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INRAE 2030 ›

From research to solutions: new priorities and new challenges

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Introduction

Philippe Mauguin
INRAE Chair and CEO

A new context with new challenges

Launched in 2020, our roadmap INRAE2030 has reached its halfway point at a time when human societies are facing ever-more-intense climate, health, social, economic, and geopolitical crises—"multicrises"[1] whose major impacts are being experienced in France, Europe, and across the globe. Because of climate change, increased energy prices, international conflicts, the consequences of the COVID-19 pandemic, and unstable food prices, malnutrition and hunger have once again climbed worldwide in recent years. Severe food crises are happening or may soon happen in many countries. In France, several forms of malnutrition are present; the most visible are the states of being overweight or obese. At the same time, human activities, and notably food systems, are having ever greater impacts on the natural environment (air, water, soil) and biodiversity: six of the nine planetary boundaries had already been crossed in 2023[2].

These crises are also affecting all the players involved in agricultural and food systems, who are grappling with major production, competitiveness, and sustainability challenges as efforts are being made to combine economic and environmental performance, food sovereignty and security, and social equity. The steady force behind agricultural and food systems, farmers are confronting socioeconomic difficulties and increasing uncertainty. How can we bolster food sovereignty given climate change, while decisively aiming for sustainable food systems, which promote the health of human populations? Recent agricultural crises in Europe and France have underscored the concerns and hurdles associated with these challenges, which demand significant changes to production systems at the same time as massive numbers of farmers will be retiring over the next 10 years. The food industry must also undergo a transformation to successfully decarbonise and facilitate the ecological transition and diversification of the agricultural industry, by reshaping its production systems to ensure that populations have access to healthy, sustainably produced, and accessible foods. In particular, France's 2025 law focused on food sovereignty and generational renewal in agriculture aims to support innovations that fuel these transitions.

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1. https://www.eea.europa.eu/en/newsroom/editorial/summer-2022-living-in-a-state-of-multiple-crises

2. The six planetary boundaries that have been transgressed are climate change, biosphere integrity, biogeochemical flows of nitrogen and phosphorus, land system change, freshwater change, and novel entities in the biosphere. https://www.notre-environnement.gouv.fr/themes/societe/article/limites-planetaires

Against this backdrop, there are increasingly high expectations that research and the research-development-innovation pipeline will help provide solutions to multiple crises. The world's major agricultural powers are heavily investing in agricultural and food R&D, with China in the lead. In the future, scientific sovereignty will be one of the keys to food sovereignty. At the same time, science scepticism is on the rise in certain segments of the French population and in numerous countries, which poses a threat to academic freedom.

Greater responsibilities

The French National Research Institute for Agriculture, Food, and Environment, INRAE, is at the forefront of research in its three areas of expertise. Upon its creation in 2020, the institute was tasked with the mission of "performing, structuring, and coordinating [...] all scientific and technological research in the fields of agriculture, food production, forestry, the environment, water, biodiversity, the bioeconomy, the circular economy, sustainable land use, and risk management[3]". Via research, innovation, and public policy support, the institute helps its academic partners, its socioeconomic partners, and policymakers navigate crucial agricultural, food, and environmental transformations.

In 2024, INRAE was entrusted with a new responsibility: leading the French scientific communities working in its areas of expertise. Notably, the institute was asked to run the Agralife[4] programme agency and steer major French research programmes, with a view to rallying national research forces. At the international scale, the institute and its partners are at the helm of a European scientific alliance striving to promote the transformation and resilience of the European agrifood industry. Similarly, INRAE is leading major global coalitions on key topics such as pandemic prevention, water resources, and forests.

3. French Decree no. 2019-1046 of October 10, 2019 related to INRAE's organisation and operations.

4. https://www.inrae.fr/Agralife

Collectively constructing innovative approaches

As we updated our main research strategy and priorities, we closely consulted with the heads of INRAE's scientific divisions and regional centres, research support departments, and research unit directors. The aim was to incorporate any advances in knowledge made since the previous iteration of INRAE2030, as well as the new research challenges and questions that have since emerged. We also engaged in exchanges with our academic partners at Agralife, with the French Academy of Agriculture, and with representatives of stakeholders dedicated to agriculture, food production, forestry, and the environment. Finally, INRAE's scientific advisory board and board of directors have refined and given their stamp of approval to the new roadmap.

Our research is structured around five major scientific priorities (SPs) similar to those laid out in the 2020 roadmap because they remain relevant. They include research priorities that have been updated based on both the current context and recent scientific advances. To better respond to certain strong societal expectations, the SPs are now accompanied by "research and innovation challenges". These challenges are focused on high-stakes topics and aim to achieve impacts within five years. They will be tackled by our research divisions in collaboration with our academic and socioeconomic partners.

Our three general policy priorities (PPs) are focused on strengthening our research impacts, expanding our academic partnerships in France and abroad, and improving our levels of environmental responsibility and institutional attractiveness. We have defined priority actions to concretely pursue each PP.

A project adapted to future challenges

Our new roadmap focuses on research capable of responding to current or future disturbances with short-, medium-, or long-term impacts on agriculture, food, and the environment. Using a comprehensive approach, it will contribute to the vibrancy of French research and will be supported by France's Research Planning Act and France 2030, the country's Investments for the Future Programme. The objective is to marshal France's entire scientific community around major research and innovation challenges.

INRAE's roadmap will be expressed through new strategic plans (2026–2030) for its research divisions and the activities of its regional research centres. It will serve as the foundation for INRAE's next Contract of Objectives, Means, and Performance (COMP) 2026–2030 with the French government, and it will provide a framework for the institute's actions and collaborations at regional, national, European, and international scales.

At present, our institute is reaffirming its commitment to academic freedom for the common good, alongside the rest of France's scientific community and the French government. More than ever, INRAE has its attention fixed on the future.

Our objective is for the INRAE community to occupy the spectrum from fundamental research to solutions-oriented research. Our intention is for INRAE to act as a hub for research and innovation in France and Europe, positioning ourselves to exchange with all stakeholders with a view to collaborating with research, development, and innovation partners to accelerate agroecological and climatic transitions in agricultural systems, to promote healthy, sustainable food sovereignty, and to preserve forests, biodiversity, and natural resources.

Management seminar.
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5 major scientific priorities (SPs)

3 general policy priorities (PPs)

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PP 2
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(SPs)

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Five major scientific priorities (SPs)

In a world facing multiple crises (climatic, health, geopolitical, social, and agricultural), the updated INRAE2030 roadmap elucidates the institute's commitment to research excellence and science at the forefront of knowledge, where the goal is to support crucial agricultural, food, and environmental transformations. With an emphasis on research impact and visibility, the roadmap particularly focuses on maintaining a level of scientific quality that meets the most rigorous international standards and highlights the expertise of the institute's research units, responsible for carrying out vanguard science in INRAE's research domains and at their interfaces.

INRAE research occurs along a continuum, from solutions-oriented research aiming for short- or medium-term impacts to knowledge-oriented, incremental, or disruptive research, which is discovering the solutions of tomorrow. To tackle immense scientific and societal challenges and address issues around France's scientific competitiveness in Europe and around the globe, INRAE has established collaborations with a wide range of academic and socioeconomic players, as well as with policymakers, and is supporting research project, infrastructure, and networking initiatives at European or international scales. These collaborations are strengthened by open science and innovation practices and occur at all levels, from regional to international. INRAE's activities dedicated to research, innovation, expertise, and public policy support align with and feed into both French policies [5] and European policies [6].

INRAE research is structured around five major scientific priorities (SPs) similar to those laid out in the 2020 roadmap because they remain relevant. These five SPs draw upon the institute's excellence in its fields of expertise [7] and participate in synergies via inter- and transdisciplinary research. This transdisciplinary approach makes it possible to decipher the complex interconnections among climate change, agricultural systems, food systems, biodiversity, natural resources, the bioeconomy, and global health. Data science and digital technologies have a major role to play, as does AI, which has specifically catalysed advances and redefined the edges of knowledge and innovation. The SPs make use of integrative conceptual frameworks such as agroecology, the sustainability sciences, and global health.

5. Notably the French Agricultural Orientation Law (LOA), French National Low-Carbon Strategy (SNBC), French National Biodiversity Strategy 2030, French National Strategy for Food, Nutrition, and Climate (SNANC), EcoAntiBio3, French Water Plan, and French National Adaptation Plan for Climate Change (PNACC3)

6. Notably the European Green Deal, Competitiveness Compass, Urban Wastewater Treatment Directive, Carbon Removal Certification Framework, and Nature Restoration Law.

7. Life, health, and environmental sciences; earth sciences; engineering, mathematics, and digital sciences; physics and chemistry; economics, the humanities, and social sciences.

These five SPs are tied to clear and ambitious research priorities that have academic, innovation, and public policy dimensions; they also specify the research being conducted and the target topics. To account for both context shifts and scientific advances, the roadmap's priorities have been updated and new priorities have been identified; for example, priorities have changed in relation to the sustainable management of natural resources (SP1), the acceleration of transitions via the engineering of agroecological systems (SP2), the development of renewable energies in the agricultural and forestry industries (SP3), and the characterisation and management of complex systems with digital twins (SP5). Each of these priorities is illustrated using concrete examples of French or European projects being carried out by INRAE.

These scientific priorities are being pursued in addition to INRAE's medium- and long-term high-level research and with the aim of fortifying the institute's position as a key force for innovation. They are being accompanied by research and innovation challenges that target priority themes with the objective of achieving impacts within five years; this work is being conducted in collaboration with socioeconomic partners. The research and innovation challenges are associated with one or more SPs.

SP1

Global changes and associated risks

Global-scale review and foresight studies (e.g., conducted by IPCC, IPBES, FAO) agree upon the magnitude and intensity of the current and future consequences of climate disruptions–including shifting trends, increased climate variability, and more frequent, more intense extreme events. They also agree upon the other risks associated with these global changes, such as biodiversity collapse, widespread biological invasions, and greater threats to natural resources.

Because it must balance the limits that define the planet's habitability with the challenges of environmental justice and equity, the ecological transition can only be successful if it relies on global development strategies that espouse environmental, economic, and social sustainability, which must be designed and evaluated. The objective is to reduce the vulnerability of agricultural, forestry, and food systems and increase resilience to the risks associated with global changes, particularly in the context of agroecological and food transitions. This work involves exploring the nature, scope, and timescale of the requisite transformation trajectories and examining ways to assess the latter's environmental, economic, and social sustainability as well as methods for accounting for tensions between the short- and long-term scales or concerns over equity among social groups. Within this framework, our research is organised around four priorities that account for the interactions and feedback among the climate, biodiversity, natural resources, and risks.

SP 1.1. Climate change: integrating mitigation and adaptation strategies

To achieve carbon neutrality, it is essential to mitigate greenhouse gas (GHG) emissions and ensure the proper functioning of carbon sinks (forests, soils, lakes). It is simultaneously essential to adapt agricultural and food systems to conditions under climate change to guarantee food security. Adaptation and mitigation can be complementary and synergistic, but antagonisms can also arise, underscoring the need for compromise. To understand and control these interactions, we need research combining multiple approaches (e.g., genetic selection, crop cultivation or silvicultural techniques, livestock breeding practices, water and input management, diversification), and we must account for local conditions to increase resilience and limit the risks of system maladaptation to climate change. Integrative approaches at a national or global scale will help support mitigation and adaptation strategies as well as their regional and national effects.

With European Green Deal funding, the INRAE-coordinated project ClieNFarms [8] aims to co-develop and deploy organisational, financial, and technical solutions to help European farms become climate neutral, resilient, and economically viable. Involved in the project are farmers, agricultural advisors, agrifood companies, public decision-makers, financial institutions, and the general public.

8. https://clienfarms.eu

SP 1.2. Sustainable management of natural resources

To satisfy their needs, human societies exploit a wide variety of biotic and abiotic natural resources; some are renewable, which does not mean they are inexhaustible. Given global population growth, the resulting environmental footprint, and the pressures exerted by anthropogenic activities, these resources must be managed quantitatively and qualitatively in a way that combines preservation and sustainability. INRAE conducts research on water resources, soils, and forests, as well as on the preservation of genetic resources, whether at biological resource centres or *in situ*. This work utilises satellite observations of the planet's surface and digital tools, among other approaches.

INRAE is leading or co-leading an array of large-scale soil-related programmes at the national to international level: the France 2030-funded programme examining carbon in continental ecosystems (FairCarboN [9]), which will be complemented by Living Soils, a programme focused on soil biodiversity and developed in collaboration with the Agralife programme agency; the European Joint Programme Soil [10], whose objective is to develop and deploy a reference framework to sustainably manage agricultural soils in the face of climate change; the Soil Carbon International Research Consortium (Soil Carbon IRC [11]) that was launched in autumn 2023 and that seeks to stimulate international collaborative research by offering resources to the various stakeholder communities engaged in soil carbon management.

SP 1.3. Preserving, adapting, and restoring biodiversity

Biodiversity has an essential role to play in the agroecological transition and is also crucial to ecosystem resilience, food security, human health, and environmental health. It is a form of natural wealth and a common good that must be preserved for its own sake as well as for the important ecosystem processes, functions, and services it provides to human societies. Anthropogenic pressures, exacerbated by climate change, are accelerating the loss of biodiversity, including that of crops and livestock (agrobiodiversity). One priority is to move beyond simple assessments and conduct innovative research that characterises, preserves, adapts, and restores biodiversity within agrosystems and regions. To this end, we must develop effective monitoring tools, and we must clarify and make use of ecoevolutionary processes and ecosystem dynamics. Additionally, we must design, test, and evaluate nature-based solutions with positive impacts on biodiversity specifically and on social, environmental, and economic health more generally.

Launched in 2024, the France 2030-funded Nature-based Solutions Programme (Solu-Biod [12]), is jointly led by INRAE and CNRS and aims to support research that facilitates the design, implementation, and evaluation of such solutions. The programme is also promoting the emergence of an entirely new economic sector. DynaBiod is a newly developed programme exploring the dynamics of terrestrial biodiversity in the Anthropocene that places an emphasis on understanding to take action. It is associated with the CBSD programme agency, which is headed by CNRS with strong support from INRAE. DynaBiod seeks to understand the spatial and temporal dynamics of biodiversity and ecosystem functioning with a view to generating predictions, taking appropriate action, and adapting to new circumstances.

9. https://www.pepr-faircarbon.fr/eng
10. https://ejpsoil.eu
11. https://irc-orcasa.eu/join-the-soil-carbon-irc
12. https://www.pepr-solubiod.fr

SP 1.4. Evaluating and thus better anticipating multiple risks

Global changes are putting ecosystems and societies at increased risk, a situation which demands updated techniques for analysing and managing the different facets of risk (hazards, exposure, degree of vulnerability, and impacts). Of particular concern are situations involving multiple risks, where there is either a combination or successive sequence of hazards (cascading risks) or the co-occurrence of different risk types. They present a particular challenge because of their possible consequences (e.g., food system destabilisation, infrastructure damage). Situations involving multiple risks are key challenges when adapting to climate change and are at the heart of the One Health approach. In this context, INRAE research specifically focuses on health risks, landslide risks, and risks linked to extreme climatic events (floods, droughts, fires), and economic risks (market risks). This work employs models and tools for anticipating and managing risks at different scales. Additionally, it aims to assess the capacity for resilience and adaptation over the short, medium, and long term, accounting for stakeholder perceptions, attitudes, and differences in vulnerability. There is also a focus on developing tools for adapting to, protecting against (insurance), and compensating for multiple risks and for limiting risk impacts regionally.

Several interdisciplinary programmes are centred on multiple risks: the XRISQUES metaprogramme [13], whose objective is to gain a better understanding of the multiple risks faced by different regions and agricultural, food, and environmental systems; the X-RISKS target project [14], which is part of the France 2030-funded Forest Resilience programme (FORESTT [15]) and whose aim is for multiple risks to be considered as part of societal and scientific issues related to forest management; and the IRIMONT target project, which is part of the France 2030-funded Risks programme (IRiMa), which focuses on the physical and social dimensions of natural hazards in mountainous regions against the backdrop of climate change.

13. https://eng-xrisques.hub.inrae.fr/
14. https://www.pepr-risques.fr
15. https://www.pepr-forestt.org/eng

Research and Innovation Challenges

Characterising and deploying genetic resources

The agroecological transition partially relies on crop and livestock diversification, notably by utilising intra- and interspecific diversity. The genetic resources conserved in INRAE-managed resource centres (over 200,000 accessions for plant species and 9,000 for animal species) serve as a solid basis for genetic improvement, and their agroecological potential remains largely untapped. While fortifying its infrastructure for conserving genetic resources, INRAE has been working with its partners to deploy the latest genomics, high-throughput phenotyping, and digital tools to functionally characterise these resources, integrating new dimensions such as links with microbial communities.

New tools for managing water resources

Quantitative alterations to the water cycle (droughts or excessive amounts of water) at different scales are among the impacts of climate change, and they are an issue of major concern, especially for agriculture. To develop trajectories for managing water resources and adapting at regional levels, INRAE will couple diverse types of models (e.g., hydrological, agricultural, stakeholder decision-making) that deal with contrasting water resource usage and agricultural regions. Comparing the results of all these models with climate projections will clarify possible future scenarios that can be useful to stakeholders.

Forest dieback: from forest monitoring to renewal

Many forests in France and Europe are showing signs of severe dieback, caused by a combination of events such as drought, fire, and pest attacks. There are major consequences for forests and the services they provide, such as carbon storage. INRAE will work with its forest management partners to develop monitoring tools to improve early detection of risks and impacts, which is essential for prevention. To this end, the institute will deploy the latest developments in remote sensing and artificial intelligence. Its actions will also focus on adaptation approaches that promote forest resilience and on measures for renewing and restoring forests.

SP 2

The agroecological transition and food system transformations

French and European agricultural and food systems are facing major challenges that are calling for them to be jointly redesigned. There is no separating the agroecological transition in agriculture–a response to the need to adapt to climate change and to reduce input use, GHG emissions, and environmental pressures–from food system transformations, where adapted practices and diets will have effects along the continuum from production to consumption.

These transitions will only be successful under certain conditions:

- The competitiveness of the agricultural and food industries must be improved by combining economic and environmental performance in the context of climate change;
- Agricultural sovereignty within Europe, food security, and social equity must be ensured;
- Agricultural and food systems must be redesigned so that they are economically sustainable and acceptable to all stakeholders, from farmers to consumers;
- Transitions must be supported and also facilitated by agricultural policies (addressing the challenges of mass production), food policies, and environmental policies that must all be consistent and effective at various scales.

In this context, original knowledge must be produced in the fields of biotechnology, economics, the humanities, and social sciences with a view to fuelling innovative solutions and shedding light on the conditions under which they can be implemented, a process involving all members of the value chain. INRAE's research priorities emphasise tools for facilitating the agroecological transition of crop and livestock systems at different scales, from farms to regions. There are other lines of inquiry in need of more robust research results, including those focused on the composition of healthy and sustainable diets, the social and economic conditions under which such diets could be adopted and made accessible to all consumers (including the most financially precarious), fair revenue distributions, and food industry competitiveness. A third research axis will explore determinant economic and social factors (e.g., impacts on farmers' work, adaptation of industry and business strategies) and transition processes in agricultural and food systems, including supportive levers of action and public policies.

SP 2.1. Supporting high-performance, low-input agriculture

Given climate change, a key determinant of agriculture's economic and environmental performance will be the establishment of productive cropping systems that use lower levels of pesticides and inputs, particularly fertilisers and water. Recent crises have greatly impacted fertiliser and energy prices, highlighting European agriculture's dependence on and vulnerability to imports. INRAE research will thus focus on ways to reduce the use of pesticides and other inputs, employing genetic selection and biotechnologies, agronomy, biocontrol and biostimulation solutions, agricultural equipment, and digital agriculture. Target areas include, for example, modifying practices and crops to improve water and nutrient use efficiency, boosting resistance and tolerance to pests and diseases, and exploiting functional diversity within crops and their environments (e.g., soils, microbiota) to stabilise production given climate risks and the importance of ecosystem services. To support

productive, sustainable agriculture, a variety of tools must be studied and deployed: the diversification of crop species, plant cover types, cropping systems, and agricultural landscapes; the coupling of animal and plant production; and sustainable soil management. It is also important to conduct multidimensional assessments of the economic, environmental, and health costs of input use, including the associated hazards (externalities).

The institute is working side-by-side with industrial stakeholders, notably in the context of the PARSADA plan to anticipate the withdrawal of plant protection products[16], and is also taking action as part of the DEPHY farm network[17]. As a result, INRAE is helping develop alternatives to synthetic inputs and promoting the widespread adoption of agricultural practices that use fewer plant protection products. For example, the PARAD project focuses on techniques for managing weeds that utilise technological innovations and combinations of agroecological tools, including agricultural equipment. This work has implications for various industries: cash crop farming; viticulture; arboriculture; fruit and vegetable farming; the production of perfume, aromatic, and medicinal plants; and organic farming.

SP 2.2. Designing sustainable livestock systems

Livestock farming is an essential part of agricultural and food systems that helps meet current and future societal needs. It is thus imperative to adapt livestock systems to emerging environmental and health challenges. Adaptations must simultaneously ensure farmer quality of life, farm economic viability, and animal welfare, while reducing the health and environmental impacts of farming. INRAE is conducting research that focuses on farm animal health under challenging conditions marked by repeated health crises (e.g., avian flu, epizootic haemorrhagic disease, African swine fever, bluetongue disease). It is also exploring the use of genetic selection for improving farm animal characteristics, animal nutrition and functional physiology, and farming types adapted to climate change. This work is also seeking to reduce the GHG emissions associated with livestock farms by modifying animal characteristics (genetics, nutrition, health) and by taking action at the regional scale, notably by closing nutrient and water cycles and by coupling mitigation strategies between specialised farms within regions or within mixed crop-livestock systems.

16. https://agriculture.gouv.fr/plan-daction-strategique-pour-lanticipation-du-potentiel-retrait-europeen-des-substances-actives-et

17. https://agriculture.gouv.fr/le-reseau-dephy-partout-en-france-des-systemes-de-production-performants-et-economes-en-pesticides

INRAE is contributing to interdisciplinary research in this area by coordinating the France 2030-funded programme Sustainable Livestock Farming: Animals, People, and Regions. Several INRAE metaprogrammes are playing a part in this research. For example, the Vaacherin project (Vulnerability, Adaptation, Attenuation in the Face of Climate Change in Ruminant and Pig Farming) is representative of the work being carried out by the CLIMAE[18] metaprogramme. The project's objective is to define and evaluate high-impact future scenarios for livestock production in three French regions and for France as a whole. These different scenarios will be used to define appropriately adapted systems that are economically viable, socially acceptable, and environmentally beneficial.

SP 2.3. Developing agroecological system engineering

It is important to ensure knowledge and innovation transfer if we wish to address the challenges facing agriculture and farmers. Part of this work requires laying and cementing the foundations of an agroecological engineering approach that is transformative and problem-solving in nature. This work allows agricultural models to be viewed with a critical eye, evaluating biotechnical features, issues related to farmer labour, and economic, social, and geographical dimensions. The above research provides a conceptual and organisational framework that can draw upon the digital sciences to integrate knowledge and creates a natural opportunity for co-construction with stakeholders (Agricultural Technical Institutes [ITAs], cooperatives, chambers of agriculture) that accounts for farm diversity, thus paving the way for transferring research results to end users. Applying this approach to concrete cases will invite the involvement of regional biotechnology catalysts, along with INRAE's network of experimental units, and the pilot farms of both technical institutes and agricultural schools.

Innovative systems are already being tested by INRAE experimental units[19] (e.g., the CA-SYS platform in Époisses, the circular orchard in Gotheron, the ASTER experimental site in Mirecourt), and they are hubs for interactions with farmer networks and technical institutes. For example, the mixed technology network (RMT) SPICEE[20] focuses on strategies for coupling crop and livestock farming, work to which INRAE experimental facilities, ITAs, and chambers of agriculture are contributing. The institute is also engaged in participative and innovative research efforts, such as those taking place at regional biotechnology catalysts and within projects funded by the Regional Innovations Programme.

18. https://eng-climae.hub.inrae.fr

19. https://eng-plateforme-casys.hub.inrae.fr
https://ueri.paca.hub.inrae.fr
https://aster.nancy.hub.inrae.fr

20. https://idele.fr/spicee

SP 2.4. Accelerating the transition to healthy, sustainable agricultural and food systems

If we wish to move towards healthy, sustainable diets that are accessible to all while also ensuring industry competitiveness and food sovereignty in France and Europe, we must take a holistic look at agricultural and food systems. INRAE research centred on transforming food systems utilises collective approaches and addresses key issues coherently at several levels, from forms of food production to forms of food consumption, via the approach of adapting practices and diets.

This research prioritises four topics: (i) the factors that allow food processing systems to change (e.g., distribution of economic value); (ii) the dynamics of co-occurring changes in consumer behaviour and the environments in which this behaviour occurs (e.g., chain supermarkets, institutional catering establishments, short supply chains) with a focus on greater sustainability; (iii) the collective spatial organisation of production, processing, distribution, and consumption sites and the effects on resource use, notably at regional scales; and (iv) understanding the dynamics of food consumption models (consistency, efficiency, and public policy synergies) with a view to recommending governance models that are appropriate for all players in the face of strong competition in Europe and internationally. Finally, any reflections around the agroecological transition of agriculture will account for the full cost of foods using multicriteria analyses.

Working with more than 90 collaborators in 29 countries, INRAE is a member of the European FutureFoodS partnership[21], which aims to define the conditions under which healthy and sustainable food systems can emerge for humans, the planet, and the climate. The partnership has a roadmap that includes project funding opportunities as well as the establishment of living laboratories and European food system observatories.

21. https://www.futurefoodspartnership.eu

Research and Innovation Challenges

Innovations for integrated crop protection

Reducing the use of synthetic pesticides is a key challenge. It occurs at the crossroads of several issues: food security, agricultural sovereignty, decarbonisation, and protection of both the environment and public health. By developing techniques for anticipating circumstances and exploiting a combination of prevention strategies, crop variety genetic resistance, and pest management at different scales, it will be possible to increase crop robustness to pests and guarantee the integrated management of crop and ecosystem health. INRAE will focus on developing the capacity to detect and identify pests accurately, rapidly, and at massive scales by combining morphological and molecular identification techniques and by developing generic high-throughput approaches for monitoring and predicting the spatiotemporal dynamics of pest populations that combine modelling and AI.

New monitoring and vaccination approaches for animal health

Climate change and international trade are increasing the frequency and intensity of epizootic diseases. It is thus crucial to adopt monitoring systems and preventive actions to protect the health of livestock and humans. INRAE is thus developing new methods for the early detection and monitoring of pathogens that exploit digital technologies and AI. The institute will utilise knowledge on infection processes to inform the development of vaccines based on the identification of vaccine antigens; the creation of technological innovations; and the establishment of a customisable vaccine platform.

Low-carbon agricultural and food systems

The shift towards low-carbon systems is likely to generate strong conflicts over biomass use and raise questions about how to close nutrient cycles, particularly in the context of the agroecological transition. The aim is to develop approaches that can be used to develop, test, and evaluate agricultural production methods that limit GHG emissions and enhance carbon sinks. In the food industry, the challenge will be to design processing steps that consume less energy and water while simultaneously ensuring the quality of the products resulting from these new low-carbon production methods. It will also be key to identify sources of losses and waste throughout the chain, so that both can be reduced or so that lost and wasted foods can be otherwise exploited, ensuring that the carbon ultimately returns to the soil.

Innovations to improve the sovereignty of the plant protein, fruit, and vegetable industries

Demand is rising for plant protein-based foods as well as for quality fruit and vegetables. Yet, France is dependent on plant protein imports and more than half of the fruits and vegetables consumed in France are imported. The plant protein, fruit, and vegetable industries are grappling with the reality that their crops are vulnerable to diseases and pests, that their crops must be adapted to climate change, and that it is essential to improve product preservation and processing conditions as well as logistics. To strike a balance among sources of dietary proteins, it will be necessary to develop new plant protein supply chains, from field to fork. INRAE, in collaboration with stakeholders, will help accelerate innovation in these industries by utilising collective approaches, recent discoveries, and agroecology concepts; by developing and combining genetic tools and crop cultivation practices; and by developing technical and economic approaches all along the value chain.

Transforming dietary regimes

Dietary regimes are still far from attaining public health and planetary health objectives and must be reassessed given environmental, health, social, and economic crises. Various innovation pathways will be explored and tested to ensure that healthy, sustainable diets are also easy, affordable, desirable, and economically sustainable for the agrifood industry and consumers. For example, this research will examine redesigned food processing methods, the organisation of distribution channels, the supply of information to consumers, and the development of evidence-based food education programmes for people of all ages and with different consumer profiles (including the most vulnerable). This work will specifically rely on digital tools.

International trade in agricultural and food products

Regional conflicts and international crises are rapidly changing trade conditions for agricultural and food products, affecting access to different markets as well as input supply chains and, as a result, the competitiveness and resilience of agriculture and the industries found both upstream and downstream. There is no guarantee of equivalence between the health and environmental regulatory standards for EU versus non-EU countries. In this context, INRAE will develop new economic analysis tools to inform and support the development of EU trade policies. This research will focus on harmonising trade policies with the objectives and instruments of other types of public policies by integrating the short- and long-term effects of international trade.

SP 3

An efficient circular bioeconomy

Taken in tandem, the concepts of the bioeconomy and the circular economy offer a framework for revamping the energy, chemical and materials industries by replacing fossil carbon with renewable carbon. Biomass usage is not sustainable unless the preservation of natural resources (in particular soil and water) and new climate-change-related pressures are taken into account. More effectively exploiting agricultural, forestry, bioindustrial, and biowaste production, particularly at regional scales, raises complex issues related to logistics, land use allocation, competition between food and non-food uses, and competition within non-food uses. Beyond technological developments, growing the bioeconomy also implies fostering the emergence of new value chains, new markets, and new players. A wide range of disciplines, including the humanities and social sciences, must be called upon to design methodologies that promote efficient and virtuous cycles and to clarify the required transition processes.

SP 3.1. Efficient use of biomass and biotechnologies

Thanks to its structural and chemical complexity, biomass has the potential to generate a wide range of products, via the replacement of fossil-carbon based products or the addition of new functionalities. However, it can be difficult to appraise the value of biomass given its intrinsic characteristics. Consequently, INRAE research has focused on developing new robust and efficient transformation processes, cascading uses for co-products, the creation of value from all types of waste, and the technical and economic considerations associated with shifts in scale. Biotechnologies are key in improving biomass transformation and harvesting biobased compounds; in particular, it would be useful to develop biocatalytic systems coupled with physical operations. Concerns around biomass usage include that health risks could result, given the circulation of biological and chemical contaminants in food and non-food production systems. To limit these new risks, life cycle analysis tools are being developed for industries dedicated to creating value from residual biomass.

Together with IFPEN, INRAE is jointly leading the France 2030-funded programme Bioproductions (B-BEST [22]), which aims to address the main challenges that arise in efforts to sustainably convert biomass into biobased products and fuels, essential if there is to be a sustainable transition to the bioeconomy and circular economy. This programme supports research that will promote understanding of biomass with a view to its reasoned transformation, the development of biocatalysts and processes based on chemistry and biotechnology, and the facilitation of transitions via operational environments and digital tools.

22. https://anr.fr/fr/france-2030/france2030/call/pepr-b-best-biomasses-biotechnologies-et-technologies-durables-pour-la-chimie-et-les-carburants

SP 3.2. Promoting renewable energies in the agricultural and forestry industries

To reduce GHG emissions and thus achieve carbon neutrality by 2050, it is necessary to encourage growth in renewable energies across all industries, including agriculture and forestry. Key options are agrivoltaics and agricultural and forest biomass (wood energy, anaerobic digestion, biofuels). This objective cannot be viewed separately from questions around how to balance food-related usage of wood, non-food-related usage of wood, and carbon sink preservation. For biomass-based energies, research is dedicated to characterising the variability and quantities of biomass from residues (crops, forests, and biowaste), optimising biomass use by improving plants, cultivation practices, or innovative processes, and predicting the associated environmental impacts. The aim is also to model changes in biomass availability under climate change and its multiple resulting constraints. Particular emphasis will be placed on regional approaches, with the aim of informing public policies and stakeholder decisions.

INRAE is a pioneer in agrivoltaics research and has partnered with private companies on numerous projects. INRAE has set up and coordinates the French National Hub for Agrivoltaics Research, Innovation, and Education (PNR AgriPV [23]). The aim is to support projects that primarily tackle agricultural issues to strike a balance between food and energy production.

SP 3.3. Supporting the economic and social dynamics of the bioeconomy

The bioeconomy involves more than a simple shift in resources. Developing biobased products requires the emergence of value chains, manufacturing and social organisations, and new players. Not only is there inherent uncertainty associated with innovation development and the accompanying social controversies, but there is also uncertainty linked to biomass availability and price volatility in a context where food security must simultaneously be guaranteed. INRAE research focuses on understanding the lock-ins hindering the bioeconomic transition. Additionally, it analyses and models the new market and contractual relationships between industrial and regional players. The institute is also exploring the dynamics of consumer demand and the role of public policies in accelerating the sustainable development and use of biobased products.

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23. https://pnr.agripv.inrae.fr

Research and Innovation Challenges

Bolstering French and European biotechnology leadership

While we have witnessed many advances in biosystems engineering thanks to synthetic biology, it is vital to speed up the cycles of designing, building, testing, and learning and to develop more robust microbial ecosystems and biocatalysts. The challenge is not only to master shifts in scale, but also to develop original biotechnological processes that employ microorganisms as cell factories capable of converting renewable resources into chemical products. Thanks to its industrial biotechnology catalysts and the European IBISBA infrastructure [24] it coordinates, INRAE will expand its research on enzyme engineering, synthetic biology, and agricultural, food, and environmental biotechnologies within France and Europe.

Developing the bioeconomy within regions

The bioeconomy can significantly boost regional development. To benefit from this momentum, it is important to analyse the requisite conditions and potential impacts associated with the bioeconomy's deployment. Spatial foresight studies will be carried out to test newly designed forms of regional organisation and will assess the latter's impacts using an approach that accounts for future uncertainty around prices, market conditions, or the climate. To this end, the institute will employ the MAELIA [25] multiagent modelling platform, for example, and will assess the bioeconomic projects being developed in France's regions. These foresight studies will guide decision-makers and planners of regional development projects as they consider agricultural biomass production and use.

24. https://ibisbahub.eu

25. https://www.maelia-iam.fr

SP 4
One Health

The One Health approach accounts for the close links and interdependencies among the health of humans, domestic animals, wild animals, plants, and the environment. It is a framework for understanding the resurgence and emergence of infectious diseases, particularly as a result of trade globalisation and the increasingly porous boundaries between human habitats and the habitats of wild animals due to phenomena such as deforestation and urbanisation. Because of their myriad impacts, global changes, and notably climate change, affect the links between human health, animal health, and the health of all ecosystems, highlighting the need to increasingly and better address global changes in research studies. Generally speaking, health-related concerns are at the heart of the changes that must be made simultaneously across the entire food system (from production to consumption) and tackling them requires interdisciplinary, global approaches.

SP 4.1. Preventing and anticipating infectious diseases

We face a constant threat: the possibility that emerging or re-emerging infectious diseases, and especially zoonotic diseases, will become epidemics affecting plants, animals, and humans. This risk is exacerbated by globalisation and climate change. INRAE research strives to develop proactive, integrative approaches to understanding and preventing the spread of these diseases, by better accounting for the complex interactions among species in ecosystems and the resulting dynamics, particularly within the food chain. The objective is to acquire new knowledge about pathogens (their biology, reservoirs, modes of transmission, evolution), infectious diseases, and the biotic and abiotic factors influencing their emergence and spread. Another research priority is developing strategies for better anticipating, preparing for, preventing, and controlling diseases (e.g., prophylaxis, animal vaccination, reducing the risk of antibiotic resistance).

Together with CIRAD and IRD, INRAE launched the international initiative Preventing ZOonotic Disease Emergence (PREZODE [26]), which has brought together more than 250 collaborators worldwide. PREZODE seeks to understand the risks of emerging infectious zoonotic diseases as well as to develop and implement innovative methods for improving prevention, early detection, and resilience. This foundation will allow for a rapid response to the risks associated with these types of diseases. At the national level, two PEPRs have espoused research priorities that account for the overlap among human health, animal health, and environmental health: PREZODE [27], which is jointly led by IRD, CIRAD, and INRAE, and MIE [28], which focuses on emerging infectious diseases and is coordinated by ANRS MIE agency.

26. https://prezode.org
27. https://anr.fr/fr/france-2030/programmes-et-equipements-prioritaires-de-recherche-pepr/prezode-preventing-zoonotic-disease-emergence
28. https://anr.fr/fr/france-2030/programmes-et-equipements-prioritaires-de-recherche-pepr/mie-maladies-infectieuses-emergentes

SP 4.2. Characterising exposure to contaminants to reduce their impacts

While food systems primarily supply us with nutritious, healthful foods, they can also pass along contaminants (e.g., pesticides, mycotoxins, plastics, PFAS). Several research axes merit exploration: chemically characterising contaminants, quantifying exposure to combinations of contaminants, and describing the hazards present, as well as predicting and managing the associated risks. Given this context, INRAE is conducting research on the dynamics of contaminant flows in relation to food production, processing, and consumption practices. It is possible to quantify human and animal exposure over lifetimes and across generations using chemical and "omics" approaches in combination with data science approaches, without any *a priori* assumptions. To better understand, detect, and limit the health impacts of contaminants, the institute is also exploring the effects on human health, animal health, and environmental health, from the scale of the cell to that of the ecosystem.

INRAE coordinates France's national metabolomics and fluxomics infrastructure, MetaboHUB [29], and is a partner in the infrastructure France Exposome [30]. Thanks to these two infrastructures, the exposome can be finely characterised via targeted and non-targeted approaches. The institute is also involved in the PARC [31] European partnership, whose goal is to design a risk assessment system for next-generation chemical substances to better protect public health and the environment.
The resulting discoveries could contribute to France's National Biomonitoring Strategy [32] and to the implementation of the national prevention programme led by INSERM's health research agency.

SP 4.3. Promoting healthy eating

Research on food production, processing, and quality is helping identify optimal trade-offs via multicriteria and multiactor approaches with a view to producing healthy, safe, and sustainable foods. This work aims to maximise levels of nutritionally beneficial compounds, while minimising levels of unhealthy compounds as well as environmental impacts. In the interests of human health, it is crucial to better integrate current knowledge on the causal relationships among diet, nutrition, and functional physiology, paying specific attention to the role of microbiota. For example, defining a new dietary balance between plant and animal proteins requires the incorporation of innovations all along the value chain.

INRAE research is identifying the specific nutritional needs of different groups of individuals (e.g., at critical developmental ages, within specific social categories). The institute is also exploring how consumer preferences relate to food characteristics, associated services, available information, and food environments.

29. https://www.metabohub.fr/home.html
30. https://www.france-exposome.org/en
31. https://www.eu-parc.eu
32. https://sante.gouv.fr/IMG/pdf/strategie_nationale_de_biosurveillance_fev2024.pdf

This work is defining and evaluating information-based strategies (e.g., environmental labelling schemes), food consumption contexts (e.g., institutional catering establishments), and economic incentives (e.g., nutrition-related taxes) with a view to bringing dietary behaviours in alignment with One Health objectives. The resulting knowledge will help guide public policies related to food and diet.

The SYALSA metaprogramme[33] is dedicated to designing quality foods and diets. In the France 2030-funded programme Food Systems, Microbiome, and Health (SAMS), the research on food systems is taking a structured approach to the dynamics of food consumption, while the research on microbiomes and health is focused on understanding how microbiota influence the relationship between diet and health.

33. https://eng-syalsa.hub.inrae.fr/

Research and Innovation Challenges

Promoting global approaches to health at regional scales

Tackling the risks of pathogen emergence and transmission among different environmental compartments (wildlife, livestock, plants, soils, human populations) requires a combination of approaches to health crises ranging from biological monitoring to prevention, preparedness, and action. In pilot regions, INRAE will test a systemic approach that will allow collective techniques to be designed and deployed with a view to managing health risks. Particular attention will be paid to coordinating stakeholders' monitoring and preparedness efforts so as to increase regional resilience.

Promoting health via microbiome-based dietary innovations

Promoting sustainable diets that prevent and/or help manage chronic diseases is a major challenge. Designing tomorrow's foods to meet this challenge will require developing innovative processing procedures (notably complex forms of fermentation). It will also require a better understanding of the interactions among foods, microbiota, and hosts and the resulting health effects, with a view to preventing and treating problems. To this end, INRAE will exploit work being done by the Ferments of the Future Grand Challenge[34], which the institute coordinates with ANIA; the France 2030-funded SAMS programme; and the French Gut programme, which seeks to prevent and treat chronic diseases by boosting microbiota research.

34. https://www.fermentsdufutur.eu/en/home

SP 5

Transitions via data science, artificial intelligence, and digital technologies

INRAE relies on data science and digital technologies to conduct research that explores and clarifies the diversity and complexity of biological, agricultural, food, environmental, and health systems. These tools are needed to predict and plan for the shifting multiscale dynamics of these systems, whether considered individually or together; this work will allow the institute to develop new and potentially disruptive solutions in INRAE's areas of action. In this context, the development of AI is having profound impacts: AI is catalysing scientific progress, taking knowledge acquisition and innovation to new heights. Consequently, the challenge is to understand, adapt, and exploit AI-based technologies in a relevant way that complements modelling, simulation, and computational statistical approaches. It is also important to establish a responsible, trustworthy framework that addresses issues of cost, transparency, and traceability.

Digital technologies are also helping transform the systems that INRAE studies. As a result, new research challenges and innovation frameworks are emerging, both because of the technological innovations generated by digital technologies and because of the impacts of such innovations on relationships among stakeholders, economic circumstances, and social circumstances.

SP 5.1. Developing methods and technologies for acquiring information

Data play a central role in research and innovation, which means it is essential to master methods and technologies for acquiring and managing information; signal processing algorithms; and appropriate information systems. For INRAE, this issue is important in various contexts and at different spatial and temporal scales, including during microscopy, drone- or satellite-based observations of regions, web scraping, surveys, and participatory approaches to data collection. Networks of sensors (e.g., optical, acoustic, chemical, biochemical) are becoming essential for detecting, quantifying, and tracking the origin of molecules or diverse signal types in fields such as precision agriculture, ecotoxicology, epidemiological surveillance, biocontrol, biodiversity studies, and environmental risk assessment. Questions arise around how to represent, manage, and process the resulting data. Thus, INRAE research aims to develop and apply shared, high-performance technologies and methods for acquiring, transmitting, and processing information, while also considering the challenges of cost, reliability, accessibility, and efficacy.

Remote sensing is a key part of INRAE research that collects large-scale observational data on the Earth at high spatial and temporal resolutions. A contributor to Data Terra national infrastructure[35], INRAE is jointly running two international initiatives: One Forest Vision[36], which is monitoring tropical forest degradation, carbon stocks, and associated biodiversity, and One Water Vision, which is focused on water resource management and is designing new monitoring methods using satellite observations to develop early warning systems for droughts and floods.

SP 5.2. Using data to understand and manage complex systems

All of INRAE's scientific priorities require the use and integration of diverse, heterogeneous data and knowledge. The goal is to understand, design, and manage complex dynamic systems with multiple sources of uncertainty whose shifts are influenced by a wide range of players. The institute employs inter- and transdisciplinary approaches to, first, develop information systems that respect FAIR principles, often in association with French or European infrastructures, and, second, massively integrate knowledge through modelling and deep learning methods. This research utilises e-infrastructure services and exploits, adapts, and hybridises statistical, modelling, and AI approaches. One purpose is to acquire knowledge; another more targeted purpose is to generate predictions and support decision-making (e.g., monitoring or warning systems, scenario comparisons, management and control of biological, social, and technical systems).

INRAE contributes to the European partnership Agriculture of Data (AgData), whose objective is to boost the agricultural industry's resilience and adaptive capacity in the face of climate change via the development of data-based solutions, methods, and indicators. A major challenge is gathering relevant existing data at the EU level, exploiting it using technologies such as AI, and contributing to European initiatives (e.g., Digital Europe, Horizon Europe) and French initiatives in this area of study.

SP 5.3. Understanding and exploring complex systems using digital twins

Dynamic systems, whether biological, environmental, social, or technical, can be represented *in silico*, making it possible to explore new ways of monitoring, experimenting, and taking action. This approach relies on virtual representations being updated at high frequencies, thanks to information capture, transmission, and assimilation technologies. This is the concept of the digital twin, whose relatively recent use in applications related to agriculture, food, and the environment should allow real advances in making predictions about and intervening in systems in a dynamic, integrative way.

The process of developing digital twins raises methodological and interdisciplinary research questions related to, for example, formal analyses of these digital models, means for testing their reliability, or the characterisation of their limits. In addition, while efforts have been made to use digital twins to represent biological systems or in the context of process engineering in relation to biotechnologies and agricultural systems, this approach could be

35. https://www.data-terra.org

36. https://www.oneforestvision.org/eng

used to a greater extent for environmental systems. In this context, the challenge is to predict how environmental systems will change under more constraining conditions (e.g., related to climate change or water resources) and given various anthropogenic pressures. The results can help guide decision-making and management strategies at different spatial or temporal scales.

Different INRAE programmes are involved in developing digital twins, including the metaprogramme Digital Biology for Exploring and Predicting Life (DIGIT-BIO [37]), with the InSiliCow project, for example, whose aim is to develop a virtual dairy facility to help manage a real farm, and the PEPR Agroeconum[38], with the collaborative project TwinFarms (Deploying Digital Twins at the Farm Level to Foster Agroecological Innovation) that has brought together INRAE, ACTA, INRIA, and AgroParisTech.

Research infrastructures and e-infrastructures dedicated to data acquisition and processing

INRAE has ambitious policies related to research infrastructures and e-infrastructures, the result of a world in which technological and analytical capacities are accelerating and there is an increased need to experiment with new agricultural practices, explore living organisms and ecosystems, and develop innovative biotechnological processes. The institute's objective is to offer top-performing services to scientific communities at both public and private establishments, as part of partnerships with other French and European infrastructure players. The communal nature of these infrastructures means it is possible to make available cutting-edge technologies while minimising the environmental impacts of the related investments and operations. These various infrastructures (analytical or technological platforms, ecosystem observation systems, biological resource centres, pilot farms, and e-infrastructures dedicated to data management and processing) bring together the players at each site and nourish INRAE's policies in France and Europe. The institute is involved in 21 infrastructures (of which it coordinates 8) that are all found on the Research Infrastructures Roadmap. INRAE is a partner in eight ESFRI projects or landmarks because it is committed to the availability of these often unique research service tools within Europe.

EU-IBISBA is an ESFRI 2018 accredited infrastructure that is accelerating the development of industrial and environmental biotechnologies in Europe. By bringing together 11 countries and innovative technologies, EU-IBISBA supports the circular bioeconomy. France, via INRAE, has offered to host EU-IBISBA's official headquarters in 2026, reinforcing the institute's key role in BioIndustry 4.0. For example, IBISBA's BioGAZ project has produced reference standards for precisely and efficiently managing the raw materials and processes used in industrial anaerobic digestion.

IN-SYLVA France [39] is a French research infrastructure coordinated by INRAE that provides experimentation services *(in situ)*, analytical services (in laboratories), and modelling services (***in silico***) focused on adaptive forest management. For example, IN-SYLVA has developed a method for the large-scale characterisation of forest soils, which can be used to predict tree sensitivity to environmental hazards and can thus help identify the most suitable adaptation method (e.g., natural regeneration, tree plantation, mixed strategy) for a given local context. The project for deploying the infrastructure within Europe will be submitted to ESFRI in 2025.

37. https://eng-digitbio.hub.inrae.fr

38. https://www.pepr-agroeconum.fr/eng

39. https://eng-in-sylva-france.hub.inrae.fr

Research and Innovation Challenges

Using artificial intelligence to accelerate the transfer of agricultural innovations

AI is a strategic tool that can help agriculture tackle the major challenges of the future, in particular the agroecological transition and adaptation to climate change. By processing large data sets, AI fosters the emergence and scaling-up of actionable solutions for all farmers. For example, it can predict health or climate risks, optimise the use of production or management tools, or help farmers automate repetitive tasks. INRAE is collaborating with partners, namely ACTA and La Ferme Digitale, to create a digital commons for AI usage in agriculture and to encourage the emergence of AI-based solutions. This work will benefit from digital twins projects already underway, as well as from the Generative Artificial Intelligence for Agriculture (GAIA) project [40], whose aim is to design a collaborative tool for generating AI agents.

Accelerating the development of agricultural equipment for the agroecological transition

The design and implementation of innovative agroecological systems has led to a greater need for precision, technical performance, and the ability to handle multiple tasks. The rise of digital technologies, robotics, and AI is helping address these obstacles via the design of adapted agricultural equipment and decision-support tools. As part of a unique partnership between research organisations and private companies, the AgroTechnoPôle in Montoldre is designing and developing research and experimentation stations by deploying the latest discoveries in detection and position sensors, information processing, and digital twins. With its partners, INRAE will be designing, testing, and exploiting technologies and agricultural equipment that meet the needs of tomorrow's agriculture: from creating robots that safely move autonomously to preserving the structure of soils with different clay fractions thanks to new types of tyres, complex cover crops, non-chemical weed control, and fertilisation regimes.

40. https://www.gaia-ia.org/en

3
(PPs)

3
Three general policy priorities (PPs)

INRAE2030's three general policy priorities (PPs) provide a framework for carrying out research that aligns with the roadmap's five major scientific priorities and a structure that helps the institute's different collectives engage with INRAE's overall strategy. The PPs will be supported by priority actions over the next five years.

The first general policy priority affirms INRAE's commitment to having economic, environmental, and social impacts by combining research, expertise, innovation, and public-policy support. It is founded on strategic partnerships with all INRAE's stakeholders in the agricultural, food, environmental, and forestry industries and on the principles of open science, which serve the common good.

Designed to tackle high-level scientific and training challenges and deal with intense international competition in a complex geopolitical context, the second general policy priority is moulded by INRAE's responsibilities as a research institution and programme agency. It is focused on uniting the entire French research community working in the fields of agriculture, food, and the environment as well as on buttressing the institute's strategy for building European and international partnerships.

The third general policy priority supports INRAE's collective functioning and research support mechanisms with a view to enhancing the institute's performance and attractiveness. In particular, it centres on the institute's corporate social responsibility (CSR) strategy, which creates connections between major societal challenges and INRAE's overarching strategy and operations.

PP 1
Increasing research impacts and accelerating innovation processes

Agricultural and food systems are facing climate, health, energy, and environmental challenges within a context of geopolitical uncertainty. As a result, there has been a reemergence of concern around competitiveness, global food security, and food sovereignty in France and Europe. The world of research and INRAE are facing high expectations: understanding and anticipating changes, acquiring new knowledge and developing operational solutions with stakeholders, accelerating solution deployment, and guiding the adaptation of public policies.

INRAE is playing a key role in discovery transfer and innovation, helping all stakeholders via a systemic approach to performance with economic, environmental, and social facets. The institute's commitment to increasing its research impacts is expressed in many ways: its ambitious policies related to partnerships with socioeconomic players, its deployment of scientific expertise and research results in support of public policies, the accessibility of its scientific work, data, and research processes in all their forms, and its support for multistakeholder dynamics within regions.

PP 1.1. Strengthening research partnerships with socioeconomic players, discovery transfer, and business creation

The complexity of value chains in agricultural, food, and forestry systems demands the engagement of highly diverse socioeconomic players, including companies of all sizes in areas ranging from agricultural supplies to product processing and distribution; cooperatives; technical institutes; chambers of agriculture; and industrial technical centres.

To this end, INRAE has four priorities as it strengthens its partnership policies:
- Fostering a culture of innovation and collaboration between the institute's researchers and socioeconomic players;
- Strengthening research partnerships and capitalising on multistakeholder dynamics;
- Accelerating the transfer and dissemination of scientific results to socioeconomic players;
- Supporting the emergence and development of start-ups in agritech, foodtech, biotech, and greentech.

The objective is to coordinate, structure, and reinforce interactions among players by mobilising research groups, support networks, the institute's subsidiary INRAE Transfert, and the institute's partners in the innovation ecosystem, paying particular attention to the links between national and regional systems.

New actions are being taken to strengthen exchanges with socioeconomic partners with a view to meeting their expectations and generating new research questions for the institute's teams. The aim is also to accelerate knowledge dissemination and solution deployment to users and to make INRAE's experimental systems available to start-ups, VSEs, and SMEs via simplified processes, following the recommendations issued by the Cour des Comptes in its recent report on innovation in agriculture [41]. The research and innovation challenges tackled between 2025 and 2030 will also help strengthen these partnerships when it comes to strategic issues.

41. https://www.ccomptes.fr/en/documents/73989

PP 1.2. Informing and guiding public action through scientific expertise

INRAE boosts its research impacts by helping inform public policies in its areas of expertise, then supporting policy implementation, and, finally, participating in policy evaluation at regional, national, European, and international levels. Focused on proposing new types of interactions between research and public action, INRAE is developing innovative approaches and operational tools in collaboration with regional public players to support various transitions, such as the regional implementation of environmental planning and adaptation to climate change (PNACC3). Within France, INRAE is solidifying partnerships, notably by continuing to develop and manage long-term public policy support systems related to the institute's domains of activity. At the European and international level, INRAE is leveraging its expertise via collective scientific assessments, research studies, and foresight studies with the aim of shaping European policy development or revision and increasing the representation of French scientists within international bodies and initiatives.

PP 1.3. Opening up science and sharing discoveries

INRAE's open science policy is aligned with the French National Plan for Open Science [42] and with European and international initiatives to make publications, data, and code accessible and reusable, thus better disseminating and creating value from the institute's work. In particular, the objective is to support the development of digital infrastructures that foster open science and the exchange of diverse scientific output as well as to guide research groups as they adopt responsible research practices around digital tools (e.g., reproducibility of results, AI use).

INRAE is fully dedicated to carrying out science "with and for society", as exemplified in its scientific mediation work and its support for exchanges among different knowledge pools (understanding scientific approaches, addressing socially relevant issues). The institute is thus committed to optimising support mechanisms for developing participatory science and research, including participatory approaches to innovation, as well as for expanding partnerships with civil society (e.g., non-profit organisations, NGOs, educational players, groups associated with third places, everyday citizens).

42. French National Plan for Open Science https://www.ouvrirlascience.fr/second-national-plan-for-open-science-npos

PP 1.4. Supporting regional multistakeholder dynamics

Dealing with the complex issues that occur at the intersection of agricultural, food, and environmental systems will require concerted action by a coalition of diverse partners in academic research, technical research, agricultural development, the private sector, regional government, technical education, and civil society.

By developing shared culture and understanding, the institute seeks to unify stakeholders and co-construct customised solutions for regional issues via the deployment of dedicated engineering resources. Therefore, INRAE is developing and supporting regional multistakeholder projects: regional biotechnology catalysts; regional innovation laboratories; the TETRAE research programme [43] for regional agricultural, food, and environmental transitions, jointly funded at present by eight French regions; joint technology units (UMTs [44]); mixed technology networks (RMTs [45]); agricultural and food technical institutes; and agricultural technical schools.

43. https://www.tetrae.fr/eng
44. https://www.gis-relance-agronomique.fr/umt-rmt/les-umt
45. https://www.gis-relance-agronomique.fr/umt-rmt/les-rmt

Priority actions

Accelerating discovery transfer to development partners and agricultural stakeholders

INRAE plays a key role within the French landscape of agricultural knowledge and innovation [46]. In accordance with its mission to perform targeted research, INRAE transfers research solutions to stakeholders throughout the agricultural world. The Research-Innovation-Transfer (RIT) unit has brought together INRAE, France's Chambers of Agriculture (CAF), and ACTA with the goal of boosting the availability and exchange of technical knowledge to support the agroecological transition of farms. INRAE's work has led to concrete improvements in crop protection, which have been transferred to and capitalised upon in areas with the greatest need (adaptation to climate change, soil and water quality). Against this backdrop and while ensuring complementarity with high-performing partners and programmes (e.g., UMTs, RMTs, TETRAE), INRAE will seek to create a portal through which research solutions can be accessed by agricultural advisors, leaders of farmer collectives, and agricultural educational establishments. To deal with the challenges associated with mass production, the institute will be working with its partners to set up regional RIT units to target knowledge that is useful to regional industrial players. This regional approach will spur engagement by cooperatives, including some that are already involved in ambitious agroecological transition projects in pilot regions.

Exploiting industrial biotechnology catalysts to deal with technological challenges

INRAE runs several industrial biotechnology catalysts focused on agriculture and agricultural equipment (Agrotechnopôle in Montoldre [47]), food and health (Ferments of the Future [48] and MetaGenoPolis [49]), and biotechnologies (Toulouse White Biotechnology [50]). These public-private consortia bring together public research institutes and private companies of all sizes. They support actions ranging from the design and co-creation of projects representing different levels of technological maturity, where the aim is to maximise industrial and scientific spin-offs, all the way to the transfer of public research results to socioeconomic stakeholders and entrepreneurs by supporting and guiding business creation. The industrial biotechnology catalysts will work towards further developing open innovation approaches for tackling key technological challenges faced by agriculture, food health, and the bioeconomy, taking advantage of their equipment, the development of disruptive technologies, and the latest developments in AI.

46. https://meteodocs.llkc.lv/index.php/s/TyBtkyY8LTc6npc#pdfviewer
47. https://www.agrotechnopole.fr/en
48. https://www.fermentsdufutur.eu/en/home
49. https://mgps.eu
50. https://www.toulouse-white-biotechnology.com/en

Making INRAE resources available to start-ups, SMEs, and VSEs

The institute provides personalised support to scientists who are launching their own companies[51], facilitates start-up access to research emerging from partnerships[52], and heads up the AgriO[53] consortium. It has the further objective of making its scientific and experimental resources available to start-ups in the course of development, whether or not the latter emerged from INRAE research. Given this context, INRAE has partnered with La Ferme Digitale to strengthen cooperation between academic researchers and agritech start-ups. The two partners will work together to make better use of the data resulting from research projects and to promote the use of digital technologies in agriculture, in particular as part of the GAIA initiative (dedicated to generative AI focused on agriculture).

Contributing to regional environmental planning

INRAE supports regional environmental planning initiatives by providing knowledge, models, and tools to regional and national stakeholders. Particular attention is paid to assessing the environmental, economic, and social impacts of global changes and the combined shifts in agricultural activities, biomass industries, and natural resource management methods using integrated models and indicators. The tools provided by INRAE will account for climate change (IPCC data regionally organised by Météo France) and changes in water resources (Explore 2 project). They will be cross-referenced with information on soils and agricultural potential to guide regional strategies for adapting agricultural and forestry systems to climate change over the long term using innovative approaches, aiming for the horizons of 2030 and 2050. This approach will be refined using feedback from various approaches and pilot projects. For example, a project has been launched in the region of Bourgogne-Franche-Comté to demonstrate the MAELIA platform's ability to support regional players who are undertaking environmental planning.

51. Start & Growth Programme: from scientific results to start-up creation
https://www.inrae.fr/actualites/start-and-grow-resultats-scientifiques-creation-start

52. Challenge InnoTech–accelerating innovation
https://www.inrae.fr/collaborer/partenariat-innovation/challenge-innotech

53. AgriO https://agrio-french-tech-seed.fr

Managing France's national platform for research data

At the request of the French Ministry of Higher Education and Research, INRAE and its partners have developed and are managing France's national platform for scientific data–Recherche Data Gouv[54] –which enables data sets from publicly funded research to be shared. As of 2024, over 5,000 data sets were available across all fields of study (e.g., the agricultural sciences, environmental sciences, health sciences, physics, engineering, the humanities, and the social sciences), and the platform has been the site of more than 1.5 million downloads since it launched in 2022. INRAE's data sets on soil quality, for example, are among the most frequently downloaded and are used by the government to support decision-making and by private companies to develop services. Research Data Gouv is looking to be recognised as a trusted data warehouse of paramount importance with a degree of certification that will cement its position within the French and European landscape. AI will be employed to facilitate access to data sets by enriching their descriptions and to improve data search functions.

54. https://recherche.data.gouv/en

PP 2

Strengthening academic partnerships at regional to global levels

Science diplomacy has become strategic, given the major upheaval in geopolitical equilibria and as underscored in the Draghi report [55] and *A European framework for science diplomacy* [56]. At the same time, the emergence of new global scientific leaders, such as China, has been impacting France's relative contribution to worldwide publications. This observation comes from the French Science and Technology Observatory, and it applies to all fields of research, including those in which INRAE has expertise.

To tackle high-level scientific and educational challenges and navigate intense international competition in this current geopolitical context, INRAE aims to energise the entire community of French researchers in the fields of agriculture, food, and the environment as well as to strengthen and develop how the institute's European and international partnership strategy is defined and implemented. Therefore, INRAE is developing academic and scientific partnerships at four complementary scales: within France, at French universities, within the European research landscape, and internationally outside of Europe. At every scale, the goal is to use partnerships underpinned by the institute's scientific priorities to expand scientific excellence and impacts and to contribute to shifts in collaborative resources and research programming:

- Within France by consolidating the research efforts of the country's national research organisms (NROs), universities, and other educational establishments, thanks to the coordination of the programme agency entrusted to INRAE and the support provided by the France 2030 Investments for the Future Programme;
- Regionally by supporting the research-training-innovation site-based strategy espoused by French universities;
- Within Europe by increasing INRAE's influence on, coordination of, and participation in European projects and by the institute playing a key role in building alliances with its counterparts;
- Internationally by creating connections between INRAE's scientific collaboration networks and the best research teams worldwide and by positioning the institute as a driving force behind international initiatives on key topics.

PP 2.1. Leading French research communities in INRAE's fields of expertise

To respond to the major challenges facing agricultural, food, and environmental systems, it is necessary to conduct systemic, interdisciplinary research at different scales and to mobilise and coordinate all the players involved. To this end, INRAE provides scientific leadership or coordination to French research communities through the programme agencies and joint programming initiatives that the institute manages or supports.

Indeed, the French government tasked INRAE with coordinating national scientific communities via Agralife, a programme agency focused on sustainable agricultural and food systems, forests, and associated natural resources. The institute coordinates 10 national research programmes and is helping steer 3 Grand Challenges as part of the France 2030 Investments for the Future Programme. INRAE also heads up the EXPLOR'AE programme [57], whose aim is to accelerate risky research on agriculture, food, and the environment. EXPLOR'AE seeks to engage with France's entire research community and strives to create the conditions that generate and support new ideas and promote more disruptive research, thus helping identify solutions to major societal challenges and facilitating the associated transitions.

Agralife: a programme agency serving French research communities

As head of the Agralife programme agency, INRAE has taken on new and complementary responsibilities. Agralife's objective is to coordinate research programming related to sustainable agricultural and food systems, forests, and associated natural resources (water, soils, and biomass).

The agency is governed by a committee with representatives from more than 30 partner organisations (NROs, higher education and research establishments, other agencies, and associations of technical institutes). It is a unique forum for exchanging ideas and implementing the government's roadmap. Responsible for carrying out the agency's actions is a service unit whose members report directly to the CEO. The unit was created to help INRAE incorporate the agency's missions while also ensuring agency independence for the benefit of the broader collective.

Agralife's main tasks are (i) structuring and managing the national research ecosystem within INRAE's areas of expertise, working in close collaboration with socioeconomic players, (ii) carrying out scientific and technological monitoring and producing foresight studies on strategic research themes with a view to prioritising new research programmes with pronounced societal impacts, (iii) coordinating the research infrastructures essential to the scientific community, and (iv) bolstering France's representation within European programmes and France's global leadership.

PP 2.2. Strengthening INRAE's engagement with site-specific dynamics

INRAE is becoming increasingly involved in the regional structuring of university sites to generate attractive, internationally visible hubs for research and training within France. This work relies on the institute's scientific partnerships at over 30 university sites and its close collaborative relationships with agricultural and veterinary colleges. Not only does INRAE share research units and infrastructure with these university establishments, but it also contributes to key projects at the sites. As a founding member of 19 university innovation clusters (PUIs), INRAE is committed to strengthening the economic and societal impacts of the research at the university sites. Side by side with leading regional universities, the institute is involved in various France 2030-funded programmes, including those focused on opening science to society, accelerating the Europe-oriented strategies of higher education and research establishments, and structuring training opportunities to provide the skills needed for tomorrow's strategic industries and professions.

55. https://commission.europa.eu/topics/eu-competitiveness/draghi-report_en#paragraph_47059

56. https://research-and-innovation.ec.europa.eu/document/download/0841de12-0dd2-4459-b59c-050943c04acd_en

57. https://explorae.inrae.fr/fr

PP 2.3. Affirming INRAE's presence within European research

INRAE plays a major role in European research, and its priorities align with the European Union's strategic agenda, the Competitiveness Compass [58], which is taking up the work of the European Green Deal over the next five years. INRAE is engaged with all of Europe's programmes, focusing on different themes at different levels. These efforts seek to generate knowledge, share data, initiate collaborations with stakeholders, support public decision-making, and promote the development of solutions to major societal challenges. INRAE coordinates and contributes to numerous European projects, shared research infrastructures, and partnership-type instruments with a view to ensuring research excellence to help tackle major societal concerns. The institute encourages its researchers to participate in the coordination of European projects by means of an effective incentive and support system, notably via its subsidiary INRAE Transfert. A specific action plan has also been set up to increase the submission of ERC projects.

Through its bi- and multilateral partnerships and its involvement in influential scientific networks, INRAE is actively helping shape European research and innovation programming. It has boosted its influence by appointing a permanent representative in Brussels. The representative's purpose is to promote the institute's positions to the European Commission and Parliament, partner European research organisations, and their groups of representatives in Brussels.

PP 2.4. Strengthening INRAE global leadership

Facing research challenges and committed to peak performance, INRAE has implemented a comprehensive policy for building and leading an international network of research players in the institute's fields of expertise. INRAE's international leadership and actions have been strengthened thanks to a proactive strategy based on diverse instruments: international associated laboratories, international research networks, and joint linkage calls for international mobility. INRAE is cognizant that international mobility, both incoming and outgoing, is important for scientists and has stepped up its logistical and financial support.

The resulting landscape is dynamic and evolving. Via strategic monitoring and with an eye to excellence, the institute identifies opportunities to launch or reinforce scientific collaborations, accounting for shifting research dynamics at a global scale. For example, INRAE is helping create an international research centre with the University of São Paulo and is exploring potential collaborations with new partners (South Korea).

INRAE and its scientific partners are tackling major challenges through international interdisciplinary programmes: climate change and its interaction with biodiversity (Soil Carbon IRC [59], One Forest Vision [60], One Water Vision), the One Health approach (PREZODE [61], World Microbiome Partnership [62]),

58. https://commission.europa.eu/topics/eu-competitiveness/competitiveness-compass_en
59. https://irc-orcasa.eu/join-the-soil-carbon-irc
60. https://www.oneforestvision.org/eng
61. https://prezode.org
62. https://worldmicrobiomepartnership.org

and transitions in agricultural and food systems (Transforming Food Systems and Agriculture through Research in Partnership with Africa–TSARA [63]). Each programme identifies the scientific hurdles to be overcome through increased international cooperation, utilising observation-based.

Priority actions

A proactive training policy

To maximise its research impacts, accelerate discovery transfer, enhance the attractiveness of its professions, and bolster its academic partnerships, INRAE will deploy an ambitious training action plan with four priorities: (i) attract the best PhD students; (ii) co-construct attractive curricula with universities and higher education establishments specialising in the agricultural sciences, veterinary sciences, and forestry; (iii) transfer the latest discoveries to stakeholders at agricultural technical schools as part of the Ministry of Agriculture's programme for experts associated with agricultural education; and (iv) support professional sectors and policymakers.

A European research alliance to more effectively respond to major challenges

INRAE will strengthen its relationships with Wageningen University and Research (Netherlands) and Aarhus University (Denmark), two of its main European partners. These collaborations have already yielded co-authored position papers and given rise to joint events in Brussels for stakeholders and policymakers. This reinforced collaboration will serve as the foundation for a major European research alliance in the fields of agriculture, food, and the environment that includes partners from other countries (e.g., Spain, Germany, countries in Eastern Europe and central Europe). An additional objective is to define and implement a strategy for influencing member states and the European Commission, as part of the development of the European research and innovation strategy or the future Common Agricultural Policy (CAP), for example.

63. https://initiative-tsara.org

Expansion of France's international leadership on key issues

INRAE jointly runs One Forest Vision, launched in 2023 and focused on using Earth observation data for tropical rainforest conservation, and One Water Vision, launched in 2024 and focused on water resource management. These two initiatives will build momentum with a view to fostering global engagement. The TSARA initiative is led by CIRAD and INRAE's counterparts in various African countries; it has already brought together 32 partnering organisations and will open up to other European and international partners. Finally, INRAE will help launch and lead the World Microbiome Partnership, which is exploring the microbiomes of humans, animals, and plants. Chaired by an INRAE researcher and open to academic partners, foundations, and private companies, the partnership will promote the development of microbiome-based biomarkers, products, and interventions in the interests of global health.

PP 3
Amplifying INRAE social responsibility, a guarantee of institutional attractiveness and performance

INRAE's CSR strategy is particularly powerful because it addresses major societal and research challenges while also acknowledging the collective as the force behind the institute's scientific strategy and people as the heart of the establishment. The difficulty is not only to attract talented employees, but also to contribute to their professional development so they can better tackle common challenges. Thus, research support is specifically leveraged to increase INRAE's attractiveness and performance–resource use is efficient, internal processes are fluid, and individual and institutional risks are controlled.

PP 3.1. A commitment to the environment commensurate with the institute's scientific ambitions

The institute's CSR strategy is aligned with its ambitious scientific goals for tackling environmental challenges and aims for INRAE to exemplify environmental responsibility by transforming its activities to have fewer environmental impacts and display adaptation to climate change. Approved by the board of directors in 2024, INRAE's low-carbon objectives were defined using a new method developed with ADEME for research players. The implementation of these objectives is guided by an action plan that was developed by all the institute's players (decision-makers, managers, and permanent employees) and that is subject to continual evaluation. In addition, INRAE is taking steps to adapt to climate change by defining complementary, integrated, and interacting pathways related to climate change, biodiversity, and resource use with a view to identifying weaknesses in each of the regions where the institute is found. In this context, INRAE is supporting employee communities who are engaged in initiatives to address these challenges[64] .

PP 3.2. Highlighting social responsibility to boost institute attractiveness

INRAE's work is rooted in scientific integrity and an ethical approach. These values are reflected in INRAE's commitment to being a socially responsible employer. The institute is dedicated to fostering a sense of community, nourishing creativity, and promoting excellence, with the goal of serving the common good and encouraging the personal fulfilment of its employees. INRAE was the first research organisation to receive the European HR Excellence in Research Award in 2010, followed by Alliance certification for gender equality and diversity. To attract talented employees and offer diverse career paths, INRAE is committed to providing its managers with initial training and continued support and to adapting its organisation to changes in research practices and collective functioning.

64. E.g., internal projects coming out of the CSR incubator, Labos 1point5 research network, Ma Terre consortium.

PP 3.3. Embracing organisational flexibility for more efficient and innovative operations

Through its general organisational structure and its support teams, INRAE is committed to offering the highest level of support to its research collectives. Given increasing regulatory constraints and the diversification of funding sources, the goal is to simplify administrative procedures and formalities to facilitate research activity. This effort must be accompanied by administrative innovation and experimentation, including exploring and evaluating the opportunities offered by AI for interconnecting and exploiting data from institutional information systems. Balancing flexibility with the control of increasing risks (e.g., human, financial, legal, technological, environmental) is a powerful and motivating objective.

Priority actions

Deploying an ambitious low-carbon action plan

To accelerate its own environmental transition, INRAE has tasked itself with reducing its carbon emissions by 70% and maximally exploiting its sequestration capacities to achieve carbon neutrality by 2050, all while maintaining its research momentum. With this target in mind, the institute adopted an initial five-year action plan in 2025 that focuses on six areas: equipment, scientific supplies and services, experimental unit activities, real estate and energy, digital technology, business travel, and daily activities (commuting, waste production, everyday purchases). During the participative process within INRAE in 2023 and 2024 that gave rise to the action plan, a number of levers were identified. The plan specifies which levers are to be prioritised in each of these areas and describes the intensity of the actions to be carried out at various institutional levels.

Strengthening INRAE's appeal

To recruit talented employees, INRAE will further underscore its attractiveness via a global communication campaign that highlights the institute's focal challenges, the excellence of its research laboratories, the quality of its infrastructures, and its core values as an employer. The institute will increase its communication efforts on its identity as an employer by expanding its network of partners and targeting an international audience. To promote INRAE's professions and work environment, steps will be taken to increase and amplify the visibility of the institute's networks of digital and professional ambassadors, augment monthly HR publications on social networks, and boost the institute's presence at local and national events. Hiring packages will also be improved to better attract talented candidates, drawing upon the example of the successful "tenure-track junior professor chairs". Particular attention will also be paid to the speed and efficiency of all stages of the recruitment process.

In addition, INRAE will improve employee retention by supporting professional development and offering diverse career paths. The major actions to be taken include revisiting and harmonising onboarding programmes for new hires across the entire institute, stepping up efforts to promote skills and desirable career paths (e.g., testimonials and videos illustrating career paths, highlighting internal successes and expertise), and encouraging intergenerational collaboration.

Finally, strategic human resource planning (GPEC) will be expanded via efforts involving INRAE's scientific divisions and research centres, with the ultimate goal of working with academic partners to collaboratively establish recruitment plans for joint research units.

Prioritising simplification in INRAE's operations

INRAE is resolutely committed to improving its support for its research collectives, which takes the form of limiting their administrative burden. These efforts are based on shared principles: *a priori* trust, reasonable requests, an organisational scheme based on delegation and subsidiarity, a stance of providing advice and guidance, and the objective of achieving convergence between joint research unit supervisory bodies in terms of procedures and information systems. Thus, the institute is adopting tools that are adapted to and as compatible as possible with those of its academic partners (as illustrated by the adoption of SIFAC and Notilus). The aim is to streamline procedures and administrative formalities, notably through the use of paperless systems, and to help managers with the organisation and management of their administrative structures (e.g., helping manage unit support activities).

In addition, and wherever possible, INRAE will work with its partners in higher education and research to explore all options for simplifying management approaches for the benefit of research groups (e.g., delegating management, management by a single supervisory body, sharing management responsibilities). The goal is for the institute to take deliberate steps towards simplification while simultaneously safeguarding the short-, medium-, and long-term security of processes in the daily lives of unit directors, project leaders, and all employees.

Establishing a comprehensive risk management plan

With the number of crises on the rise, the institute is developing a global systemic approach to risk, building upon both its proven ability to overcome recent crises and the strong risk management culture in its laboratories. The institute will globally map risks to ensure the continuity of its scientific activities, the health and safety of its employees, and the integrity of its research and resources. It will set up a dedicated internal governance structure to identify, analyse, and prioritise risk management actions.

INRAE 2030 ›

147, rue de l'université
75338 Paris Cedex 7
Phone: +33 1 (0)1 42 75 90 00

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