## CONTENTS

### FOREWORD

#### 1 RESEARCH STRATEGY
- 10 Areas of research
- 17 An open and active partnership policy
- 22 Research that permeates teaching

#### 2 RESEARCH POTENTIAL
- 26 Organisation of research potential
- 30 Financial resources

#### 3 SCIENTIFIC OUTPUT
- 34 Academic output and transfer of technology
- 36 Valorisation and scientific culture

#### 4 INTERNATIONAL DEVELOPMENT
- 42 International scientific output
- 44 Exchanges and networks
- 45 Research programmes

### EXAMPLES OF PUBLICATIONS

<table>
<thead>
<tr>
<th>RESEARCH UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>54 Agronomie</td>
</tr>
<tr>
<td>55 BIOGER-CPP</td>
</tr>
<tr>
<td>56 CIRED</td>
</tr>
<tr>
<td>57 ÉCOFOG</td>
</tr>
<tr>
<td>58 Économie publique</td>
</tr>
<tr>
<td>59 ÉCOSYS</td>
</tr>
<tr>
<td>60 ESE</td>
</tr>
<tr>
<td>61 G-EAU</td>
</tr>
<tr>
<td>62 GABI</td>
</tr>
<tr>
<td>63 Génétique végétale</td>
</tr>
<tr>
<td>64 GÉNIAL</td>
</tr>
<tr>
<td>65 GMPA</td>
</tr>
<tr>
<td>66 IJPB</td>
</tr>
<tr>
<td>67 LEESU</td>
</tr>
<tr>
<td>68 LEF</td>
</tr>
<tr>
<td>69 LERFOB</td>
</tr>
<tr>
<td>70 MÉTAFORT</td>
</tr>
<tr>
<td>71 MIA</td>
</tr>
<tr>
<td>72 MICALIS</td>
</tr>
<tr>
<td>73 MOSAR</td>
</tr>
<tr>
<td>74 PNCA</td>
</tr>
<tr>
<td>75 PRODIG</td>
</tr>
<tr>
<td>76 SAD-APT</td>
</tr>
<tr>
<td>77 TETIS</td>
</tr>
</tbody>
</table>
The position and the reputation of a higher education institute is dependant on the quality of its teaching and the skills and competencies acquired by its graduates, but also from the quality of the research activities it carries out. The attention and means afforded to AgroParisTech for its research activities are constantly on the increase. The institute has chosen to invest in research in a way that permeates the teaching activities and in the same way, questions that arise from teaching nourish research work.

This document presents an overview of AgroParisTech’s scientific activities since 2009. It is aimed at its academic partners, partners in industry, as well as students and the public at large, who may be curious about the research carried out in an Institute of Life Sciences and the Environment. The research strategy of the institute is set out in this document, the themes of research it deals with, the different types of academic production, of innovation, of transfer of technology and of communication both in France and internationally. It is also given a snapshot of the different research units that AgroParisTech and its partners supervise, which allows us to quickly get an overview of the scale of competencies and means at the disposal of the research units, placing the emphasis on the strong points (both scientific and technical) of these units.

Reading this report will enable you to understand how the institute is organised in order to produce research at the best possible level with a wide variety of themes, related to major issues of society with the aim of contributing to changes in the agriculture, forestry, food science, environmental and health sectors that are being carried out across the globe.

This report is dedicated to the memory of two colleagues who recently and prematurely passed away, professors Olivier Lapierre and Bertrand Ney. Through their numerous and extraordinary activities, that they were unfortunately unable to finish, they both contributed in their own way to the modelling of the scientific image of AgroParisTech and its reputation.

Enjoy finding out about our research activities, in the hope that it will give you the desire to collaborate with us, come and learn in our laboratories or to find out more about the subjects.

Thierry Doré, Scientific Director
AgroParisTech

AgroParisTech – an Institute of Life Sciences and the Environment – is a higher education teaching and research institute in the fields of agronomic sciences and techniques, the agri-food sector, forestry, management of spaces and natural resources and land management and development. AgroParisTech fulfils its mission on both a national and international level in the following areas of activity: teaching, lifelong learning, research, dissemination of knowledge, scientific and technical cooperation, transfer of technology and support to business start-ups.

AgroParisTech has forged multiple alliances with other corresponding institutions. The institute is a founding member of ParisTech which brings together 11 graduate engineering schools, and one graduate management school in science and technology and prioritises collective activities in particular on an international level and with industry, and Agreenium which brings together the major actors in research and higher education in life sciences and technology and the environment. A multi-centre institute, AgroParisTech is strongly implicated in different territorial groups which are linked to its themes (Communities of universities and institutions) which have resulted from the French 2013 law on higher education and research, especially that of the Université Paris-Saclay.

AgroParisTech has 540 non-teaching members of staff, 230 academic staff, 24 Joint Research Units which the institute has joint supervision of, 8 locations with 4 in the Île-de-France region (around Paris) and 2,200 students of which 400 are PhD students.

www.agroparistech.fr

Joint Research Units which AgroParisTech has joint supervision of

- Agronomie INRA
- BIGGER-CPP - Biologie et gestion des risques en agriculture - Champignons pathogènes des plantes (Biology, Agricultural Risk Management - Pathogenic Plant Fungi) INRA
- CIRED - Centre international de recherche sur l’environnement et le développement (Centre for International Research on Environment and Development) CIRAD, CNRS, École des Ponts ParisTech, EHESS
- ÉCOPFOG - Écologie des forêts de Guyane (Ecology of Guiana Forests) CIRAD, CNRS, INRA, Université des Antilles et de Guyane
- Économie publique (Public Economic) INRA
- G-EAU - Gestion de l’eau, acteurs, usages (Water Resource Management, Actors and Uses) CIHEAM-IAM, Montpellier, CIRAD, IRD, IRSTEA, Montpellier SupAgro
- GABI - Génétique animale et biologie intégrative (Animal Genetics and Integrative Biology) INRA
- Généalogie végétale (Plant Genetics) CNRS, INRA, Université Paris-Sud
- GENIAL - Ingénierie, procédés, aliments (Food, Process, Engineering) INRA, CNAM
- MÉTAFORT - Mutation des activités des espaces et des formes d’organisation dans les territoires ruraux (Changes in the Activities, Spaces and Types of Organisation in Rural Areas) INRA, IRSTEA, VetAgro Sup
- MICALIS - Microbiologie de l'alimentation au service de la santé humaine (Food and Gut Microbiology for Human Health) INRA
- MOSAR - Modélisation systémique appliquée aux ruminants (Systemic Modelling applied to Ruminants) INRA
- PNCA - Physiologie de la nutrition et du comportement alimentaire (Nutritional Physiology and Feeding Behaviour) INRA
- PRODIG - Pôle de recherche pour l’organisation et la diffusion de l’information géographique (Research Pole for the Organisation and Dissemination of Geographic Information) CNRS, ÉPHE, IDP, Université Paris-Diderot, Université Paris 1 Panthéon-Sorbonne, Université Paris-Sorbonne
- SAD-APT - Sciences pour l’action et le développement - Activités, produits, territoires (Science for the Action and Development - Activities, Products, Territories) INRA
- TETIS - Territoire, environnement, télédétection et information spatiale (Land, Environment, Remote Sensing and Spatial Information) CIRAD, IRSTEA

* Created 1st January 2015
INRA: Joint supervisory bodies
AgroParisTech's research activity is consistent with a dual approach of academic excellence and engineering research.
**Correlations between areas of research and major disciplines**

<table>
<thead>
<tr>
<th>Correlation Matrix</th>
<th>Living systems</th>
<th>Agroecosystems, forests, landscapes</th>
<th>Natural resources</th>
<th>Food, nutrition and health</th>
<th>Carbon materials, synthons, energy</th>
<th>Social systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science and engineering of forests and agronomy</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Environmental science and engineering</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Science and engineering of bio-sourced materials</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Life sciences and engineering</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Applied mathematics and computer science</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Economics, management and social sciences</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

**Examples of research work carried out in the key areas by AgroParisTech**

The investment of AgroParisTech in the six research domains is illustrated by numerous research activities of which the results have become published articles, scientific communication or books. Here are several examples of research work activities that illustrate the main areas that the institute focuses on.

### Living systems

#### Protein phosphorylation: a fundamental regulatory mechanism

**Objectives**

The understanding of the complex relationship between the diverse components and effectors of cells is a major issue for future medicine and biotechnologies. Protein phosphorylation is a post-translational modification implicated in a large number of cellular phenomena. Its versatility and reversibility makes it one of the most powerful systems of regulation and signalling. The cellular mechanisms are as varied as the cellular cycle, growth, metabolism, morphology or virulence of the micro-organisms that are linked to this type of regulation. Protein phosphorylation by serin/threonine kinases and the tyrosine kinases is relatively non specific, in terms of His/Asp kinases that are linked to this type of regulation. Protein phosphorylation by serin/threonine kinases and the tyrosine kinases is relatively non specific, in terms of His/Asp kinases of two component systems, and is of a major biological importance. The Cellular Signalling team (Joint Research Unit MICALIS INRA/AgroParisTech) studies the networks of phosphorylation in the model bacterium *Bacillus subtilis*.

**Methodology**

Several studies have been carried out.

- The study of the role of evolution of genes coding for kinases: the Ser/Thr/Tyr kinases have a genetic plasticity superior to that of the average procaryote genes. The team’s aim was to find a role for this potential of rapid evolution.
- The study of protein phosphorylation networks: the Ser/Thr/Tyr kinases, due to their wide specificity, make up a complex information network. They can autophosphorylate and participate in known signalling cascades but a great number of their activities are often considered as a background activity. The team therefore decided to study the pertinence of these phosphorylation reactions in otherwise unknown roles.
- The study of the biological effects of protein phosphorylation by Ser/Thr/Tyr kinases: the study of new signalling pathways and metabolic control.

The team works in close cooperation with the bioinformatics teams at INRA and the Université Évry-Val d’Essonne in order to create projects around systems biology.

**Results**

The study of the phosphoproteome has enabled researchers to extend knowledge of numerous phenomena such as the modulation of the affinity for DNA of regulatory proteins via Ser/Thr/Tyr kinases phosphorylation or the demonstration of the implication of tyrosine kinases in the metabolism of polyunsaturated fatty acids via the regulation of the expression of Cytochromes (Cyps) P450. The team also investigated certain mechanisms of the Ser/Thr/Tyr kinases in the sporulation of *Bacillus subtilis* and the pathogenicity of *Listeria monocytogenes*. In a wider context, it was proposed that a study be carried out of the role of the rapid evolution of genes of complex Tyr kinases in the adaptability of bacteria.

**Article reference**

Livestock breeds are social constructs, as much if not more so than biological entities. They are defined as such and managed by breeders who decide their breeding goals within a collective organisation. Their raising areas range from limited territories – which we call local breeds – to national and international ones. Within the context of a strong specialisation in production areas and sectors, the economic valorisation of local breeds often comes from the development of original outlets with or without an official label of quality or origin. But, in what way, do these processes lead to the modification of breeding management? And to what extent does the territorial registration of breeds and its evolution over time, participate in the professional and collective redéfinition of those concerned?

Methodology
These two issues were addressed in two projects, both financed by the ANR (French National Research Agency), and a PhD thesis and a Master’s internship. As this research is in its very essence, interdisciplinary, it was carried out in collaboration with geneticists (Genetics, Animal Breeding and Reproduction training and research group at AgroParisTech, the Genetics Department of the Institut de l’élevage), animal scientists that study breeding systems (INRA, SAD Division) and Sociologists (particularly from the AgroParisTech Sociology training and research group). The work was organised around case studies of the different themes being investigated to varying degrees: (i) the overview of a large number of cases with little data but that is easy obtainable; (ii) the detailed analysis of a smaller number of cases, that illustrated a diversity of situations and (iii) the in-depth analysis of a small number of cases that were considered as particularly important. The detailed analysis involved interviews with a large number of local actors, farmers surveys and analysis of data recorded on the farm.

Results
The combination of surveys carried out with farmers and the analysis of national genetic evaluation results of breeding animals allowed to distinguish two clearly different strategies of local dairy cattle breed management within a mountainous area (Northern Alps) and in cheese producing sectors (registered as a protected designation of origin AOP, Appellation d’origine protégée). On the one hand, the Abondance breed was used in a relatively wide range of habitats (both on the plains and in the high mountain areas) and for a varied range of sectors, breeders choose their management strategies and management of constraints both in the choice of bulls for insemination and feeding practices. On the other hand, the Tarentaise breed was raised mainly in mountainous and high mountain areas and for one protected designation of origin AOP product (Beaufort cheese); then, the breeders consider that the breed is adapted to this system and don’t feel the need to differentiate in their choice of bulls according to their location. This second local breed is therefore very specialised and as such, its development could be restricted.

In the context of an island, we analysed the parallel between the development of the AOP Cured meats from Corsica project, the evolution of the Nustrale local pork breeders, associated with this AOP and the evolution of breeding systems subject to particular specifications. We demonstrated that the activation of a local genetic resource as a factor of territorial anchorage is a complex process that generates tensions between the different actors and presents both opportunities and questions, and even dangers, for the resource itself. The experience of interdisciplinary research on these questions, on a wide variety of case studies, has enabled us to publish an article that takes the position: “no development, no conservation”, based on the case for the preservation of farm animal genetic resources and opening up the discussion for a public, primarily concerned with the preservation of biodiversity. The research was also the opportunity to reflect upon the concept of livestock breeds, linked to the evolutions in the breeding sector and society.

Article de référence

Objectives
Since the end of the 1990s, researchers have been questioning the effects of global warming on the spatial distribution of plant species. Up to now, specialists were particularly worried about mountain species that were considered the most vulnerable to climate change. A study published in Science in 2008, by the researchers from LERFOB Joint Unit Research in collaboration with the CNRS (the French National Centre for Scientific Research), demonstrated that mountain plants had started to migrate in altitude [5 metres on average since the 1980s] as a result of the rise in the average temperature. The study published in Nature in 2011 by the same team, aimed to identify if the changes in flora were homogeneous in the geographical space or if they varied according to the ability of the plants to find refuge a short distance away. To address these issues, the authors compared the changes in plant communities linked to climate change between different zones on both the lowlands and in mountainous areas.

Methodology
The authors used exhaustive plant species inventories carried out between 1945 and 2008 on 76 426 localised sites in forests, both in mountainous areas and on the lowlands. These surveys came from the National Forestry Inventory, the Sophy floristic CNRS database and the EcoPlant database of AgroParisTech/INRA. As each one of these species is held to be a precise range of temperatures, the authors were able to reconstruct the temperatures through bioindication from the information from the species inventories of each plot and to compare them to the temperatures measured in the year that the floristic inventory was carried out. The authors subsequently compared the temperatures measured and the floristically reconstructed temperatures over time between the lowlands and the mountains.

Results
The climate data provided by meteorological services indicate that the temperature has remained relatively constant over the period from 1965-1986 before beginning to rise from 1987 onwards. The floristic surveys were therefore divided into two groups, those before 1986 and those after. In the 1965-1986 period the floristically reconstructed temperatures and the measured ones are similar in both the lowlands and the mountains. This suggests a close equilibrium between species composition and temperature conditions in both contexts. In the 1987-2008 period, the results highlight the differences between the measured and floristically reconstructed temperatures. The discrepancy between the climatic and floristic values is three times higher on the lowlands (the reconstructed temperature by plants is inferior by 1.29 °C to the measured temperature) than in the mountains (difference of 0.42 °C). The analysis of the evolution of the measured and floristically reconstructed temperatures between the periods 1946-1986 and 1987-2008 demonstrates that, in the mountains, there is a progressive replacement of species adaptable to a cold climate, by species that are adaptable to a warmer climate that allowed plant communities to compensate 0.54 °C of the 1.07 °C increase of the observed temperature. On the other hand, for plant communities on the lowlands, this compensation was only 0.02 °C for a similar warming (1.1 °C) which reveals a growing imbalance between forest flora on the lowlands and the climate. This lack of reactivity by species on the lowlands can be explained by a greater fragmentation of their habitat as compared to mountain areas. On the other hand, the actual distance to be covered from one generation to another to find a favourable climate for their development is much more important on the lowlands (35.6 km on average) than in the mountains (11.1 km) where the slope enables plants species to rapidly find cold conditions near the summits. In view of the distance of dispersion that rarely exceeds several hundred metres a year, the herbaceous forest species find it difficult to compensate for the rise in temperature observed on the lowlands by natural migration.

Article de référence
Bertrand R., Lenoir J., Piedallu C., Rofrío-Délion G., de Ruffray P., Vidal C., Pierrat J.C., Gégout J.C.. 2011. Changes in plant species inventories carried out between 1945 and 2008 on 76,426 localised sites in forests, both in mountainous areas and on the lowlands. In the 1965-1986 period the floristically reconstructed temperatures and the measured ones are similar in both the lowlands and the mountains. This suggests a close equilibrium between species composition and temperature conditions in both contexts. In the 1987-2008 period, the results highlight the differences between the measured and floristically reconstructed temperatures. The discrepancy between the climatic and floristic values is three times higher on the lowlands (the reconstructed temperature by plants is inferior by 1.29 °C to the measured temperature) than in the mountains (difference of 0.42 °C). The analysis of the evolution of the measured and floristically reconstructed temperatures between the periods 1946-1986 and 1987-2008 demonstrates that, in the mountains, there is a progressive replacement of species adaptable to a cold climate, by species that are adaptable to a warmer climate that allowed plant communities to compensate 0.54 °C of the 1.07 °C increase of the observed temperature. On the other hand, for plant communities on the lowlands, this compensation was only 0.02 °C for a similar warming (1.11 °C) which reveals a growing imbalance between forest flora on the lowlands and the climate. This lack of reactivity by species on the lowlands can be explained by a greater fragmentation of their habitat as compared to mountain areas. On the other hand, the actual distance to be covered from one generation to another to find a favourable climate for their development is much more important on the lowlands (35.6 km on average) than in the mountains (11.1 km) where the slope enables plants species to rapidly find cold conditions near the summits. In view of the distance of dispersion that rarely exceeds several hundred metres a year, the herbaceous forest species find it difficult to compensate for the rise in temperature observed on the lowlands by natural migration.

Article de référence
Food, nutrition and health

Rationale design of safe food packaging

Objectives

The safety of food contact materials is subjected to several scientific controversies for both plastics materials, which are suspected to be a significant source of endocrine disruptors, and non-plastic materials recycled cardboard/papers, inks, etc. involved in several recent crises. The Joint Research Unit GENIAL proposes to replace the current safety management enforced on a material basis by a global preventive approach aiming at minimising the risk of contamination for any assembly or composite system at all stages of its life cycle. These goals have been pursued more particularly within the research programme Migresives and the European research programme SafeFoodPack Design funded by the French National Research Agency.

Methodology

The experiment alone cannot be used to access all scales and steps of the contamination problem. The main idea consisted in using our capacity to model mass transfer to prepare the responses, the scenarios and their possible ramifications associated to the leaking of substances from one material into another one or into food. Modelling has been developed at several scales: from the scale of the supply chain down to molecular scale to establish relationships between the chemical structures of contaminants and their transport properties (diffusion coefficients and their activation, activity coefficients and sorption heats). With the support of the industry, a large set of composition data of packaging materials has been collected in particular with the help of fast deformulation methods involving FTIR et 1H NMR spectroscopic techniques.

Results

A general method borrowed from the aeronautical industry Failure Mode Effects and Criticality Analysis (FMECA) has been adapted to the physics of involved phenomena and to the concepts used to assess hazards for food contact materials. It enables to identify in a semi-supervised way, with the help of an open source computational platform, the steps, the materials and the substances, which are critical for the safety of the food in contact. The whole approach introduces food safety as a regular criterion for the rationale design of packaging as other criteria such as barrier performance, mechanical resistance and recyclability.

Besides, experimental work and simulations of molecular dynamics showed that the rate of diffusion of intentionally added substances to plastic materials could be dramatically reduced by adding flexible segments close to their centre of mass or by increasing their symmetry. In the same vein, these studies at molecular scale provided a rigorous framework for the interpretation and prediction of the contamination of aqueous, dairy, dry food in direct contact or not with the packaging. The large set of physico-chemical data either measured or calculated as well as composition data of representative packaging materials on the French market will be made broadly available to the community by the end of the project SafeFoodPack Design in December 2014.

Main scientific partners: Synchrotron Soleil, CNRS-Institut Charles Sadron, Laboratoire national d’essais et de métrologie.

Article reference


Carbon materials, synthons, energy

Lignocelluloses: a source of functional molecule and synthons for green chemistry

Objectives

Lignocelluloses are raw materials that are both abundant and environmentally friendly, used as biomass as a partial substitute for oil for the production of energy, fuel, materials and valuable molecules enable the management in the future of the increasing scarcity of oil whilst reducing greenhouse gas emissions and the negative health impacts of certain every day products. The Lignocellulose biopolymers: from cell wall assemblies to synthons for green chemistry [Apsynth] team (ULPB Joint Research Unit) is attaching increasing importance to exploiting its knowledge of the biochemistry of raw materials and its expertise to design new pathways towards lignocelluloses. The primary objective is to make use of the phenolic components of the plant cell wall, lignins and associated phenolic acids, to obtain bio-sourced molecules that can be used either directly as material components or as basic molecules (synthons) for the synthesis of new plastic materials.

Methodology

The approach used by the team relies on three complementary strategies: (i) the study of industrial byproducts produced by biorefineries currently converting agricultural residues (wheat straw, corn stalks), (ii) the understanding of the reactivity of phenolic molecules with tuned model compounds synthesised in the laboratory, (iii) the exploitation of the natural variability of plants in order to identify potential structures of interest. All these strategies rely on the methods of structural analysis developed in the Joint Research Unit with the help of the Plant Observatory, analytical chemistry platform. In order to ground these research questions in a socio-economic context, a network of collaborations have been put in place with industrial stakeholders from the whole value chain, from industries of primary processing of biomass to chemicals and materials industries.

Results

Considered, for a long period of time, as industrial waste products of paper manufacture, with the primary use of direct combustion, lignins emerge today as functional molecules, that are sources of added value. Thus, in collaboration with the GENIAL Joint Research Unit, the Apsynth team has demonstrated that wheat straw lignins, incorporated into a biodegradable matrix of polylactic acid, give rise to free radical scavenging activity of the finished material. This result enables us to envisage the use of lignins as antioxidants in active packaging. Apart from their antiradical activity, lignins are good agents of hydrophobisation, giving rise to starch films with surface properties similar to those of Teflon through simple physical treatment. The biodeversion of lignins allows the recuperation of small phenolic molecules, like ferulic acids, by a process of depolymerisation. Already used in the areas of health and cosmetics for its biological activity, this molecule was exploited to design a whole family of phenolic molecules used as macromonomers for the synthesis of antioxidant, biodegradable polymers that offer an adjustable thermal resistance. This work gave rise to a patent and is continued this day by the Industrial Agrobiotechnologies chair.


Article reference


Synthesis strategy of new biobased antioxidant polymers from phenolic synthons derived from lignins

FROM LIGNIN

PHENOTIC

MACRO-BISPHENOL

BIO-BASED

DIOLS

ANTIOXIDANT PROPERTIES

MECHANICAL AND

HYDROPHOBICITY

ALIPHATIC/AROMATIC POLYMERS

OF BIOREFINERIES

ENZYMATIC

SYNTHONS

ANTIOXIDANT PROPERTIES

MACROMONOMERS

ENZYMATIC

SYNTHONS

SYNTHESIS
Social systems

Agri-environmental policies for the preservation of biodiversity

Objectives
The degradation and fragmentation of natural habitats is the primary cause of the erosion of biodiversity in the world. Research work has been carried out in the Économie publique Joint Research Unit on the incentives for preserving the habitats of endangered species on agricultural land. How to encourage farmers to adopt practices and land use that respect biodiversity? At what level should their efforts be financed when we don’t yet know the exact cost of their conversion to good practices?

These questions have been addressed by paying particular attention to the fact, which is largely accepted in ecology but studied very little by economists, that not only the size of the preserved habitat but also its spatial configuration has an impact on biodiversity. The related research work concentrates on agri-environmental policies that take into account both the spatial prerequisites and the problems related to information on the cost of preservation.

Methodology
In order to address these issues, several public policy instruments were compared with the aim of preserving a certain number of hectares of grassland with a given spatial configuration. Grassland represents a priority natural habitat for numerous species. Several spatial provisions have been envisaged depending on the species in question. An economic model Outopie that simulates the behaviour of farmers was used. The hypothesis is that farmers maximise their gross margin taking into account different technical and other regulations.

In collaboration with ecologists at CNRS-Chizé, the model used was applied to a study area on the Plaine de Nort (Poitou-Charentes region) on a Natura 2000 site where there are cereal crop farmers and livestock breeders. One of the species of interest in this zone is the little bustard (Tetrax tetrax), a bird that is under threat of extinction at a national and global level and has therefore become emblematic. The Outopie model enables us to determine, in terms of the public policy applied, the choice that each farmer makes on land use and agricultural practices and therefore to generate a schematised “landscape” on which we can associate a spatial indicator. One of the spatial indicators that has been upheld is the Ripley, which enables us to test if pastures are divided up in a random way within the zone that corresponds to the needs of the little bustard. Other indicators enable us to avoid the fragmentation of the habitat that is being studied. The instruments tested are a subsidy by hectare of grassland, an auction to allocate conservation contracts and an agglomeration malus. The criteria for comparing these instruments are (i) the total cost of the policy (the total of the financial compensation paid out) in order to reach a given percentage of grassland (economic efficiency) and (ii) the ability to reach the desired spatial pattern, measured by the spatial indicator (spatial efficiency).

Results
Through the auction system, farmers are in competition with one another which enables the allocation of conservation contracts to the most deserving, that is to say, to the farmer that asks for minimum finance by hectare of pasture. In our case, this mechanism allows us to achieve the same percentage as an grassland as with the subsidy, but reduces the cost by half. The agglomeration malus consists of awarding subsidies by hectare of grassland when the amount is reduced if the converted plot is adjacent to existing grassland (in this instance, we are hoping to avoid aggregation as the maintenance of the little bustard population relies on several dispersed habitat sites). The agglomeration malus achieves the desired spatial configuration with the same level of cost as the subsidy. To conclude, the auction is more desirable than the subsidy in terms of improved economic efficiency whereas the agglomeration malus is preferable to the subsidy for a better spatial pattern of the habitat. We cannot come to a conclusion on the comparison between the auction and the agglomeration malus because we have to weigh up the economic efficiency criteria and the spatial criteria.

Article reference
Correlations between the Joint Research Units and major research domains covered by AgroParisTech

<table>
<thead>
<tr>
<th>Living systems</th>
<th>Agroecosystems, forests, landscapes</th>
<th>Natural resources</th>
<th>Food, nutrition and health</th>
<th>Carbon materials, synthons, energy</th>
<th>Social systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOME-COPERNICUS</td>
<td>AGRONOMIE</td>
<td>AGRONOMIE</td>
<td>CIREN</td>
<td>CIREN</td>
<td>CIREN</td>
</tr>
<tr>
<td>ÉCOFOG</td>
<td>ÉCOFOG</td>
<td>ÉCOFOG</td>
<td>ÉCOFOG</td>
<td>ÉCOFOG</td>
<td></td>
</tr>
<tr>
<td>ESE</td>
<td>ESE</td>
<td>ESE</td>
<td>ESE</td>
<td>ESE</td>
<td></td>
</tr>
<tr>
<td>GABI</td>
<td>GABI</td>
<td>G-EAU</td>
<td>G-EAU</td>
<td>G-EAU</td>
<td></td>
</tr>
<tr>
<td>GÉNÉTIQUE VEGETALE</td>
<td>GÉNÉTIQUE VEGETALE</td>
<td>GÉNIAL</td>
<td>GÉNIAL</td>
<td>GÉNIAL</td>
<td></td>
</tr>
<tr>
<td>IJPR</td>
<td>LEESU</td>
<td>LEESU</td>
<td>LEESU</td>
<td>LEESU</td>
<td></td>
</tr>
<tr>
<td>LIEF</td>
<td>LIEF</td>
<td>LIEF</td>
<td>LIEF</td>
<td>LIEF</td>
<td></td>
</tr>
<tr>
<td>MIA</td>
<td>MIA</td>
<td>MIA</td>
<td>MIA</td>
<td>MIA</td>
<td></td>
</tr>
<tr>
<td>MICALIS</td>
<td>MICALIS</td>
<td>MICALIS</td>
<td>MICALIS</td>
<td>MICALIS</td>
<td></td>
</tr>
<tr>
<td>MOSAR</td>
<td>MOSAR</td>
<td>MOSAR</td>
<td>MOSAR</td>
<td>MOSAR</td>
<td></td>
</tr>
<tr>
<td>PNCA</td>
<td>PNCA</td>
<td>PNCA</td>
<td>PNCA</td>
<td>PNCA</td>
<td></td>
</tr>
<tr>
<td>SAD-APT</td>
<td>SAD-APT</td>
<td>SAD-APT</td>
<td>SAD-APT</td>
<td>SAD-APT</td>
<td></td>
</tr>
<tr>
<td>TETIS</td>
<td>TETIS</td>
<td>TETIS</td>
<td>TETIS</td>
<td>TETIS</td>
<td></td>
</tr>
</tbody>
</table>

REGIONAL PARTNERSHIPS

Based at eight different locations, AgroParisTech also develops specific alliances at a regional level and through different competence poles that are under the jurisdiction of the French Ministry of Agriculture:
- STVE (Sciences and Technologies of Life Science and the Environment) in the Île-de-France area (Paris region);
- Faberol (Forrestry, Agri-food, Biotechnologies and the Environment in Lorraine) in the Lorraine region;
- Agropolis International Centre in Montpellier;
- Estive (Teaching, Technological Sciences and Innovation in the domain of Life Science and the Environment).

In other regions there are partnerships which are less formalised: this is the case in Guyana, around the Joint Research Unit ÉCOFOG which is the epicentre of scientific activity on tropical biodiversity or in the Champagne-Ardennes region where a teaching and research Chair was created in industrial agrobiotechnologies between AgroParisTech and local government authorities as stakeholders.

The dialogue with the socio-economic sector is also evident through the joint commitment of research programmes financed by the private sector. The increase in the annual turnover of research contracts signed with private companies, across the spectrum, is testament to these relationships.

In 2012, contracts signed with companies represented the biggest shares of annual turnover, that is almost 30%. These partnerships involve actors from a variety of backgrounds. If companies with more than 500 employees participate in a quarter of research contracts financed by the private sector, the share of technical centres and professional and interprofessional organisations is equally important. The socio-economic interactions remain extremely receptive to new partners.

Over and above these links, AgroParisTech would like to prioritise the reinforcement of structured partnerships. Research and teaching chairs are a major element of these partnerships in the long term. The creation of the AgroParisTech Foundation in April 2012, under the aegis of the ParisTech Foundation, serves to reinforce this dynamic process.

Correlations between the Joint Research Units and major research domains covered by AgroParisTech

Profile of private sector actors involved in research contracts during 2012

- 26% – Major groups > 500 employees.
- 19% – Technical centres
- 19% – Companies > 500 employees
- 11% – Professional and interprofessional organisations
- 10% – Consular agencies
- 9% – Foreign companies
- 6% – Other (foundations, NGOs...)
A strong implication in the Université Paris-Saclay

As a founder member of the Foundation for Scientific Cooperation Paris-Saclay Campus, AgroParisTech is actively involved in the collective creation and development of the future Université Paris-Saclay. The aim of Paris-Saclay is to create a pluridisciplinary and internationally renowned teaching and research campus in the Île-de-France region (Paris area) and this project is an ideal opportunity for AgroParisTech to benefit from a remarkable academic and scientific environment to which it can contribute in its key areas of expertise. AgroParisTech and INRA are leading an investment around life sciences and engineering for agriculture, food and the environment within this new university.

Teaching and research chairs

Responding to the will of actors in the socio-economic world to strengthen close collaborations and the ambition of AgroParisTech to build long term structured partnerships, the development of teaching and research chairs is one of the strategic objectives of the institute.

<table>
<thead>
<tr>
<th>Title of chair</th>
<th>Duration</th>
<th>Academic partners</th>
<th>Socio-economic partnerships</th>
<th>Overall budget</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eco-conception of Buildings and Infrastructures</td>
<td>5 years + 5 years</td>
<td>MINES ParisTech, École des Ponts ParisTech</td>
<td>Vinci</td>
<td>€3 000 k</td>
</tr>
<tr>
<td>ParisTech - Suez Environnement Water for All</td>
<td>5 years + 6 years</td>
<td>MINES ParisTech</td>
<td>Suez Environment</td>
<td>€1 500 k</td>
</tr>
<tr>
<td>Prospective Modelling for Sustainable Development</td>
<td>5 years + 5 years</td>
<td>MINES ParisTech, École des Ponts ParisTech</td>
<td>Ademe, EDF, Renault, Schneider Electric, Total</td>
<td>€2 500 k</td>
</tr>
<tr>
<td>Food, Nutrition, Food Behaviour</td>
<td>5 years</td>
<td></td>
<td>Danone Research</td>
<td>€1 500 k</td>
</tr>
<tr>
<td>Industrial Agrobiotechnologies</td>
<td>8 years</td>
<td></td>
<td>Champagne-Ardenne Region, the Marne district and Urban area of Reims</td>
<td>€12 000 k</td>
</tr>
<tr>
<td>Forests for Tomorrow</td>
<td>5 years</td>
<td></td>
<td>National Forestry Office</td>
<td>€1 200 k</td>
</tr>
<tr>
<td>Sustainable Demand Supply Chain</td>
<td>5 years</td>
<td>System U, Solipresta, Terrena (GIR)</td>
<td></td>
<td>€1 500 k</td>
</tr>
</tbody>
</table>

Teaching and research chairs at the end of 2013.

The Water for All chair

Created in 2008 by ParisTech and the Suez Environment Foundation, the Water for All chair is jointly managed by MINES ParisTech and AgroParisTech. Its aim is to contribute to teaching and research activities in the area of access to water and sewerage systems.

Taking an active interest in urban drinking water and sewerage services in emerging and developing countries, the Water for All chair has, since its creation, supported research projects, theses in particular, that are linked to these themes and also collaborations with business partnerships. The project involves the G-EAU unit which is jointly supervised by AgroParisTech. The research projects associated with this chair are mainly focused on governance, services regulations, the conditions for access to water and sewerage systems for populations, the quality and performance of the services provided, tools for funding and sustainable schemes for management.

A strong commitment in the “Investments for the Future” initiative

As a dynamic and strategic partnership for AgroParisTech, the institute is strongly committed to the research component of the French “Investments for the Future” programme that subsidises “excellence” projects whose aims are to increase the scientific influence and reputation of France. This programme has led to the implementation of Initiatives for Excellence Projects (IdEx), Facilities for Excellence (ÉquipEx) and Laboratories for Excellence (LabEx) that AgroParisTech is closely associated with.
RESEARCH THAT PERMEATES TEACHING

The guarantee of a quality education in areas that are evolving rapidly means teaching students in close proximity to research. AgroParisTech guarantees this through its five teaching and research departments, which ensure the interaction between the two facets of the institute’s mission, and through its research units which contribute significantly to educational provision.

MASTER AND POST-MASTER PROGRAMMES

Scientific knowledge, that is more and more sophisticated and that is directly linked to the results of research work, is gradually integrated into the curriculum. The academic staff and researchers in the Joint Research Units ensure that students benefit from the results of their own programmes, but equally from the international research work that they are involved in. Over and above this knowledge, the students benefit from the proximity of the research activities in two other ways, (i) because future graduates learn what research methods are and what they bring to the skill of reasoning and (ii) because this proximity allows them to reflect upon the place of scientific knowledge in the evolution of society. The research domains covered by AgroParisTech include many subjects that are controversial in and to society and it is therefore fundamental for future graduates to have a direct contact with research (in its triple cognitive, technological and ethical approaches).

PHD TEACHING AT DOCTORAL SCHOOLS

As the AgroParisTech institution is situated at different sites around France, it is implicated in different and varied ways in four doctoral schools in which approximately one hundred PhD students are enrolled every year:

- ABIES Doctoral School (Agriculture, Food, Biology, the Environment and Health), attached to the Université de Lorraine, Nancy;
- GRN Doctoral School (Geosciences and Natural Resources), attached to the Université de Montpellier 2, Montpellier;
- RP2E Doctoral School (Science and Resources Engineering, Processes, Products, the Environment) attached to the Université de Montpellier;
- SIBAGHE Doctoral School (Integrated Systems in Biology, Agronomy, Geosciences, Hydrosciences and the Environment) attached to the Université de Montpellier 2, Montpellier;

Situated at the interface of sciences that are linked to agriculture, food, the environment and health, ABIES is a fundamentally pluridisciplinary doctoral school that prioritises in particular hybrid research projects in life science, engineering science, mathematical modelling and/or economic and social sciences and management. In order to ensure a continuity between Master and PhD studies, the fields of activity at the doctoral school cover the domains and themes in the Engineer and Master level curriculum at AgroParisTech.

The education programme specifically created by the ABIES Doctoral School aims to offer a coherent and original response to the needs of PhD students and of competencies required by employers. This offer aims to complement the teaching acquired in the research teams and favours the development of transferable skills: communication, language skills, project culture, creativity, etc. It is organised around four major areas of identified competencies and skills: scientific skills, project and team management skills, personal abilities/learning “how to be” and the valorisation of transferable skills.

The PhD curriculum at the heart of the ABIES doctoral school has enabled its PhD students to successfully find employment, in a large range of professional roles (higher education and research, government departments and the private sector) in both France and abroad. 35% of young PhD graduates pursue a career abroad.

Breakdown by doctoral school of number of PhD students registered with AgroParisTech in 2012/2013

<table>
<thead>
<tr>
<th>School</th>
<th>Number of PhD students</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABIES</td>
<td>45%</td>
</tr>
<tr>
<td>SIBAGHE</td>
<td>36%</td>
</tr>
<tr>
<td>GRN</td>
<td>14%</td>
</tr>
<tr>
<td>RP2E</td>
<td>5%</td>
</tr>
</tbody>
</table>

PhD supervision in several of the units that AgroParisTech co-supervises (number of theses and number of supervisors in 2012-2013)

<table>
<thead>
<tr>
<th>School</th>
<th>Number of theses</th>
<th>Number of supervisors</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABIES</td>
<td>60</td>
<td>30</td>
</tr>
<tr>
<td>SIBAGHE</td>
<td>40</td>
<td>20</td>
</tr>
<tr>
<td>GRN</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>RP2E</td>
<td>10</td>
<td>5</td>
</tr>
</tbody>
</table>

Sectors of employment of young PhD graduates from five years after completion of their theses (2012 data)

<table>
<thead>
<tr>
<th>Sector</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Higher education and research</td>
<td>50%</td>
</tr>
<tr>
<td>Private sector</td>
<td>40%</td>
</tr>
<tr>
<td>Other (administration...)</td>
<td>8%</td>
</tr>
<tr>
<td>Unemployed</td>
<td>2%</td>
</tr>
</tbody>
</table>
AgroParisTech’s policy reflects the will of the institute to reinforce a dynamic consolidation of its research potential.
ORGANISATION OF RESEARCH POTENTIAL

A REINFORCED RESEARCH STEERING STRATEGY

The management of the institute’s research policy is driven by the Scientific Council, the institute’s Scientific Direction and the Teaching and Research Departments. During the 2009-2013 period, the management of research activities has evolved with the development of an improved articulation between the different instances and the affirmation of the role of the Scientific Council.

A REGIONAL ORGANISATION

Located at eight sites, four of which are situated in the Île-de-France area (the Paris Region), AgroParisTech puts its geographical diversity to good advantage in a scientific organisation founded on regional alliances and regular interactions between centres. AgroParisTech’s research potential is thus organised around five regional poles which the Joint Research Units, that AgroParisTech supervises, are linked to.

- As the majority of the AgroParisTech’s research units are in the Paris region, the research potential is concentrated in this area. 65% of scientists work in the 18 Joint Research Units that AgroParisTech jointly supervises in this region. These units work on the all of the major areas of research and subjects studied at the institute. Several of these units also participate, in the Plant Sciences LabEx (Laboratory of Excellence) at Saclay (SPS) and the Biodiversity, Agroecosystems, Society, Climate LabEx (BASC).

- AgroParisTech’s campus in Montpellier is linked to two Joint Research Units which study water management, at one site and systems of spatial information at the other who also contribute to the GeoSud ÉquipEx.

- As an internationally recognised forestry and wood centre, the Nancy Campus brings together two research units associated with the Laboratory of Excellence for Advanced Research on the Biology of Tree and Forest Ecosystems (ARBRE LabEx).

- Housing the MÉTAFORT research unit, the Clermont-Ferrand Campus has a recognised expertise in domains linked to territories and local government authorities.

- The centre at Kourou in French Guyana is specialised in the management of tropical ecosystems through the ÉCOFOG unit that it houses. The centre contributes to the Centre for the Study of Biodiversity in Amazonia LabEx (CEBA) and works in close collaboration with the Nancy and Montpellier research centres on the themes.

Operating at both regional and national levels, AgroParisTech covers a wide spectrum of research themes in order to maintain and develop strategic partnerships, whilst also developing the competencies to carry out its teaching mission.

Research activities at AgroParisTech centres

- Living systems
- Natural resources
- Food, nutrition and health
- Agroecosystems, forest, landscapes
- Carbon materials, synths, energy
- Social systems

Areas of research: Living systems, Natural resources, Food, nutrition and health, Agroecosystems, forest, landscapes, Carbon materials, synths, energy, Social systems
AgroParisTech maintains a stable level of staffing academic staff of approximately 230 scientists. 80% of this research potential is situated currently in the Joint Research Units. AgroParisTech’s academic staff represents approximately a quarter of permanent staff in the Joint Research Units, the equivalent of 13% of full-time staff. Other scientists, whose academic disciplines are less represented at AgroParisTech, but that are essential to teaching (such as biology of reproduction, environmental law, sociology of food) carry out their research activities in research units that are not supervised by AgroParisTech.

**NUMBER OF STAFF**

AgroParisTech’s scientists are situated currently in the Joint Research Units. AgroParisTech’s scientists are situated currently in the Joint Research Units.

**RESEARCH TOOLS**

As well as the significant human “potential”, the implementation of the institute’s scientific policy requires facilities and equipment and agricultural and forest areas for study.

AgroParisTech’s partnership policy enables academic staff to benefit from the pooled facilities in the Joint Research Units. The AgroParisTech centres have, for example, technical platforms that enable academic staff to carry out cutting-edge research in the food domain (Nicolas Appert Technology Centre and the “Francilien” Platform for Arable Crop Studies (Frece) in the greater Paris area, in tropical ecology in Kourou (French Guyana), in plant biology and in animal biology at the INRA Centres (Versailles, Jouy-en-Josas). AgroParisTech also provides academic staff with the agricultural lands and forests that they need to carry out their research. AgroParisTech also has at its disposal several specialised libraries such as the one in Montpellier on the subject of water and forest ecosystems and one in Kourou on humid tropical forests.

Nicolas Appert Technology Centre

Located at the Massy Centre, the Nicolas Appert Technology Centre is representative of AgroParisTech’s investment in research and transfer of technology.

With a total surface area of 1,300 m², the platform is equipped with 45 pilot project units that facilitate the study of food process engineering. The centre was set up to provide scientists with the means to design and develop experimental pilot projects.

Dedicated to the transfer of technology and innovation, the platform also enables scientists to carry out studies (feasibility, development, production and characterisation of products, dimensioning of equipment). The work space and facilities for industrial partners to carry out pilot case studies are also available.
The financing of scientific activities comes from different sources (chairs, European programmes, research contracts...) AgroParisTech has, in addition, its own means of funding dedicated to the implementation of the scientific policy of the institute.

**CONTRACTUAL ACTIVITY**

Participating also to its research objectives and to the development of its facilities, AgroParisTech’s contractual activity reflects the dynamic nature of the partnership policy of the institute and the implication of its academic staff.

If we consider all of the contracts signed by AgroParisTech or by its partners in the jointly supervised research units, the number of research contracts is approximately around 200 per year. The overall total of research contracts has risen significantly, from €50.8M in 2009 to €65.7M in 2012.

The distribution of the sources of funding of these contracts reflects not only the partnerships forged with the institute and the Joint Research Units, but also the importance of public funding and the increasing share of private sector funding.

As an essential part of AgroParisTech’s scientific policy, contractual activity participates considerably to the financial means dedicated to research activities and also reflects the strategic orientation of the institute in terms of research.

**NON CONTRACTUAL RESOURCES**

As a complement to resources from research contracts, the resources managed directly by the scientific direction of the institute, that are dedicated to research activities (not including PhD teaching), come from the following sources:

- the Ministry of Agriculture,
- the French National Research Agency (ANR), which allocates funding to institutions that house teams that operate projects that are financed by the Agency (ANR),
- patents,
- allocation from the institute.

**Evolution of the number of and the overall amount of contracts signed between 2009 and 2012**

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Contracts</th>
<th>Overall Amount of Contracts (€M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>345</td>
<td>50.8</td>
</tr>
<tr>
<td>2010</td>
<td>275</td>
<td>58.3</td>
</tr>
<tr>
<td>2011</td>
<td>245</td>
<td>42.5</td>
</tr>
<tr>
<td>2012</td>
<td>194</td>
<td>45.7</td>
</tr>
</tbody>
</table>

**Distribution of income from contracts signed in 2012**

- 54% – ANR (French National Research Agency)
- 22% – Private sector
- 21% – Public sector
- 3% – European Union

**Allocation of external contract research budget resources in 2013**

- 78% – Ministry of Agriculture
- 12% – ANR (French National Research Agency)
- 9% – AgroParisTech
- 1% – Patents
AgroParisTech’s research policy enables academic staff to carry out scientific activities from fundamental to applied research.
The number of articles that appear in peer reviewed scientific journals signed by at least one of the institute’s academic staff has been rising steadily over the past five years, whereas the number of scientists has remained stable. Between 2009 and 2013, the number of articles produced has increased by 25%.

<table>
<thead>
<tr>
<th>Year</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Papers in peer reviewed journals</td>
<td>266</td>
<td>279</td>
<td>297</td>
<td>297</td>
<td>333</td>
<td>1472</td>
</tr>
</tbody>
</table>

An analysis of the distribution of themes of scientific output from peer reviewed scientific journals in terms of the discipline of the journals in which the articles are published shows the diversity of the different areas of research of AgroParisTech. Three distinct poles emerge: Agricultural sciences (24%), Plant and animal science (19%), Environment/ecology (11%). The rest of output is split into 16 other areas which are forming part of four subject area: Life sciences and health (Biology and biochemistry, Neuroscience and behaviour...), Engineering (Materials science…), Basic sciences (Mathematics, Physics, Chemistry) and Human and social sciences (Economics and business...).

To analyse the reputation of the journals in which AgroParisTech publishes, the institute uses a method developed by INRA (Solagri & Magri 2000). This method enables the classification of journals into five categories, from exceptional to mediocre, by calculations that classify each journal with other journals in the same subject area.

This analysis shows that AgroParisTech academic staff publishes articles in quality journals:
- 65 % of articles are published in excellent or exceptional journals, that is to say in the top 25 % of their category;
- 86 % of articles feature in journals that are in the top 50 % of their category.

The academic staff at AgroParisTech exchanges and communicates with the scientific community, the socio-economic world and the public at large through the dissemination of the results of their research work. The dissemination of results goes through different channels, such as in written publications in scientific reviews or in books and at congresses.

**KEY FIGURES OF PUBLICATION ACTIVITY**

The institute’s scientific output represents more than 3,700 references from 2009-2013. The output that is destined for the scientific world takes on two forms:
- papers in peer reviewed scientific journals (ACL);
- communications (Com.S) at conferences.

Scientific output is 78% oriented towards academia and is more or less equally distributed between published papers and communications.

The output, in terms of transfer of technology, destined for the socio-economic world (policy makers, professionals, private and public owned companies, public services, teaching institutions and local authorities, etc.) appears in non academic reviews and at conferences and events open to a broader public than in the research sector.

**Participation in the Open Access movement**

AgroParisTech is part of a movement bringing together a group of initiatives that aim to make scientific output free of charge and more accessible. On the one hand, an increasing number of papers are published in journals that are part of Open Access and on the other hand, AgroParisTech has put into place an important open archive (HAL portal) in which authors can archive their own scientific output.

This archive contributes to the visibility of the institute and of the teacher researchers linked to the HAL portal which is the 3rd most important portal in the world in terms of its visibility.

With more than 8,100 references the archive is growing strongly. The number of references registered doubled in 2012 and 2013.

**Distribution of scientific output by category AgroParisTech 2009-2013**

- 40% – Paper in peer reviewed journals
- 28% – Communications
- 13% – Transfert
- 9% – Other

**Classification of publications from 2009-2013 by scientific subject area in peer reviewed scientific journals**

- 24% – Agricultural sciences
- 23% – Life sciences and health
- 19% – Plant & animal science
- 11% – Environment/ecology
- 10% – Engineering
- 7% – Basic sciences
- 7% – Human and social sciences
SCHEMES OF VALORISATION AND TRANSFER OF KNOWLEDGE

AgroParisTech is committed to activities of valorisation and transfer in different forms in terms of both the nature of the partnerships and the arrangements agreed upon for the partnerships. The main type of valorisation and transfer that academic staff is involved in are primarily linked to competitiveness poles, structures (Instituts Carnot) and networks (Scientific Interest Groups - GIS) that include “public” partners and private companies. All of these schemes participate in the development of innovation generated research.

RESEARCH: A SOURCE OF INNOVATION

The way in which research is both organised and carried out at AgroParisTech incorporates an important dimension of applied research. Whether it be in the framework of partnerships with companies or with research organisations, academic staff at AgroParisTech are committed to an approach that favours innovation.

Some of the work undertaken at AgroParisTech leads to patents and licences. The application of research is also expressed through innovative projects. This is particularly the case for example with the Grignon Positive Energy Programme (GE+) and the Innovative Research Project for Productive Parisian Roofs (T4P).

THE DISSEMINATION OF SCIENTIFIC CULTURE AND PARTICIPATION IN PUBLIC DEBATES

The contribution to the dissemination of scientific culture and public debate is part of AgroParisTech’s objective to share scientific knowledge with the widest number of people possible. This is even more necessary for the institute in terms of life sciences studies which involve the understanding of “uncertainty” and to deal with opposing debates and ethical questions.

As AgroParisTech wants to maintain and develop this objective and mobilise all its abilities to contribute to a dialogue between science and society, it has developed over the past few years a proactive policy in this area, from the consolidation of action to the implementation of new initiatives.

AgroParisTech is also the editor of the French Forestry Review, which publishes six editions a year (both on paper and via internet: http://documents.irrevues.inist.fr/handle/2042/4752) and actively contributes to the dissemination of scientific knowledge in the area of wood and forestry.

Since 2013, AgroParisTech participates in addition to the Têtes chercheuses at the Huffington Post. This scheme enables PhD students, young doctors and academic staff to publish articles and to present research work on the dedicated web site (www.huffingtonpost.fr/news/agroparistech-tetes-chercheuses), this forum enables the access to original publication of research work.

The institute also participates in various public events such as the Fête de la Science (an annual national science promotion event), the International Agriculture Show (Salon international de l’agriculture) or the national Sustainable Development Week. AgroParisTech is also an actor in public debates through the numerous conferences that its academic staff contributes to or that the institute organises.

AgroParisTech also values the dissemination of its scientific output and participates in the diffusion of scientific culture via the France Culture Plus Platform, and UVED (the online university dedicated to the environment and sustainable development), (TunesU...)

EXPERTISE AND ANIMATION OF RESEARCH ACTIVITIES

Expertise and research animation activities are carried out in different yet complementary fields of activity, that add value to the dissemination and recognition of the scientific output of AgroParisTech.

As spaces that are devoted to the exchange on and expression of research activities, conferences and seminars are essential events that AgroParisTech academic staff contribute to in a significant way, either through their expertise, or by initiating and organising events with the different actors involved. Science communication presented at these events makes up 70 % of transfer activities.

Most of these conferences and seminars have an international dimension, which enable academic staff from the institute to increase not only the visibility and reputation of their research but of the institute itself. They also provide the opportunity to reinforce academic links at a national and international level.

The frequent participation of AgroParisTech academic staff at these scientific events, where they present their expertise, takes on several different forms: implication in groups of experts linked to public or private organisations on a national and international level (Intergovernmental Panel on Climate Change – IPCC; the Organisation for Economic Cooperation and Development – OCDE; the European Food Safety Authority – EFSA; the French Agency for Food, Environmental and Occupational Health Safety – ANSES) and in various scientific councils of partner organisations and on editorial boards...
The Grignon Positive Energy Programme (GE+) is an emblematic project for AgroParisTech in terms of research and development. The programme uses the Grignon experimental farm as a resource as it enables the application of the institute’s teaching and research objectives.

Located at three sites, the Grignon experimental farm has 400 hectares of crops, a herd of 135 dairy cows and 500 mother ewes and their young. As well as the academic staff involved in the project, 20 people work on the development of crop production, breeding and the transformation of dairy products from the farm.

In 2005, AgroParisTech and the Centre for the Study and Research of the Economy and Organisation of Animal Products (Céréopa) launched, at the farm, an applied research and development project: Grignon Positive Energy (GE+). The programme’s aim is to evaluate the methods and techniques that will reduce the negative impacts on the environment caused by farming (fossil energy resources consumption, greenhouse gas emissions, alterations to biodiversity and water quality) whilst maintaining the profit margins and high production targets. Since 2009, the project has been deployed throughout a network of farms around France that rose to 25 in 2012. The programme supports and implements, on the farm, technical solutions for crops and breeding that reduce the environmental impacts of farming and enable a long term assessment of environmental indicators that can be used to verify the efficiency of the chosen levers.

The programme is so far showing positive results which translate into:
- the rise in importance of the experimental capacity of greenhouse gas emissions measurements;
- the development of diagnostic testing tools on the farms and at a territorial level;
- the significant development of the GE+ demonstration network.

Encouraged by these results, the programme is currently entering into its 3rd phase (Acte 3, 2014-2017) which will enable the development of its transfer activities to agricultural professionals and the agricultural sector.

www.agroparistech.fr/energiepositive/-English-version-.html

Les Disputes d’AgroParisTech

In 2013, AgroParisTech launched a new event called Les Disputes d’AgroParisTech with the aim of encouraging reflection and debate around various themes that are linked to life sciences and the environment.

Aimed at the general public but also to a well informed audience, these debates are made up of a series of round tables organised around the same theme and backed up by a documentary film. The scientific experts from AgroParisTech and other scientific networks are invited to present their complementary or opposing points of view on the social, economic, scientific and ethical themes proposed.

Each year is dedicated to a different current topical issue and there are three sessions throughout the academic year. In 2013/2014, the subject was urban agriculture.
AgroParisTech has a number of important international collaborations developed over several years through different scientific cooperation projects.
INTERNATIONAL SCIENTIFIC OUTPUT

JOINT INTERNATIONAL PUBLICATIONS
One of the indicators of international collaboration is the number of joint international publications in peer reviewed scientific journals from 2009 to 2012 on the Web of Science (87% of articles produced by AgroParisTech in peer reviewed scientific journals during the same period).

35% of AgroParisTech academic staff publications bear testimony to an international collaboration. The map of countries that have international authors as co-signatories indicates the importance of collaborations with Europe and America. 56% of the articles come from collaborations with European institutions, 20% from North or South America and 12% from Africa. The institutions with which AgroParisTech maintains and develops contacts with, via research communities, are located in 67 different countries, of which 20 are in Europe (30%).

INTERNATIONAL CONFERENCES
Another criteria identified for the visibility of academic staff work is their presence at international scientific events. Science communication intended for the academic world is always presented at international conferences, both in France and abroad, and represents 38% of the scientific production of AgroParisTech.

A geographical analysis of scientific communication overall shows that most communication is carried out in Europe but also, if less so, on the American continent (North and South). These scientific events are an important channel for the visibility for AgroParisTech and are also excellent opportunities for networking.
As research work implies curiosity, exchanges and the confrontation of different points of view, research and collaborations know no geographical boundaries. The research dynamic is supported by the different schemes that are set up by AgroParisTech but also from the Joint Research Units.

NETWORKS AND INTERNATIONAL PARTNERSHIPS

For many years, AgroParisTech has been active in the creation of European networks that link research, teaching and innovation with the research areas by theme, linked to the research domains of the institute: food sciences and technologies, sustainable forests, animal breeding and genetics, etc. As well as these networks of research excellence, that provide a real visibility for the institute and enable academic staff work to be part of a global dynamic, AgroParisTech maintains more individual links with certain teaching and research institutions such as Pennsylvania State University in the USA, the Asian Institute of Technology in Thailand, the University of Pretoria in South Africa... Established collaborations are primarily in Europe, in North and South America and Asia and can take different forms: organisation of joint seminars, hosting researchers and expertise...

INCOMING AND OUTGOING MOBILITY OF TEACHER RESEARCHERS

Whether it be incoming or outgoing, academic staff mobility is an essential part of international scientific cooperation. AgroParisTech encourages its professors to carry out medium and long term stays abroad. This mobility is often the result of international partner framework agreements signed by the institute or by the Joint Research Units. Recent stays in research laboratories from academic staff were with North Carolina State University of Raleigh in the USA, the Universidad Nacional del Comahue in Argentina, the Université du Québec in Canada...

AgroParisTech attaches importance to developing the reception of international scientists in the Joint Research Units. The institute dedicates a portion of its resources for the full or partial cost of expenses for this activity and ensures that the invited professors are accompanied throughout the process.

OUTSIDE EUROPE

Whether they are part of a regional or national programme, many research programmes that AgroParisTech’s academic staffs contribute to are part of European cooperation, a means of reinforcing the international dimension of its scientific activities.

As well as the networks that the institute is involved in and that it is committed to maintaining and developing, the participation in programmes of an international dimension is an important channel for the scientific development of the institute.

This is the case for example with the TASTE project (Transnational Research Linking Agricultural, Rural and Sustainable Development Aspects), a research programme supported by the ANR (French National Agency for Research) which is linked to several European partners. The research activity of AgroParisTech’s academic staff relies heavily on European programmes linked to the European 7th Framework Programme (FP7) for research and development, the Union’s main instrument for the funding of research in Europe for the 2007-2013 period. Amongst the research programmes that the institute is financed by, 6 % were European programmes in 2012. These programmes represent a contractual annual budget of €5.1M which corresponds to 13 % of the annual research programmes budget.

OUTSIDE EUROPE

AgroParisTech is also committed to developing scientific cooperation with other countries, and in particular, North and South America. Several research programmes that AgroParisTech jointly supervises contribute to the strengthening of these scientific links. AgroParisTech wants, in addition, to develop specific academic links with developing countries drawing on existing partnerships.

For many years, AgroParisTech has been active in the creation of networks that link research, teaching and innovation.

INCOMING AND OUTGOING MOBILITY OF TEACHER RESEARCHERS

Whether it be incoming or outgoing, academic staff mobility is an essential part of international scientific cooperation. AgroParisTech encourages its professors to carry out medium and long term stays abroad. This mobility is often the result of international partner framework agreements signed by the institute or by the Joint Research Units. Recent stays in research laboratories from academic staff were with North Carolina State University of Raleigh in the USA, the Universidad Nacional del Comahue in Argentina, the Université du Québec in Canada...

AgroParisTech attaches importance to developing the reception of international scientists in the Joint Research Units. The institute dedicates a portion of its resources for the full or partial cost of expenses for this activity and ensures that the invited professors are accompanied throughout the process.

OUTSIDE EUROPE

Whether they are part of a regional or national programme, many research programmes that AgroParisTech’s academic staffs contribute to are part of European cooperation, a means of reinforcing the international dimension of its scientific activities.

As well as the networks that the institute is involved in and that it is committed to maintaining and developing, the participation in programmes of an international dimension is an important channel for the scientific development of the institute.

This is the case for example with the TASTE project (Transnational Research Linking Agricultural, Rural and Sustainable Development Aspects), a research programme supported by the ANR (French National Agency for Research) which is linked to several European partners. The research activity of AgroParisTech’s academic staff relies heavily on European programmes linked to the European 7th Framework Programme (FP7) for research and development, the Union’s main instrument for the funding of research in Europe for the 2007-2013 period. Amongst the research programmes that the institute is financed by, 6 % were European programmes in 2012. These programmes represent a contractual annual budget of €5.1M which corresponds to 13 % of the annual research programmes budget.

OUTSIDE EUROPE

AgroParisTech is also committed to developing scientific cooperation with other countries, and in particular, North and South America. Several research programmes that AgroParisTech jointly supervises contribute to the strengthening of these scientific links. AgroParisTech wants, in addition, to develop specific academic links with developing countries drawing on existing partnerships.

For many years, AgroParisTech has been active in the creation of networks that link research, teaching and innovation.
Knowledge and Innovation Communities Programmes (KIC)

Created in 2008 as an independent structure of the European Union to facilitate European integration in higher education, research and innovation, the European Institute of Innovation and Technology (EIT) spawned integrated European partnerships called KIC (Knowledge and Innovation Communities), which act as operational units. These KIC are also established around Europe with five or six "colocation centres" (CLC).

These communities bring together universities, companies and research institutes and work to prioritise, through various activities and joint projects, the development of new processes, products and services, support to new businesses and the training of a new generation of entrepreneurs.

Amongst the three first KIC put into place, AgroParisTech is particularly involved as an affiliated member with Climate KIC and is a member of the colocation centre at Paris-Saclay Campus. Linked to a consortium of several of the most prestigious European universities ( Wageningen University & Research Centre, Imperial College London, ETH Zürich...), this KIC addresses the fight against climate change, and the adaptation to this change via eight challenge platforms: Land and Water Management and Engineering, Bioeconomy, Adaptation Services, Greenhouse Gas Monitoring, etc.

Five new KIC are to be launched from 2014-2020. Amongst these are: Food4Future dedicated to agrofood sector which put out a call for applications in 2016 and be launched in 2017. In preparation for the setting up of this KIC and in order to consolidate its position as a key European and international player in the area of food and its byproducts, AgroParisTech belongs to a large European consortium called Food4Eist. The emphasis in this project will enable the institute to position itself alongside stakeholders, be they academic (INRA, Wageningen University & Research Centre, Lund University, etc.) or industrial (Unilever, Barilla, Tereos, etc.).

The TASTE project (Transnational Research Linking Agricultural, Rural and Sustainable Development Aspects – RURAGRI)

AgroParisTech in partnership with INRA, Bordeaux Sciences Agro, Jönköping International Business School (JIBS, Sweden), the Università di Milano (Italy) and the Karlsruhe Institute of Technology (Germany) set up a research programme analysing rural development in Europe through the relationships between rural/urban environments, public policy and different forms of governance in Austria, France, Italy, Holland and Sweden.

This ERANET project (European Research Area Network) is part of the RURAGRI programme which aims to improve the coordination between different research programmes on the questions linked to the future of rural territories and their adaptation to public policies. Its goal is to identify the problems and find intelligent development methods for rural and peri-urban zones in Europe using fifteen case studies. It also aims to produce tools, knowledge and scientific analysis that will contribute in the long term to a well thought out reasoned European rural development strategy.

Launched in 2013 for three years, the programme is coordinated by the SAD-APT Joint Research Unit and is also linked to the METAFORT Joint Research Unit.

The Organic Taste Ecropolis programme - Organic Sensory Information System (OSIS)

From 2009-2011, AgroParisTech participated in a European research programme Organic Taste Ecropolis which brought together 20 partners from six European countries (Germany, France, Italy, Holland, Poland, Switzerland) from small and medium sized companies (SMEs), associations linked to SMEs and research and higher education organisations.

With the aim of providing and exchanging information on data on the taste of organic products, the programme has carried out a scientific analysis of organic market needs, the sensory profiles of organic products, consumer preferences, marketing strategies and the impact of organic regulation on the sensory properties of products.

All of this information is available on the European data base OSIS (Organic Sensory Information System) which was created in the framework of this programme.

The AgFoodTrade project (New Issues in Agricultural, Food and Bioenergy Trade)

Financed by the European 7th Framework Programme (FP7) for research and development, the AgFoodTrade programme brought together, between 2008 and 2011, several European (Denmark, France, Ireland, Italy, Poland and Slovakia), African (the Institute Sénégalais de recherche agricole, Senegal) and American (the International Food Policy Institute, USA) partners to work on socio-economic research on agricultural exchanges, food safety and bioenergy.

The programme analysed the main factors affecting food trade (demographic, socio-economic, technological and political changes) drawing on a series of case studies in Europe and America. The impact of growth in the biofuels sector was also studied.

The programme led to the creation of a database that was developed in collaboration with the CEPII (French research centre in the domain of international economy) and software for modelling international trade created in partnership with the Universidad de Calabria in Italy.

Also intended to support public policy, the project provided the decision makers implicated in commercial negotiations and the design of agricultural policy, an expertise founded on scientific data, as well as operational instruments.

The international REPLAY programme (Reducing Post-harvest Losses to Increase Food Sustainability)

This project, supported by the European Commission, and involving AZTI-Technalia (Spain), Stichting Dienst Landbouw Innovatie Oeconomie (Netherlands), CRIC (Research International, OLO, Holland), Katholieke Universiteit Leuven (KUL, Belgium) and AgroParisTech, transcods European borders by involving partners of organisations from numerous other countries: Instituto nacional de tecnologia industrial (INTI, Argentina), Agrosense Limited (New Zealand), the Commonwealth Scientific and Industrial Research Organisation (CSIRO, Australia), Oregon University System (OSU, USA), Instituto tecnológico de estudios superiores de Monterrey (ITESM, Mexico), Universidad de Santiago de Chile (Usach, Chile).

Created as a five year project in 2013, the programme aims to prioritise scientific exchanges between the different partners in order to develop tools and innovative methods which allow for a more sustainable management of foodstuffs after harvest. Relying on a synergy generated by the collaborations of its members, the programme includes studies ranging from the quality of foodstuffs, the sustainability of the food chain, food conservation methods to distribution channels and technology employed.

In the long term, the project’s aim is to create a joint programme between the partners.
Even if the quality of the journals that AgroParisTech publishes in is very good, that does not necessarily determine the quality of a particular article. The amount of times an article is cited is a more important factor in determining the quality and importance of the article. Here are some examples of frequently cited or well acknowledged articles.
RESEARCH UNITS

Are presented below the Joint Research Units which AgroParisTech has joint supervision as at 1st January 2015.
The mission of the Agronomie research unit is to contribute, through its research and teaching activities, to the production of knowledge and methods to design and assess cropping systems that meet the challenges of sustainable development. The work carried out in the laboratory aims in particular to develop cropping systems that respond to different objectives: reducing their dependency on synthetic inputs, reducing their negative impacts on the environment, enabling a satisfactory economic profitability, reducing the use of fossil fuels and allowing the production of diverse products (particularly for food and energy use). In order to achieve this, the unit analyses the process of biological regulations, develops methods and tools for the design and the evaluation of innovative cropping systems, analyses the relationship between the spatial organisation of cropping systems and pests (weeds insects, pathogens), and evaluates the performance of cropping systems at a global level. The work of the unit makes use of the analysis of cropping systems, both past and present, as well as the design of new systems. The scale of research work comprises the field, the region, the country and the world.

**SCIENTIFIC OVERVIEW**

- **Creator and host of the research network on Innovative Culture Systems (SiC).**
- **Close partnerships with numerous players in the socio-economic and regulatory world implicated in research work: chambers of agriculture, public authorities, health and sanitation agencies, technical institutes, networks of farmers, cooperatives, and breeding companies.**
- **Writing numerous guides and creation of practical and methodological tools for use by players within extension services and for public authorities.**
- **Strong implication in higher education and continuing education in agronomy and agroecology.**
- **Participation in several international programmes: Pratique, Pure, AgMIP, Price, Solibam, Logistec, Endure Network.**

**FIELDS OF RESEARCH**

- **The unit is composed of one group whose activity is organised around three scientific themes:**
  - Analysis and modelling of biological regulations within agroecosystems
  - Analysis, at the field level, of the relationships between cropping systems, biodiversity and ecosystem services.
  - Analysis, at the landscape level, of the relationships between cropping systems, uncultivated habitats, pests and their natural enemies.
  - Modelling of the relationship between the spatial organisation of cropping systems, pests and their natural enemies.
  - Methods of design and evaluation of cropping systems
  - Identify and evaluate the cropping systems carried out in France.
  - Develop design methods and tools adapted to the new challenges in agriculture, involving all the major stakeholders concerned at the different levels (field, water catchment area, small region).
  - Develop ex ante multi-criteria assessment tools, that can be used by all the players concerned, for the assessment of innovative technical solutions and cropping systems.
  - Develop tools to evaluate the available varieties using a diversity of traits, with the aim of helping choose the right variety adapted to the crop context and to the crop management.
  - Develop methods and design tools for ideotypes that can be adapted to cropping systems and climate conditions of the future.
  - Evaluation on a global scale, of the performance and impact (on the environment and agricultural production) of current and future world cropping systems.
  - Use of models and statistics to analyse the variability of output and the risks of losses due to extreme climate events.
  - Use of meta-analysis to synthesise knowledge on cropping systems at a global level.

**KEY POINTS**

- **Participation in several international programmes: Pratique, Pure, AgMIP, Price, Solibam, Logistec, Endure Network.**

**CONTACT DETAILS:**

- **Avenue Lucien Bretignières**
- F-78850 Thiverval-Grignon
- +33 (0)1 30 81 54 20
- agronomie@grignon.inra.fr
- www6.versailles-grignon.inra.fr/agronomie
- Number of permanent staff: 30

**BIOGER-CPP**

Biologie et gestion des risques en agriculture - Champignons pathogènes des plantes

**SCIENTIFIC OVERVIEW**

- **The BIOGER-CPP unit develops research projects aimed at better understand pathogenic plant fungi which are one of the major constraints on agricultural production (cereal crops, oil seed crops and vines).** The research concentrates on both the biology of the fungi and their infectious mechanisms, and their evolving dynamics, epidemics and impact on production and the quality of harvests. The pluridisciplinary approach of BIOGER-CPP enables the unit to develop reciprocal research from the field to the gene. The study carried out at BIOGER-CPP also designs and manages methods to combat disease, taking into account the knowledge we have on plant/pathogen interactions, the epidemiological dynamics and the evolution of fungis populations.

**FIELDS OF RESEARCH**

- **The unit is made up of six groups:**
  - **Epidemiological group**
    - Characterise the development of plant disease and the factors that influence the dynamics of disease.
    - Design and assess ways of managing resistant varieties that are both efficient and sustainable.
    - Study the trigger point and the importance of the components of the biological cycle of pathogens in an epidemic.
  - **Fungicides, Modes of Action and Resistance group (AMAR)**
    - Study the adaptation of the pathogen to its plant host and understand the role of specific fungi structures that penetrate fungi and their host.
    - Characterise the mechanisms at work in the interaction between fungi and their host.
    - Identify the genetic base of the power of the pathogen and characterise its variation at the level of populations.
    - Understand the adaptation of the pathogen to its plant host and its environment.
  - **Effector and Pathogens in Leptosphaeria maculans group (EPLM)**
    - Understand the mechanisms involved in the adaptation of Leptosphaeria maculans to raspessed through an integrated approach (gene to field).
    - Characterise the determining molecules from the interaction between raspessed and fungi (effectors, virulence proteins).
    - Propose efficient and sustainable strategies founded on the knowledge of biology, populations and genetics of the pathogen.

**KEY POINTS**

- **Close partnership with the ARVALIS plant pathology laboratory and CETIOM on the etiology, diagnosis and analysis of phytopathogenic fungi populations and the means of combating these diseases.**
- **Implication in the RASC (Biodiversity, Agroecosystems, Society, Climate) LabEx (Laboratory of Excellence) and coordination of the biotics network of RASC and Plant Science at Saclay LabEx.**
- **Active participation in the Science and Engineering Pole of Life Sciences for Agriculture, Food and the Environment.**
- **Joint coordination of the technical mixed unit Integrated Protection of Wheat and Rapeseed in Terms of Pathogens and Insects, Sustainable Management and Varietal Resistance.**

**CONTACT DETAILS:**

- **UMR (Joint Research Unit) 1290 AgroParisTech*, INRA**
- Research Unit Director: Marc-Henri LEBRUN
- Number of permanent staff: 30
- under the supervision of from January 2015
- Campus AgroParisTech
- Avenue Lucien Bretignières
- F-78850 Thiverval-Grignon
- +33 (0)1 30 81 54 52 – girophbio@versailles.inra.fr
- www6.versailles-grignon.inra.fr/bioger
CIRED was founded in 1971 by Dr. Ignacy Sachs in reaction to the Club of Rome thesis on the limits to growth. CIRED’s mission was and still is to explore strategies that articulate environment and development goals - “sustainable development” as we call it today. CIRED analyses these strategies at the global level, at the level of regions/countries, and in key sectors: energy, cities, and land-use. CIRED research also explores how sustainable development policies are debated in the presence of scientific controversies, and revisits the role of economic analysis in this context. CIRED research relies on a constant dialogue between social sciences, earth sciences, natural sciences and engineering sciences. From 2008 to 2013, CIRED has 203 publications in international peer-reviewed journals. CIRED is one of the leading contributors to the work of the Intergovernmental Panel on Climate Change (IPCC) with four authors and 105 leading contributors to the work of the Intergovernmental Panel on Climate Change (IPCC). CIRED is one of the leading contributors to the work of the Intergovernmental Panel on Climate Change (IPCC) with four authors and 105 leading contributors to the work of the Intergovernmental Panel on Climate Change (IPCC). CIRED is one of the leading contributors to the work of the Intergovernmental Panel on Climate Change (IPCC) with four authors and 105 leading contributors to the work of the Intergovernmental Panel on Climate Change (IPCC). CIRED is one of the leading contributors to the work of the Intergovernmental Panel on Climate Change (IPCC) with four authors and 105 leading contributors to the work of the Intergovernmental Panel on Climate Change (IPCC). CIRED is one of the leading contributors to the work of the Intergovernmental Panel on Climate Change (IPCC) with four authors and 105 leading contributors to the work of the Intergovernmental Panel on Climate Change (IPCC).

KEY POINTS

• Important international expertise activity for IPCC, OECD and other major international organisations.
• Key role in the Agrimonde Prospective, which highlighted the importance of diet and the evolution of methods of production for the future pathways of the agricultural sector as a whole.
• Development of state of the art tools, including the Incaim-R model, internationally recognised Integrated Assessment Model.
• Member of the Energy Modelling Forum (Stanford University) and of the Low Carbon Society Research Network.
• Coordination of the Emerging Energies Emerging Landscapes international network.
• Joint supervision of the Modelling for Sustainable Development chair supported by Ademe, EDF, Renault, Schneider Electric and Total.
• Coordination of the RUDS network and participation to the Climate, Health, Society research network.

FIELDS OF RESEARCH

CIRED explores the articulation between environment and development around four major research axes:

Sectoral analysis
• Grouped around three poles: energy, cities and land-use.

Development strategies, taking into consideration environmental and social constraints
• Bring together work on development strategies (across sectors), taking into consideration environmental and social constraints at global, national and regional levels; and research on cross-cutting themes: equity, competitiveness, financing low-carbon economy and macroeconomics under environmental constraints.

Uncertainties, controversies, negotiations and decisions
• Explore how economics and social sciences can inform the public deliberation process in a context of uncertainty and controversy.

Models, tools and databases
• Bring together the tools necessary to carry out the above mentioned research activities.

ECOFOG

ÉCOFOG

ECOFOG is a research unit of AgroParisTech. The unit is concerned with tropical ecology in the widest sense. The project of the unit is to integrate different approaches in ecology and material science to:

• Understand the relationships between biodiversity and the functioning of evolving tropical forest ecosystems, whether cultivated or not, as a result of climate and anthropic changes.
• Encourage innovation in the valorisation of forest resources within the context of this important biodiversity, but taking into account the constraints of usage linked to the humid, tropical environment.
• The research work of the unit brings together primarily the following academic disciplines: community ecology, genetic ecology, functional ecology, microbiology, botany.

KEY POINTS

• Creation of the CBEA (Centre for the Study of Amazonian Biodiversity) LabEx (Laboratory of Excellence) which prioritises cutting edge research on the biodiversity of Guianas and studies the different aspects: biodiversity, ecology, genetics, modelling, biodiversity and health, human sciences, etc.
• Creation of a business start-up Solizac which enables the transfer of methods of diagnosis and analysis of the microbiological functioning of soils developed by the unit.
• Implication in numerous networks of research and teaching, in particular in Brazil (Rainfor, ATIN, TmFO).

FIELDS OF RESEARCH

The unit is organised into three groups:

Population Ecology group
• Understand the mechanisms that determine the ability of a species to establish itself within a given space (ecology) as well as historically evolutionary, adaptive and demographically at the origin of current interconnections between species and their environment.
• Describe the mechanisms that lead to the current distribution of different species, the populations within the species and the individuals within the populations.
• Six thematic areas: ecophysiological and biomechanical interactions with the environment, the evolution and genetics of populations adaptation, demography and spatial dynamics, speciation, biotic relationships between populations, modelling.

The Ecology of Communities and Ecosystems group
• Observe the communities of plant species and the ecosystems of tropical, humid forests.

Observe and carry out experiments on multiple species and their local environments to better understand the factors that contribute to the structure of communities and ecosystems in order to predict, through modelling, their responses to global changes.

Study the interaction between the three levels of integration in the ecological organisation of forests: the trees, the continuum of soil-litter as well as the microbial communities that occupy them; the exchanges, especially of water cycles, carbon, nitrogen between the previous strata and the atmosphere.

Materials and Molecules group
• Describe and understand defense and communication strategies, the occupation of space by trees (facing constraints such as gravity, wind or rain) or the circulation of fluids between the different plant compartments.
• Develop different interdisciplinary approaches including biology.
**ÉCONOMIE PUBLIQUE**

**Public Economics**

UMR (Joint Research Unit) 210 AgroParisTech, INRA

**Number of permanent staff: 28**

**Important issues within society regarding agriculture and research conclusions, the unit hopes to highlight the policies but also by the public at large. As a result of its can be used not only by public decision makers on economic**

**Analytical methods, simulations and tools for reflection that political policies in the agricultural and the food industry and international trade. The aim of the unit is to develop**

**and international trade, paying particular attention to agricultural**

**products.**

**Research fields: the Common Agricultural Policy (CAP), the effects of environmental policies and the international context, the modelling of the European agricultural sector, major crops in France and genetically modified organisms (GMOs).**

**The environment, energy and public policy**

**Assess the impact of public policies on agricultural activities and the environment.**

---

**SCIENTIFIC OVERVIEW**

The work carried out at the Économie publique research unit is concerned with public and environmental policies in agriculture and the food industry and international trade. The aim of the unit is to develop analytical methods, simulations, and tools for reflection that can be used not only by public decision makers on economic policies but also by the public at large. As a result of its research conclusions, the unit hopes to highlight the important issues within society regarding agriculture and the environment.

**KEY POINTS**

- Participation in BASC (Biodiversity, Agroecosystems, Society, Climate) LabEx (Laboratory of Excellence).
- Development of international cooperation, in particular through the coordination of major European research and development programmes (AgFoodTrade, Genedic, TradeAg).
- Important role as expert for national and European decision makers (European Parliament, European Commission, ministerial departments).

**FIELDS OF RESEARCH**

**The research work of the unit is organised around three major themes:**

**Agricultural policy and the evolution of agriculture**
- Analyse the relationship between the evolution of agriculture and its economic, political, regulatory, social, and technical environment.
- Evaluate the consequences of agricultural political reforms.
- Have a better understanding of the current situation of farms especially related to the disparities in income generation.
- Analyse the evolution of agricultural trends by taking into account the changes in demand and the socio-economic and technical context.

**Research fields:** the Common Agricultural Policy (CAP), the effects of environmental policies and the international context, the modelling of the European agricultural sector, major crops in France and genetically modified organisms (GMOs).

**The environment, energy and public policy**
- Assess the impact of public policies on agricultural activities and the environment.
- Carry out an economic analysis of agricultural and food products. Research fields: the greenhouse effect, agricultural practices that are respectful of the environment, the exploitation of agricultural products into non-food products, biofuels, land-use, biodiversity, contractual and regulatory tools.
- Analyse the determining factors and the consequences of international trade, paying particular attention to agricultural and food production.
- Have a better understanding of the determining factors, especially the role of commercial and political policies.
- Study the consequences of international trade and the liberalisation of economies and the interactions with the environment. Research fields: preferential commercial agreements, negotiations at the World Trade Organization (WTO), issues around sanitary and phytosanitary measures, access to markets, articulation with the CAP.

---

**ÉCOSYS**

**Écologie fonctionnelle et écosystèmes des agricolesystèmes**

**Functional Ecology and Agroecosystemic Systems**

UMR (Joint Research Unit) AgroParisTech, INRA

**Research Unit Director: Enrique BARRIUSO**

**Number of permanent staff: 28**

**The ÉCOSYS Joint Research Unit is the result of the merger between the Économie publique and the Physicochimie et écotoxicologie des sols agro-systèmes contaminés (Physical Chemistry and Ecotoxicology of the Soil of Contaminated Agro-systems) unit, which were active up to 2014. The work of the new ÉCOSYS unit aims to treat in an integrated way the functioning of agroecosystems and their relationship with the environment. Agroecosystems are created as a result of external constraints and drivers and internal ones. These drivers can directly impact on agroecosystems, but more often, the impacts are caused by the farmers’ practices (nitrogenous fertilizers, pesticides, organic amendments, waste products, soil tillage…) which allow the farmer to alleviate or bypass constraints in order to maintain production objectives. To understand this functioning, the ÉCOSYS unit works with concepts of functional ecology and ecotoxicology, taking into account the flux of matter and energy and the functions of isolated organisms and the interaction with their environment.**

**KEY POINTS**

- Important analytical and experimental technical platforms: the Biochem-Env platform for environmental biochemistry, the platform for chemical environmental analysis, radiotopes, greenhouses and air conditioned chambers.
- Medium-term field observatories (recycling and storage of organic matter, greenhouse gases emissions) and patrimonial long term filed experiments for the study of soil properties.
- Modelling infrastructure, numerical calculations and management of a databases including scientific and technical expertise within the domains of biogeochemical processes, transfers, plant development and integrated assessment.

**FIELDS OF RESEARCH**

**The unit is organised around four disciplinary groups:**

**Plant Ecophysiology group**
- Take into account the wide ranges of environmental and genotype variables, piloting the functioning of crops (available nitrogen in the soil, climatic variables, pests, pollutants).
- Focus on the phenomena of resilience of the agroecosystems in order to determine the eco-physiological process and the associated functional traits.
- Go beyond production into biomass or grain by taking into account other services provided by the agroecosystem.

**Soil Science group**
- Study the role of soil in the global functioning of agroecosystems subject to drivers linked to global changes.
- Analyse the soil functions in relation to the associated ecosystems services.

**Bioclimatology group**
- Understand the pollutants and particles exchanges between the biosphere and atmosphere.
- Study the fate of nitrogen (and pesticides) to supra-plot scales.
- Evaluate the environmental impact of crops using an integrated approach.

**Ecotoxicology group**
- Study the dynamics of the interactions between micropollutants and organisms in the soil.
- Analyse the contribution of ecotoxicology in the multicriteria evaluation of soils within the agroecosystems and the services outputs.
- Describe the long term effects of low doses of mixtures of contaminants in the soil.
- Make progress towards the elaboration and validation of soil ecotoxicity indicators.
Research Unit Director: Jane LECOMTE
Université Paris-Sud
UMR (Joint Research Unit) 8079 AgroParisTech, CNRS,
between observations in situ, experimentation and anthropic or natural. These activities rely on the synergy of species that comprise them to environmental changes, both society. These include the responses of ecosystems and the functioning of ecosystems and their interactions with society. These include the responses of ecosystems and the species that comprise them to environmental changes, both anthropic or natural. These activities rely on the synergy between observations in situ, experimentation and mathematical modelling as tools for understanding, synthesis and prediction.

**FIELDS OF RESEARCH**

- **Microbial Diversity, Ecology and Evolution group (DEEM)**
  - Biodiversity and the ecology of microbial communities, both prokaryotes and eukaryotes.
  - Metagenomics, genomics, transcriptomics and the genomics of individual cells.
  - Phylogenomics and early evolution.
  - Ecology and evolution of microorganisms/bird interactions.

- **Ecology of Populations and Communities group (EPC)**
  - The impact of the interaction between climate change and the presence of invasive species.
  - Ecotoxicology.
  - The impact of urbanisation.

- **Plant Ecophysiology group (EV)**
  - The functional approach and the modelling of flows of carbon and nitrogen in forest ecosystems.
  - The functional understanding and modelling of isotopic components 13C.
  - The adaptation of alpine plants to extreme conditions.

- **Ecological and Societal Trajectories group (TESS)**
  - Translocation of species and the adaptation to climate change.
  - The ecological engineering of urban and peri-urban areas, participative simulation.
  - The biodiversity of cultivated habitats and the transition towards agroecology.
  - The scientific knowledge and ecological local knowledge in the management of socio-ecosystems.

- **Evolution of Angiosperms group (EVA)**
  - The evolution of species complex and the organisation of genomes.
  - The evolution of the flower and of pollen.
  - The diversification of angiosperms.

- **Genetics and Evolving Ecology group (GEE)**
  - Genomics and ecology of interactions.
  - Functional genomics and evolving plants and fungi.

- **Early detection of stress using approaches based on the understanding of fluorescent signals.**

**KEY POINTS**

- Diversity of ecological themes studied.
- Active participation in several research consortiums: ClimateGIS (Paris Research Consortium Climate-Environment-Society), IDEFY (Institute for the Diversity, Ecology and Evolution of the Living World, IFREMER (École de France regional federation of research on the environment).
- Contribution to the BASC (Biodiversity, Agroecosystems, Society, Climate) LabEx (Laboratory of Excellence).
- Development of experimental platforms that enable cutting edge research.

**SCIENTIFIC OVERVIEW**

The scientific activity of the ESE unit covers a wide range of fundamental and applied research in ecology and evolution, including evolution and phylogeny of plants and microorganisms, genetics and dynamics of populations, ecology of communities, conservation ecology, ecotoxicology, functional ecology and plant ecophysiology. One of the main research objectives of the ESE unit is to study the evolution and the dynamics of biodiversity, the evolution and functioning of ecosystems and their interactions with society. These include the responses of ecosystems and the species that comprise them to environmental changes, both anthropic or natural. These activities rely on the synergy between observations in situ, experimentation and mathematical modelling as tools for understanding, synthesis and prediction.

**CONTACT DETAILS:**

Université Paris-Sud Bât 362
Rue du doyen André Guinier
F-91405 Orsay Cedex
+33 (0)1 69 15 64 92 – direction.ese@u-psud.fr

---

**Bio EAU**

Gestion de l'eau, acteurs, usages Water Resource Management, Actors and Uses

**SCIENTIFIC OVERVIEW**

The G-EAU unit is concerned with the adaptive management of water, aquatic environments and their uses. The research work of the unit uses an interdisciplinary approach and aims to explore the different components within the dynamics of socio-hydrosystems and their interactions. The final outcome is to comprehend possible evolutions taking into account exogenic factors (climate change, social issues, demographics...) or technical or institutional innovations (technology, infrastructure, regulations, adaptation policies...). The unit also aims to better understand these different dynamics and to develop innovative solutions that influence public policy.

**FIELDS OF RESEARCH**

- From operational management to the analysis of different scenarios of resources allocation
  - Identify more efficiently current water resources and past hydroligic and foreseeable future developments as a result of global changes (climate and the physical environment, socio-economic transformations) and the interaction of existing and scheduled infrastructures.
  - Explore different ways of improving real time management of storage infrastructures and water transfer.

- Public policy, service management and risks related to water
  - Analyse public policies, regulations and multilevel governance.
  - Understand the interaction between the rules (formal and informal, rights, values and customs...), management tools in a wider sense (instruments, systems but also indicators, monitoring units, good practice guides), and the stakeholders or actors implicated in upstream and downstream decisions.

- Irrigated agriculture
  - Study the way in which irrigation plans are designed to be best adapted to present and future contexts of production.
  - Evaluate in an integrated manner multiairrafer perveance performance (techniques, economics, social and environmental issues) and multilevel performance (land plot, farm, perimeters, drainage basins).
  - Analyse the emergence, the implementation and diffusion of technical, organisational and institutional innovations.

**KEY POINTS**

- Co-ordination of the SICMED programme and the international multidisciplinary MISTRALS meta-programme.
- Chosen to coordinate the CHEX-TERRA programme by the ANR Chair of scientific excellence.
- Joint supervision for two of the five specialisations for the Water master programme.
- Creation of a platform for scientific and technical exchanges on irrigation in the south (COSTEA) with AFEID (French Association for the Study of Irrigation and Drainage) and AFD (The French Development Agency).
- Participation in the Water for All chair, co-financed by SUER Environment and the AFD.
- Business incubator to three start-up companies: LISODE, DIATAR, ROUZ.

**CONTACT DETAILS:**

Irta
36, rue Jean-François Breton BP 5095
F-34196 Montpellier Cedex 5
+33 (0)4 67 04 63 00 – contact@g-eau.net
www.g-eau.net

---

**SCIENTIFIC OVERVIEW KEY POINTS**

Diversity of ecological themes studied.
Active participation in several research consortiums: ClimateGIS (Paris Research Consortium Climate-Environment-Society), IDEFY (Institute for the Diversity, Ecology and Evolution of the Living World, IFREMER (École de France regional federation of research on the environment).
Contribution to the BASC (Biodiversity, Agroecosystems, Society, Climate) LabEx (Laboratory of Excellence).
Development of experimental platforms that enable cutting edge research.

**CONTACT DETAILS:**

UMR (Joint Research Unit) AgroParisTech, CIRAD, CIRHEAM-IAM Montpellier,
IRD, IRSTEA, SupAgro Montpellier
Research Unit Director: Olivier BARRETEAU
Number of permanent staff: 78

---

**SCIENTIFIC OVERVIEW**

The research work of the G-EAU unit is organised around three main areas of research:

- From operational management to the analysis of different scenarios of resources allocation
  - Identify more efficiently current water resources and past hydrologic and foreseeable future developments as a result of global changes (climate and the physical environment, socio-economic transformations) and the interaction of existing and scheduled infrastructures.
  - Explore different ways of improving real time management of storage infrastructures and water transfer.

- Public policy, service management and risks related to water
  - Analyse public policies, regulations and multilevel governance.
  - Understand the interaction between the rules (formal and informal, rights, values and customs...), management tools in a wider sense (instruments, systems but also indicators, monitoring units, good practice guides), and the stakeholders or actors implicated in upstream and downstream decisions.

- Irrigated agriculture
  - Study the way in which irrigation plans are designed to be best adapted to present and future contexts of production.
  - Evaluate in an integrated manner multiairrafer perveance performance (techniques, economics, social and environmental issues) and multilevel performance (land plot, farm, perimeters, drainage basins).
  - Analyse the emergence, the implementation and diffusion of technical, organisational and institutional innovations.

**KEY POINTS**

- Co-ordination of the SICMED programme and the international multidisciplinary MISTRALS meta-programme.
- Chosen to coordinate the CHEX-TERRA programme by the ANR Chair of scientific excellence.
- Joint supervision for two of the five specialisations for the Water master programme.
- Creation of a platform for scientific and technical exchanges on irrigation in the south (COSTEA) with AFEID (French Association for the Study of Irrigation and Drainage) and AFD (The French Development Agency).
- Participation in the Water for All chair, co-financed by SUER Environment and the AFD.
- Business incubator to three start-up companies: LISODE, DIATAR, ROUZ.

**CONTACT DETAILS:**

Irta
36, rue Jean-François Breton BP 5095
F-34196 Montpellier Cedex 5
+33 (0)4 67 04 63 00 – contact@g-eau.net
www.g-eau.net
**GABI**
Genétique animale et biologie intégrative
Animal Genetics and Integrative Biology

**SCIENTIFIC OVERVIEW**
The scientific orientations of GABI aim at better understanding the basis of genetic variability and biological functions and at developing methods and tools for the genetic improvement and conservation of animal populations. Research activities rely on interdisciplinary competencies in genetics, genomics, biostatistics and biology and range from gaining new knowledge to applying innovative methodology and transferring knowledge in the field. The unit hosts researchers from its two supervising institutions, INRA and AgroParisTech, as well as from the Commissariat à l’énergie atomique (CEA – French Alternative Energies and Atomic Energy Commission), École nationale vétérinaire d’Alfort (ENVA – Alfort Veterinary School) and several technical organisations, in particular the Institut de l’élevage (French Livestock Institute), UNCEIA (a professional institute for breeding) and the Institut français du cheval et de l’équitation (French Horse and Riding Institute).

**KEY POINTS**
- Platforms open to external users, which are part of the ARPEJ network at the Jouy-en-Josas centre: genomics and microgenomics (BioRIDGE, Animal Biological Resources for Integrative and Digital Genomics, national INRA certification), histology, transmission electron microscopy of the MIMAZ platform (regional INRA certification).
- Links with animal experimental facilities: cattle, trout, bass, pigs, chickens, quail, mink, zebras.
- Joint supervision of the technological unit 3G (Genetic and Genomic Management of Bovine Populations).
- Coordination of the project Investment for the Future CREB-Anima (Network of Biological Resource Centres for Animals).
- Impact on animal selection programmes: a key role for the genetic evaluation of breeding animals.
- International collaborations: European PhD programme (EDS-ARG), sequencing consortia (pigs, cattle, trout, rabbits, guinea-fowl, horses), bilateral research programmes on cattle selection with emerging countries, international research programmes on the genetic bases of the adaptation of animals to Mediterranean or tropical climates and characterisation of the genetic diversity of farm animals in Mediterranean and Sub-Saharan Africa countries.

**FIELDS OF RESEARCH**
The unit includes eight research groups and a platform team. Research themes are structured on three major scientific areas:

- **Genetic variability and traits variation**
  - Recording phenotypes (production, health, adaptation...), genetic architecture of traits, identification of causal mutations, functional analysis of identified polymorphisms.
- **Gene, genome and population dynamics**
  - Organisation and regulation of the expression of genomes and epigenomes, metagenomics, biostatistics applied to systems biology (Bayesian methods, mixture models, inference of networks, integration of heterogeneous data), characterisation and management of animal biodiversity, genetics and genomics of animal populations and spatial analysis of landscape genetic data.
- **Performances prediction**
  - Prediction of genetic values for traits transmitted from generation to generation (genetic improvement, genomic selection), prediction of phenotypes during the individual's life course (identification of biomarkers of physiological states and responses to various disturbances).

---

**GÉNÉTIQUE VÉGÉTALE**
Plant Genetics

**SCIENTIFIC OVERVIEW**
The Génétique végétale Joint Research Unit leads research on genetics/genomics and evolution of complex traits (multifactorial genetics). The projects give priority to integrative biology, from gene and metabolic networks to populations or variaties studied in the field under various agronomic conditions. The joint objectives of the unit are:
- (i) generating knowledge in fundamental multifactorial genetics, in the areas of modelling of quantitative variation, evolution of quantitative traits, search for gene of quantitative trait and dynamics of genetic resources; (ii) optimising selection methods by combining genomics approaches and exploitation of genetic resources. The targeted traits are involved in growth, development and adaptation.

**KEY POINTS**
- Facilities: large proteomics platform (Pappso) and high quality experimental fields.
- Member of BASC (Biodiversity, Agroecosystems, Society, Climate) LabEx (Laboratory of Excellence).
- Founding member of the IDEEV (Institute for Diversity, Ecology and Evolution of Living World).
- Network of partnerships with numerous companies and organisations from the seed and agricultural sectors, both national (Biogeema, Promais, Réseau Semenciers Paysannes, ARVALIS, etc.) and international (Bayer BioScience, Syngenta Seeds, Generation Challenge Programme, etc.).
- Development of genetics, genomics and proteomics software’s: MétaQTL, BioMercator, Thaliadb, CODA, OptiMAS, etc.
- Coordination or participation in Investments for the Future projects: AMAIZING, RESET, BREEDWHEAT, SUNRISE, IMSV.
- Lead of the French national network Protéome vert which brings together platforms and users of proteomics in plant biology.

**FIELDS OF RESEARCH**
The unit is organised into four research groups:

- **Fundamental Quantitative Genetics group (GQMS)**
  - Study of the genetic bases of complex traits and of the mechanisms of response to selection; optimisation of genetic resource management and of the process of selection.
- **Diversity, Evolution and Adaptation of Populations group (DEAP)**
  - Management of agrobiodiversity, genetic bases of local adaptation, participatory plant breeding.
**GENIAL**

**Ingenierie, procédés, aliments**

Food, Process, Engineering

**CONTACT DETAILS:**
1 avenue des Olympiades
F-91305 Massy
+33 01 69 93 51 27
elen.gautier@agroparistech.fr
www.umr-genial.eu

---

**SCIENTIFIC OVERVIEW**

The food industry is faced with major issues around competitiveness. The current major challenges are to guarantee food security (feed population and food sanitary quality), ensuring that food is chemically and biologically healthy) and nutritional (safeguarding the fair access to nutrients). The GENIAL unit studies the complete life cycle, from raw materials to their uses and consumption. The unit concentrates on the products, including the rational concept of the balance between all the different properties (sensory, sanitary, nutritional and technological) and also the procedures (under control, innovative and ecologically conceived).

**KEY POINTS**

- Interdisciplinary structuring projects ANR (Bisens, Satin…) Carnot Project Quotidien Modena, FUN Satirone, INRA-Did’it Pleasin, Industrial Agrobiotechnologies (ABI) chair.
- Approach of rational design of products and processes: observation and description of different phenomena at different scales.
- Tools for knowledge transfer to companies: Île-de-France Platform for Grain Crop Studies (FRECE), and Nicolas Appert Technology Centre, a technological platform G (300 m²) that houses 45 operational units.
- Design of original methods of analysis and optimisation.
- Implementation of eco-design approaches to processes: ABC INRA-CEPIA Ecotrans, Ademe-Total VES+—ANR Cooperé…

**FIELDS OF RESEARCH**

The GENIAL unit is divided into five groups which work transversely:

- *Structuration of Products through Processing group (SP2)*
  - Understand, monitor and predict how different food characteristics are organised at different levels during their elaboration and storage; also integrating product and process interactions.
  - Generate and model the structuring of an ongoing unitary operation.
  - Understand the interactions and reactions that generate food products for a specific functionality.

- *Developing Food Quality through Chemistry and Processing group (CALIPRO)*
  - Measure and understand the dynamics of chemical reactions in model environments within food products undergoing transformation, develop models coupling chemical kinetics and transfers and carry out processes to predict how the components react in order to master food properties.
  - Evaluate and optimise energy consumption and the ecological footprint of processes whilst ensuring the quality of food products.

- *Man, Food and Processes group (HAP)*
  - Develop multifactor and multi-criteria modelling tools and innovative methods that take into account the diversity and variables of consumers.
  - Propose other means of communication designed for consumers.

- *Analytical Engineering from the Quality of Foodstuffs group (I2A)*
  - Characterise the quality of non-targeted (rapid) global approaches and targeted molecular approaches.
  - Developing chemometric tools to extract and treat pertinent information from complex data.

- *Interactions of Materials with Contact group (I2MC)*
  - Understand and predict the properties of the transport of small organic molecules within dense polymer materials.
  - Design materials with optimised properties for a given application (the logic of reverse engineering).
  - Create decision making tools for the design and conducting of membrane processes.

- *Transversality and Modelling (TRANSMOD)*
  - Develop tools for mechanistic modelling and digital simulation of the interactions produced by a multilevel and multi-phenomena approach.

---

**GMPA**

**Génie et microbiologie des procédés alimentaires**

Microbiology and Food Process Engineering

**CONTACT DETAILS:**
Centre AgroParisTech de Grignon — Bâtiment CRAI
Avenue Lucien Bretignères
F-78850 Thiverval-Grignon
+33 01 30 81 54 97 — Francois.boue@grignon.inra.fr
www6.versailles-grignon.inra.fr/gmpa_eng

---

**SCIENTIFIC OVERVIEW**

The GMPA Joint Research Unit’s mission is that of research and teaching in the field of engineering of the transformation of agricultural, food and biological products. The research concentrates on the management of the physical and biological processes that control the transformations, from the biosources to the human being (digestion), with the aim of producing knowledge and tools that contribute to the elaboration of quality products (sensory, nutritional, safe and environmental). Its activities cover the acquisition of knowledge of cheese microbial ecosystems, processes of food fermentation and the improvement of fractioning and stabilising. The research extends to the automation of bioprocesses, including the development of prototypes, tools for measuring through modelling and the integration of different types of knowledge. The systemic mechanisms of the breakdown of food in the mouth and in the digestive system are an integral part of the operations of transformations studied. The method used relies on the use of both experimentation and modelling with the aim of integrating knowledge from the basic operations to the combination of all the processes involved.

**KEY POINTS**

- Genuine pluridisciplinary group approach that brings together molecular biology, microbiology and microorganisms and process engineering, physics and physico-chemistry, the understanding of mechanisms and structure, sensory analysis, mathematics and cognitive sciences.
- High performance technical platform for the development of prototypes and measuring tools adapted to industrial demand.
- A high performance analysis platform (gas-liquid chromatography and mass spectrometry).
- Participation in numerous national and European programmes and projects and the joint coordination of the Modultest programme.
- Orientation towards external technical platforms, including the use of large scientific instruments and apparatus.

**FIELDS OF RESEARCH**

The unit is divided into four research groups:

- *Bioproducts, Food, Microorganisms and Processes group (BIOMIP)*
  - Analyse the orientation of metabolism and microorganisms, the elimination of inhibitory metabolites and the stabilisation of functionalities.
  - Use pertinent markers of physiological conditions, in situ and in dynamical studies (spectroscopy, imagery) during the process of stabilising in fermentation, for example.
  - Make the links between the production processes of bio-sourced molecules by biocatalysis and their extraction (collaboration with the Industrial Agrobiotechnologies chair).
  - Develop adaptable methods to control and optimise the system, taking into account the environmental impact.

- *Cheese Microbial Ecosystems group (ECOMIC)*
  - Acquire new knowledge on microbial dynamics and diversity.
  - Study the expression of the functions of technological interest in bacteria and ripening yeast.

---

**Bioproducts, Food, Microorganisms and Processes group (BIOMIP)**

- Understand the adaptation of microorganisms in the ripening process to their environment.
- Food, Digestion and Perception group (ADP)
  - Understand the mechanisms of breakdown of food in the mouth and in the upper part of the digestive tube linked to their properties (composition, rheology, mechanical properties, structure).
  - Develop modelling processes of the release kinetics of target compounds (sensory stimuli and nutrients).
- Modelling, Analysis and Knowledge Integration for Food and Biological Complex Systems group (MALICES)
  - Study the construction of the silicone models to represent the dynamics of complex food and biological systems.
  - Control the global behaviour of a process by reducing its intrinsic uncertainty.
The IJPB unit brings together a unique set of resources and competencies in biology, chemistry and mathematics dedicated to the study of plants. It covers a wide sphere of activities, which range from fundamental research work on the development and physiology of plants to targeted research on both the food and nonfood use of plant products in the context of sustainable development. The research groups of the unit are particularly concerned with the evolution and functioning of genomes, how plants respond to the stress they are subjected to from their environment, the diverse aspects of functioning of genomes undergoing meiosis (recombination), the micro- and macro-levels of biological containment; three techniques platforms.

**KEY POINTS**

- Facilities that enable cutting edge research: 5,000 m² of facilities for experiments, devoted to crops and the phenotypical evaluation of plants under controlled conditions (greenhouses and growing rooms at different levels of biological containment); three techniques platforms.
- Profoundly multidisciplinary approach to biological and agronomic problems.

**FIELDS OF RESEARCH**

The IJPB unit brings together five scientific poles of research:

1. **The dynamics and expression of plant genomes**
   - Understand the essential mechanisms in the structure and functioning of genomes underlying meiosis (recombination), genomic shocks (polyploidisation), as a result of biotic or abiotic stresses (epigenetic controls, transposons), as well as the epigenetic regulations of the epigenic expression of small RNAs.
   - Develop approaches to genetics, cytology, molecular biology and the biochemistry of proteins of cruciferous plants (*Arabidopsis thaliana* and *rapeseed*), solanaceae (*tobacco* and *tomato*), and basic angiosperms like *Physcomitrella patens*.

2. **Adaptation of plants to the environment**
   - Study plant responses to their constraints from a physiological, metabolic and developmental point of view, using primarily genetic, genomic and molecular approaches.
   - Analyse the abiotic constraints of the environment, such as those linked to the limited availability of nitrogen, water, cold and osmotic stress.

3. **Plant cell wall, function and utilization**
   - Study the cell wall, its makeup, structure and construction on biological models, but also on species of agronomic and/or industrial interest.
   - Improve the adequacy between plant resources and their uses (bioenergy, plant fibres, green chemistry).

4. **Reproduction and seeds**
   - Study the sexual life cycle of plants (gametes, reproduction, formation and seed quality, germination, lipidic and proteic reserves).
   - Identify the genes implicated in the mechanisms studied.
   - Elucidate on the biological and functional structure of proteins or metabolites produced.
   - Explore the networks of interactions involved.

5. **Morphogenesis, signalling, modelling**
   - Study the plant cell, its mechanism for division, for growth and for differentiation.
   - Analyse and model mechanisms which form the basis of the development of higher plants.
   - Propose innovative strategies in biotechnology for plant resources and their uses.

---

**LEESU**

**SCIENTIFIC OVERVIEW**

The research work at LEESU focuses on urban water from different angles: the physical and hydrological aspects through the study of the rainwater cycle, the biogeochemical aspects with the study of chemical contaminants, the microbiological aspects with the study of drainage basins and their impact on the receiving environment, and the socio-technical aspects, with the study of water policies and uses and their evolution in urban environments. LEESU develops applied and implicative research. Its research work is linked to societal issues, primarily with the today’s issues of the implementation of sustainable development policies and their impact on the water sector. These policies are mostly influenced by the adaptation to climate change. With this dual perspective in mind, LEESU anchors its activities within close and sustainable operational partnerships with local authorities in the Paris region and with large water companies.

**KEY POINTS**

- Original and pertinent position in French research on urban and peri-urban areas: development of scientific, metrological and methodological research at the highest level.
- Participation in the Urban Futures LabEx (Laboratory of Excellence), a major contributor in highlighting the achievements of French urban research at an international level.
- Strong implication in scientific networks at regional, national and international levels: OSU EfHve, PIRESOIRE URRES and GLACPE, Climate-KIC, European Academy of Wind Energy.
- Participation in the Hydrology for a Resilient City chair, supported by Veolia.

**FIELDS OF RESEARCH**

- **Hydrology, meteorology and complexity (HM&Co)**
  - Carry out a multi-level analysis of hydrometeorological processes through observation and modelling.
  - Develop operational tools for the optimisation of water management and overland flow in urban areas.

- **The sources and flows of contaminants in urban drainage basins**
  - Study of the sources and the impacts of certain emerging and/or priority contaminants, both chemical and microbiological.
  - Gain a better understanding of the role of the management structures of overland flow.

- **The functioning of receiving environments populated by humans**
  - Study the bioavailability of chemical contaminants, physico-chemical factors that explain the dynamics and distribution of waterborne pathogens and the influence of the hydrodynamics on chemical and biological functioning.
  - Explore the different contributing factors of the contamination of receiving environments.

**ACTORS AND DECISION MAKING PROCESSES IN URBAN WATER MANAGEMENT**

- Study the way in which scientific knowledge in the field of water leads to the modification of urban planning, the management of water in towns and the perceptions of water by citizens.
- Analyse how new public policies linked to water management lead to new scientific questions.
The work of LEF is organised around two axes of research and an observatory:

**The economics and multifunctionality of forestry**
- Understand how the wide variety of functions and uses of forest resources (production of goods and services, socio-cultural and ecological use) can be integrated into the sustainable development of forestry.
- Study the implications of both, market and natural risks on forest management as well as the options and the issues surrounding the adaptation to climate change.
- Analyse the offer, the demand and the instruments of valorisation of environmental services produced by forestry.
- Study the interactions between different forestry goods and services in order to inform management choices and public policies relating to forestry.

**Modelling of the forestry sector**
- Carry out a macroeconomic analysis of forestry in France.
- Provide an overall vision of the sector in order to simulate the impact of public policy.
- Analyse the short and medium term trends.

**The LEF economic observatory**
- Collect and centralise a large range of information, data and statistics, with the aim of facilitating research, teaching and expertise activities.
- Ensure that the data is kept relevant and sustainable for the future use of long term research.
- Participate in the ARBRE (Advanced Research on the Biology and Ecology of Forests) LabEx (Laboratory of Excellence).
- Active participation in several national, international and European programmes: ACCAF (Adaptation to Climate Change in Agriculture and Forestry), AFORECK (joint research network on the adaptation of forests to climate change), UIFRO (International Union of Forestry Research Organisation), EARE (European Association of Economists of the Environment), NEWFOREX (New Ways to Value and Market Forest Externalities Project).
- Recognised expertise in forestry economics with European political decision makers through the EFI (European Forest Institute).
- Development of the French Forest Sector Model (FFSM), the first model of analysis on the French forest sector.

**FIELDS OF RESEARCH**

**In the context of climate change and the increasing constraints on the multifunctionality of agriculture and forestry, the LERFOB unit develops research on the ecological dynamics of forest resources, bringing together different disciplines (the ecology of species and plant communities, modelling and simulation of the growth and the production of forest populations, the biomechanics of wood, plant architecture, statistical analysis).**

The research is mainly directed towards public decision making and the management of natural and cultivated resources and spaces, in relation to the training of forest professionals with a strong component of research and development.

**The work of the research unit is organised around three axes in which both research groups participate (Forest Ecology; Growth Production and Wood Quality) with the support of operational decision making tools used in silviculture (diagnostic, prediction and prospective tools and equipment).**

**Key Points**
- Participation in the ARBRE (Advanced Research on the Tree and Forest Ecosystem) LabEx (Laboratory of Excellence) that aims to explore and analyse the functioning of forest ecosystems in the context of global change.
- Development of data bases (Digitalis, EcoPlant, Habitat forestier), of systems of observation and experimentation.
- Recognised expertise in interdisciplinary engineering approaches and the joint construction of partnerships with the key players in forest resource management especially through two teams of training and expertise (Mission for the Management of Forest Vegetation; Silviculture and Reforestation).
- Partnership in the Forest of Tomorrow chair.

**SCIENTIFIC OVERVIEW**

**Participants**
- Sylviculture and Reforestation.
- Mission for the Management of Forest Vegetation; Silviculture and Reforestation.
- Partnership in the Forest of Tomorrow chair.

**FIELDS OF RESEARCH**

**The work of the research unit is organised around three axes in which both research groups participate (Forest Ecology; Growth Production and Wood Quality) with the support of operational decision making tools used in silviculture (diagnostic, prediction and prospective tools and equipment).**

**Key Points**
- Participation in the ARBRE (Advanced Research on the Tree and Forest Ecosystem) LabEx (Laboratory of Excellence) that aims to explore and analyse the functioning of forest ecosystems in the context of global change.
- Development of data bases (Digitalis, EcoPlant, Habitat forestier), of systems of observation and experimentation.
- Recognised expertise in interdisciplinary engineering approaches and the joint construction of partnerships with the key players in forest resource management especially through two teams of training and expertise (Mission for the Management of Forest Vegetation; Silviculture and Reforestation).
- Partnership in the Forest of Tomorrow chair.

**SCIENTIFIC OVERVIEW**

**Participants**
- Sylviculture and Reforestation.
- Mission for the Management of Forest Vegetation; Silviculture and Reforestation.
- Partnership in the Forest of Tomorrow chair.
Rural areas are currently undergoing important shifts, both global changes (climate change, globalisation of trade) and local mechanisms that arise from urban pressure and new expectations from the population. These changes concern not only agricultural activity but other economic activities that have important repercussions on local governance.

The unit’s ambition is to understand and support the transformations happening in rural areas by developing tools and methods of analysis which focus on the activities which produce goods and services and also on the users of spaces who compete for its use; in particular agriculture, forestry, but also tourism, residential development and the conservation of local habitats.

**FIELDS OF RESEARCH**

- **Systems of Animal Husbandry, Coordination and Territories group (SELECT)**
  - Produce analytical frameworks on the dynamics of husbandry, the different practices of use of spaces and agricultural work and how this interacts with the dynamics of spaces such as territorial development.
  - Develop operational methods and tools for advising stakeholders (professionals and local authorities) in the context of teaching missions and through partnerships.

- **Construction of Forms of Territorial Organisation group (CFORT)**
  - Understand and accompany different types of territorial organisation and rural and peri-urban territorial projects for sustainable development of territories.
  - Produce methods, concepts, tools and engineering facilities for territorial development to understand the transformation of different types of territorial organisation and to accompany and enable the stakeholders to act.

- **Evolution of Uses, Public Intervention and Development of Rural and Peri-urban Areas group (EIDER)**
  - Analyse the changes that affect rural and peri-urban areas.
  - Analyse and evaluate public intervention in rural and peri-urban areas.
  - Analyse the ability of local stakeholders to innovate in the context of rural and peri-urban spaces.

**KEY POINTS**

- Coordination of national projects (ANR Mouve, DIVA Alligator) and European ones: Trans, Catch C, HARMONY, RURAL, DOMAINE, e-Link.
- Reinforced collaboration with several European structures: Institut für Ländliche Strukturforschung (Institute for Rural Development Research-IFLS, Frankfort), Universidade de Évora (Portugal), Wageningen University (Netherlands), Scuola Superiore Santa Anna (Italy).
- Partnership of the Statistics and Genomes group with the universities of Évora (Portugal), Wageningen (Netherlands) and the University of Rome (Italy), and European ones: Trans, Catch C.

**SCIENTIFIC OVERVIEW**

The MIA unit brings together statisticians and computer scientists, specialised in statistical modelling and computing for biology. Their skills and competencies are related to methods of statistical inference (complex models, models with latent variables, Bayesian inference, data assimilation model selection, ...) and algorithms (generalisation, transfer of techniques from other domains...). The unit thus develops original generic statistical methods or approaches motivated by specific biological problems. Its activities rely on a good understanding of the culture of the disciplines that are the end-users of the research work: ecology, environment, molecular biology and systems biology.

The MIA unit participates in numerous research schools, workshops or PhD courses on statistics and modelling for life science and contributes to the distribution and reputation of research activities on the interface between statistics and biology.

**FIELDS OF RESEARCH**

- Modelling and Risk in Environmental Statistics group (MORSE)
  - Study environmental and climate risks, particularly in the fields of pollution and hydrology.
  - Contribute to the development of statistical methods which enable researchers to address areas of expertise and data that are more and more complex such as those in ecology.

- Research themes: hierarchical modelling (compound Poisson models, non reversible models, ad-hoc development of models).

**KEY POINTS**

- Participation in the Statistical Trajectories network.
- Partnership with the ANR (French National Research Agency) MoVeYa (MORSE group) that has enabled to cast light on the spatial and temporal evolutions of avalanche risks in the Alps over the past 50 years.
- Co-host of the StatOmique group which brings together around 40 statisticians or bioinformaticians at a national level from different research institutes implicated in the analysis of genomic data of different organisms.
- Supervision of the Statistics and Genomes group in the ANR (French Research Agency) NeMo focusing on the analysis of and inference of biological networks which was initially oriented towards molecular biology but has fostered developments in ecology.
- Participation of the Statistics and Genomes group in the Investment for the Future project Algorithmics, Bioinformatics and Statistics for Next Generation Sequencing, particularly in the detection of ruptures in genomic signals.
- Participation of the Statistics and Genomes group in the investment for the future project AMAIZING which aims at developing a variety of maize for sustainable productions and quality by means of, amongst other things, genomic selection.
**SCIENTIFIC OVERVIEW**

The MICALIS research unit's aim is to develop innovative research in the field of microbiology and food in the interests of human health. The work of the research unit is founded on the development of cellular biology, metagenomics and microbiological systems.

**FIELDS OF RESEARCH**

- The 20 research groups are linked around three major themes with complementary scientific objectives:
  - Microbial food and intestinal ecosystems: functional interactions food/microbiota/host
  - Characterise different microbial ecosystems through the analysis of their metagenomes.
  - Study the interactions between human microbiota and human cells.
  - Ecosystems studied: human gut and buccal microbiota, cheese and meat ecosystems, yeasts...
  - The risks and security of microbiological safety in food: mechanisms of the emergence and control of opportunistic pathogenic microorganisms.

**KEY POINTS**

- Working space of 10 000 m² that comprises five technological platforms: a proteomic analysis platform, a microscopy platform, an animal house that has animals without gut flora or with gut flora that is controlled; a research centre dedicated to yeast; a pre-industrial demonstration unit Metagenopolis; dedicated to the analysis of links between the components of human gut microbiota and the health of individuals.
- Development of economic partnerships focused on innovation in the agri-food industry, biotechnologies and health.
- Development of economic partnerships focused on innovation in the agri-food industry, biotechnologies and health.
- Development of economic partnerships focused on innovation in the agri-food industry, biotechnologies and health.
- Develop tools to identify and define prevention strategies to combat opportunistic microorganisms.
- Study the responses of beneficial microorganisms, the alteration of the pathogen, the constraints on food production and conservation.
- Microorganisms studied: lactic bacteria, streptococcus, enterococcus, staphylococcus, Bacillus cereus, bacteria spages...
- Systemic and synthetic biology: from the global approach of biological processes to biotechnological applications
- Study microorganisms or biological processes as integrated systems.
- Model in order to predict and control their behaviour.
- Exploit the use of biosynthesis for use in food, white chemistry or health.
- Microorganisms studied: Bacillus subtilis, commensal firmicutes and opportunist pathogens, oiled yeastas...
- Study the flow of nutrients, particularly fatty acids.
- Phenotype individual variation in performance throughout the life span of the animal.
- Well being and animal behaviour
- Understand the factors that influence feeding behaviour and the consequences on the animal's well being.
- Model the feeding behaviour of ruminants.
- Behavioural phenotyping studies.

**SCIENTIFIC OVERVIEW**

The aim of the MOSAR unit is to understand, characterise and predict the relationships between livestock and their feeding environment in order to develop tools that increase the efficiency of use of food resources whilst optimising performance, adaptive capacity and wellbeing. The unit carries out research work in: animal nutrition, animal behaviour, rumen physiology, energy metabolism and modelling. The common research theme of this work is the description and quantification of the processes by which ruminants obtain, ingest, digest, metabolise and partition nutrients between production and other life functions. The work is centred around lactating goats at the level of the whole-animal, but with collaborative projects that integrate the underlying levels (cellular and molecular) and higher levels of aggregation (herd, farm systems).

**FIELDS OF RESEARCH**

- Acquisition and Allocation of nutritional resources.
- From 2014, the MOSAR reorganised its research into two themes:
  - Digestion and feed quality
  - Well being and animal behaviour
- From 2014, the MOSAR reorganised its research into two themes:
  - Digestion and feed quality
  - Well being and animal behaviour
  - Well being and animal behaviour
  - Well being and animal behaviour
  - Well being and animal behaviour
  - Well being and animal behaviour
- Phenotype individual variation in performance throughout the life span of the animal.
- Well being and animal behaviour
- Understand the factors that influence feeding behaviour and the consequences on the animal’s well being.
- Model the feeding behaviour of ruminants.
- Behavioural phenotyping studies.
- From 2014, the MOSAR reorganised its research into two themes: Acquisition and Allocation of nutritional resources.
The aim of the PNCA unit is to contribute to the analysis of the nutritional efficiency of the energy contribution of proteins in different physiological and physiopathological situations. Protein intake is a determining nutritional factor in the body’s homeostasis and the role of protein intake in digestive and metabolic dysfunctions are questions of public health. The establishment of benchmarks on the quality of protein intake in order to satisfy physiological needs is a topical issue in the current context of thinking on the balance between sources of animal and plant protein and the research into new sources of protein.

**FIELDS OF RESEARCH**

The work of the research unit is around three major themes:

- **Protein intake** - Nutritional needs, the maintenance of functions and tissue, body make up
  - Evaluate the impact of protein intake (quantity of proteins, composition of amino acids, presence of fractions of bioactive peptides and available profiles of these components) and the nutritional absorption of proteins in different situations (energy restriction, dysfunctioning, catabolic cachexia states).
  - Study the impact of the physiology of the intestine and the makeup of microbial activity which influences the health of the host.
  - Analyse in both animals and human beings, the different reactions to the impact of proteins on metabolism and satiety, taking into account the differences and predisposition to obesity.
  - Study as result of consumption data, the relationship between food choice, protein intake and whether nutritional recommendations are satisfactory.

- **Protein intake and the control of food intake**
  - Study the control of protein ingestion and the role of homeostatic mechanisms and recovery systems in the control of ingestion and food choice.
  - Analyse the nature of information transmitted to the brain from the nervous and humoral pathways and their influence on the pathways of homeostatic energy ingestion and the pathways implicated in recovery systems.
  - Analyse in both animals and human beings, the different reactions to the impact of proteins on metabolism and satiety, taking into account the differences and predisposition to obesity.
  - Study as result of consumption data, the relationship between food choice, protein intake and whether nutritional recommendations are satisfactory.

- **Protein intake and digestive and metabolic disorders**
  - Evaluate if the changes in protein uptake contribute to the prevention or aggravation of digestive and metabolic disorders brought on by nutritional or risked physiological conditions.
  - Measure the synergistic and antagonistic effects between proteins and other nutrients.
  - Integrate polymorphism and interindividual variation of responses to different diets.

**KEY POINTS**

- Active participation in ALIAS (Food, Feeding and Health) project.
- Coordination of national and European projects: SURPROL, OVENUTHIAL, BISENS, ANCA chair.
- Participation in the ANCA (Food, Nutrition and Food Intake) which facilitates exchanges between the different professional actors concerned.

**SCIENTIFIC OVERVIEW**

The unit’s objective is to improve the knowledge and interaction around the topics of development and the environment. The unit seeks to understand the world in which we live, in both countries in the South and the North, in terms of spatial and territorial dynamics. The unit develops both fundamental and applied research, that leads to partnerships, renewed by the skills, themes, tools, know-how and responses the unit provides and whenever possible to the demands of local decision makers.

**FIELDS OF RESEARCH**

The unit’s research work revolves around four different topics and one valorisation axis:

- **Changes to territories, production processes and globalisation**
  - Structure territorial changes with the production processes.
  - Analyse the transformations in urban and rural areas in a globalised world that are linked with their associated forms of governance and their relations with development.
  - Better understand the dynamics that apply to each space (state, region, town, local areas) that are likely to influence the implementation of development projects and policies.

- **Risks, vulnerabilities and territorial management**
  - Identify the theoretical and practical links between development and the environment.
  - Better understand social and environmental vulnerabilities in specific areas.

- **Political geography of resources**
  - Analyse both land and sea natural resources, land tenure, as well as the different actors’ strategies involved – whether state or not – and the relationships between them.
SCIENTIFIC OVERVIEW

Resolutely committed to an interdisciplinary approach, the research work of the SAD-APT unit deals with complex research issues around the dynamics of socio-technical and socio-ecological systems, linked to transformations in the worlds of agriculture and rural areas. The unit has a strong preference for research work via partnerships with actors and organisations in agricultural and territorial sectors. Producing both fundamental and applied scientific knowledge, the unit is interested in research issues that are grounded in the essential questions of our times: the contradictions and complementarities of the use of spaces and resources; the expression of multiple functions; the place of information within these systems.

The unit is organised into four pluridisciplinary groups: Urban Agriculture group (AIDDA), Analysis and Spatial Modelling group (AMOS), Distribution of Data and Information group (SISO), and Uses of Spatial Information and Governance group (USIG). The SAD-APT unit contributes to the production of knowledge, tools and methods that allow a better understanding of the dynamics and interactions between nature and society in order to accompany local actors in territorial management and natural renewable resources. The unit uses an integrated approach to the chain of spatial information, from acquisition to treatment and from management to use by the actors involved. The research is applied to agriculture, the environment, resources, territories, health, etc. Based on this research, the unit devotes an important part of its activities on teaching, training, expertise and the support of public policy making.

Reconciling Environment and Production within Territories and Supply Chains group (CONCEPTS)

The group leads research on the computing on the management of environmental data that is both spatial and complex, with the aim of responding to the issues linked to the large volumes and flows of data, the structuring of information and its usage. The group adds value to and develops methods and modelling tools that are both explanatory and predictive. The unit studies the spatial organisation of systems and in particular, the uncertainties of data and the results of modelling, on the construction of spatial indicators and the development of a tool to simulate landscape dynamics.

Spatial Information Systems, Modelling, Extraction and Distribution of Data and Information group (SISO)

The group leads research on computing on the management of environmental data that is both spatial and complex, with the aim of responding to the issues linked to the large volumes and flows of data, the structuring of information and its usage. The group develops concepts, methods and tools for use in spatial information in the decision making process and of collective action especially in local areas. It contributes to the understanding of the interactions between the environment and society, the organisation of systems of governance and the place of information within these systems.