remain economic and financial. It is crucial to provide them with the necessary financial means for this transition.
A key prerequisite is to rethink economic paradigms to enable a transition that truly meets the scale of the challenge:

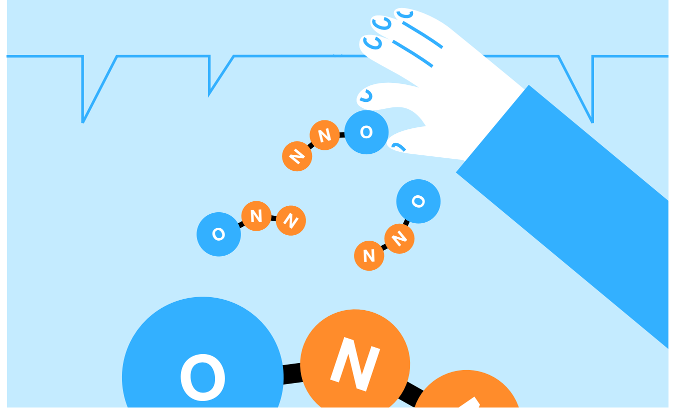
- **Accepting and supporting an increase in production costs:** Ensuring fair income levels requires remunerative prices, which means accepting higher prices in exchange for better quality, stronger social and environmental standards, and enhanced origin guarantees;
- Aligning demand with production: Supply and demand must be addressed simultaneously to secure markets for French agricultural products and prevent a shift toward cheaper, lower-transparency imports, which could ultimately increase global GHG emissions;
- Prioritising incentives over punitive measures to encourage professionals to commit to the agroecological transition.

At the national level: clarifying the roadmap and supporting stakeholders

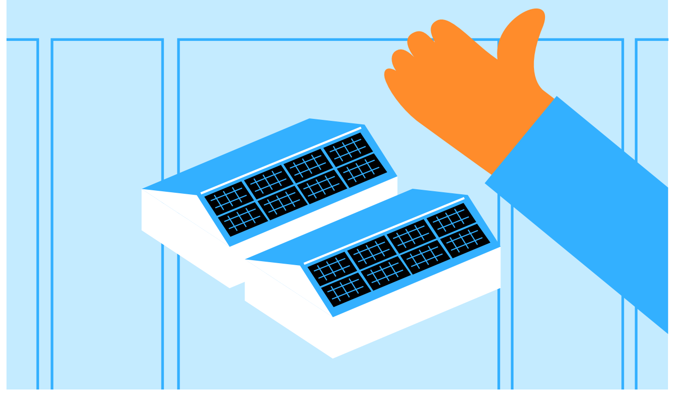
1 **Clarify the strategic objectives assigned to the agricultural sector,** accelerating planning efforts through the effective implementation of action plans, aligned with European policies. This requires strong political commitment, controlling land artificialisation, building strategic reserves, and integrating cross-sector planning across the economy.

2 **Provide clear long-term perspectives for the livestock sector,** tailored to different territories and farming models. This involves implementing robust policies to align national supply and demand for animal products, supporting low-carbon and resilient livestock systems, and prioritising French or even locally sourced animal feed.

3 **Promote resource-efficient and sustainable nitrogen management structures by** finalising a fertiliser sovereignty plan, supporting the development and viability of legume-based and nitrogen-efficient crop sectors, and adapting regulations to facilitate the use of new organic fertilisers.

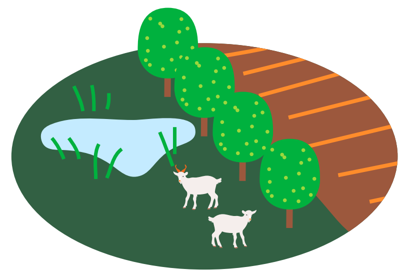


4 **Support the decarbonisation of agricultural infrastructure and machinery** by introducing fiscal incentives for on-farm consumption of renewable energy, promoting shared equipment use, and encouraging service-based access to underutilised machinery.

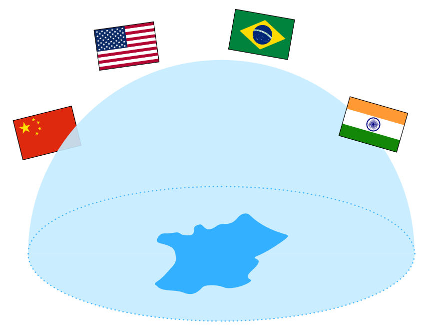


Ensuring the economic security of farmers

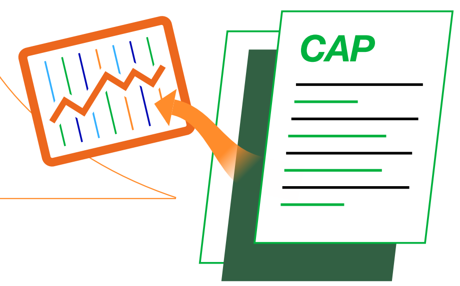
Remove economic barriers to the adoption of agroecological practices by encouraging crop diversification and carbon-storing practices (hedgerows, agroforestry), increasing coupled subsidies for legumes and low-input crops, expanding compensation and risk-financing mechanisms for practice changes (Agro-environmental and climate measures, Payments for Environmental Services, Low Carbon Mark), and introducing multi-year Agroecological Transition Contracts.



Protect French farmers from international competition by implementing protectionist measures against third countries as well as within the European Union (mirror clauses, import quotas) and by providing specific coupled subsidies for sectors that require them.



Mitigate the impact of market volatility on farm profitability by improving CAP support mechanisms through countercyclical aid, exploring market withdrawal strategies for a portion of production intended for domestic consumption, and strengthening multi-year contractual agreements across all sectors with industry-wide approval.



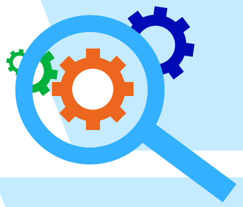
Anticipating skills, research, and knowledge needs

Leverage farmers' collective intelligence: facilitate the transmission of knowledge between peers, develop, facilitate, and value on-farm experimentation and the status of farmer-researcher, and strengthen connections between research and agricultural activity.

Facilitate and intensify professional initial and further training on agroecological transition, on climate change mitigation and adaptation, and on the sector resilience

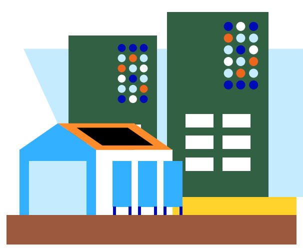
Plan and support the necessary restructuring of agricultural employment, ensuring a better territorial distribution of needs, and launching an unprecedented effort to enhance attractiveness, placing future farmers' aspirations at the heart of the discussion.

Deepen research on key topics, including agricultural vulnerabilities, projected yield changes in response to climate and energy uncertainties (both extreme and continuous), carbon storage, the mitigating effect of cover crops, and the economic models of farms.



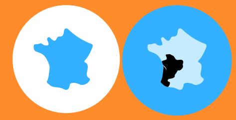
Ensure technology serves climate, energy, and environmental objectives by:

- Regulating the deployment of agricultural innovation so it truly supports the agroecological transition,
- Preventing new dependencies or risks,
- Ensuring resources are allocated efficiently,
- Applying the precautionary principle to avoid over-reliance on technological fixes,
- Implementing evaluation methods to assess the real "added value" of agricultural technology.

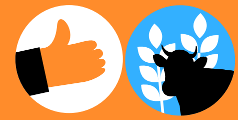


Mobilising territorial actors (sectors, local authorities)

Plan the agricultural transition at the territorial level, setting specific yet nationally and regionally coherent objectives, with appropriate resources. It also requires an operational implementation in line with the competencies of local stakeholders (e.g., policies on starting a farm business, on public procurement, urban planning zoning…).



Promote resilient agricultural systems and production resilient to climate evolutions, tailored to local conditions, reconnecting crops and livestock production, and supporting the transition of climate-vulnerable farming sectors.



Facilitate decision-making on biomass and water resource use by supporting local observatories, dialogue platforms, and cooperation efforts on biomass and water supply and demand. Establish a balanced and legitimate water resource governance framework.

Support local cooperatives and farmers in developing new agricultural sectors (e.g., legumes, low-input crops, resilient and high-value-added livestock, diversified crop collection), adapting existing supply chains, and maintaining essential infrastructure and services (e.g., livestock processing facilities…).

For farmers: committing to agroecology

Contribute to the dissemination of knowledge on ecosystem, climate, and energy challenges by taking part in collective initiatives to share resources, pool investments, and innovate together.

Adopt agroecological practices on the farm to enhance production sustainability, reduce dependence on fossil-based inputs, and strengthen overall system resilience.

The Shift Project is a French think tank advocating the shift to a post-carbon economy. As a non-profit organisation committed to serving the general interest through scientific objectivity, we are dedicated to informing and influencing the debate on energy transition in Europe.

THE SHIFT PROJECT

Our partners
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