LIPH4SAS

Livestock phenotyping for sustainable agroecological systems

A national research infrastructure for livestock phenotyping

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INRAE

> What is a Research Infrastructure (RI) ?

RI = facilities, resources and services that are used by the research communities to conduct research and foster innovation in their fields. They include :

- **major scientific equipment** (or sets of instruments),
- **knowledge-based resources** (collections, archives, scientific data…)
- **e-infrastructures** (data & computing systems, communication networks …)
- any other **essential tools** to achieve **excellence in research & innovation**.

(from ESFRI roadmap - https://www.esfri.eu/esfri-roadmap)

ESFRI = European Strategy Forum on Research Infrastructure created in 2002 by the EU's council of Ministers to **identify, prioritize, and support** the development of **pan-European research infrastructure** of strategic importance.

ESFRI regularly produces a Roadmap (currently 2021 roadmap) that includes :

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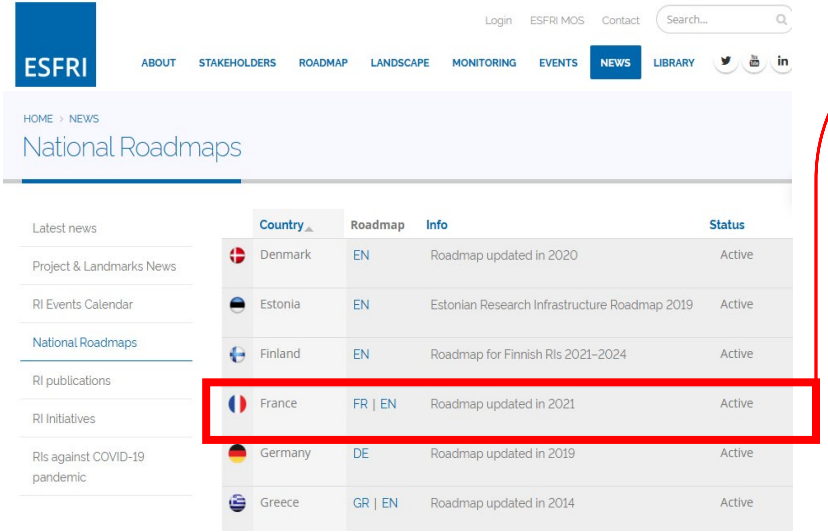
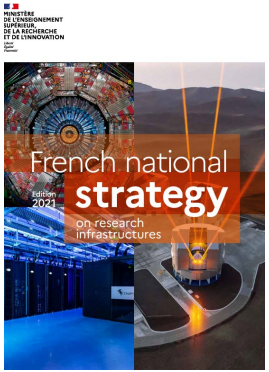
> What is a Research Infrastructure (RI) ?

National Roadmaps (NR)

- The European Commission and ESFRI encourage Member States and Associated Countries to The development of NR for RIs are encouraged by the EC and ESFRI.
- NR are vital blueprints : 1) to set national priorities and: 2) to earmark funds for both national and pan-European RIs including ESFRI ones





Biology & health IR

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> LIPH4SAS: objectives

LIPH4SAS is a national distributed research infrastructure dedicated to the phenotyping of farm animals,

LIPH4SAS implements experiments and collects phenotypes and samples for the scientific communities in animal science,

with the objective of promoting the transition to a more sustainable food and agricultural systems, based on agroecological principles.

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> LIPH4SAS: origins

LIPH4SAS has been created in 2021. Its implementation has benefited from :

- the existence of 3 INFRA-IA projects :
- The development of :
  - A functional exploration platform (PIXANIM)
  - An information & computing network for livestock phenotyping

LIPH4SAS is currently an INRAE RI managed by 2 INRAE divisions

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> LIPH4SAS: a distributed research infrastructure

10 entities :

- Four experimental units dedicated to **ruminants** (**HERBIPÔLE – UEP – PAO – P3R**);
- Two **porcine** experimental units (**3P – GENESI**);
- An experimental unit (**PEIMA**) and an experimental installation (IE **NUMEA**) for **fish** farming;
- A **functional exploration platform** dedicated to medium to large animals (**PIXANIM**);
- A network of computer specialists in charge of data management and the development of phenotyping tools (**SICPA**)

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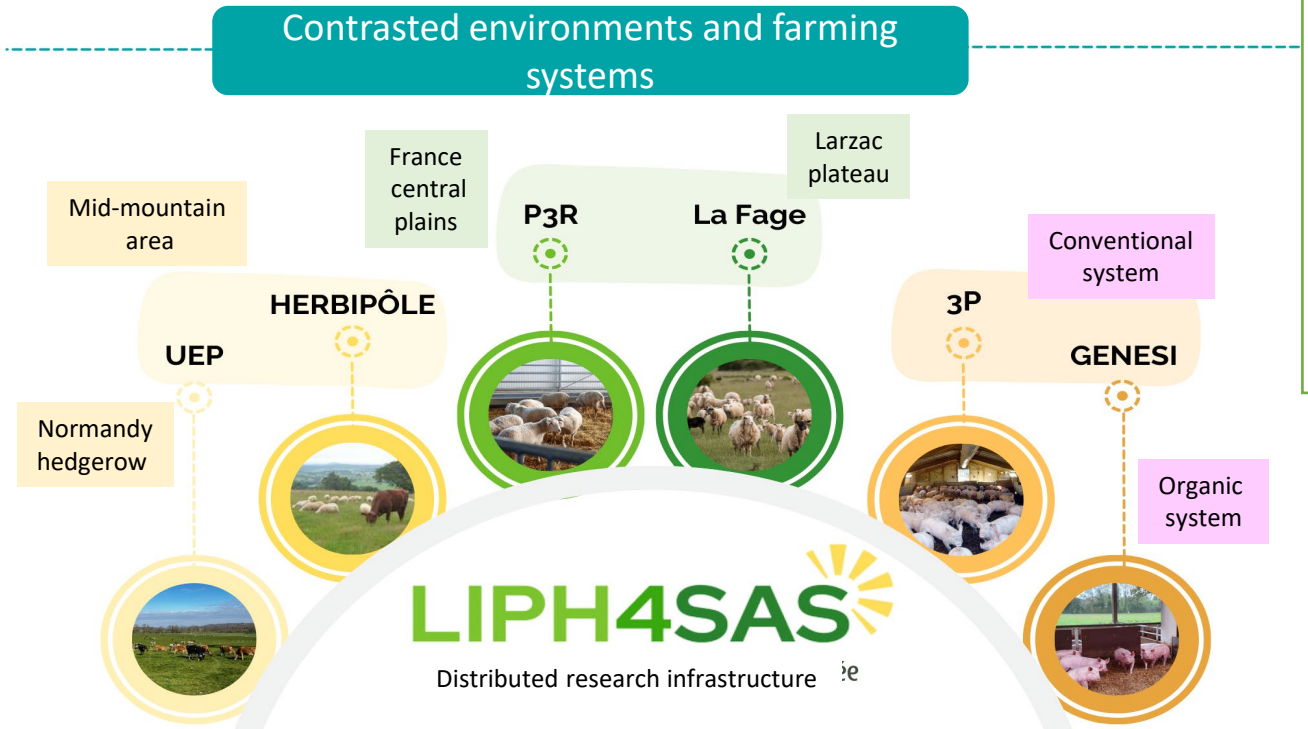
LIPH4SAS: what extra-value ?



Diverse and accurately characterised environmental and farming conditions, enabling the study of G xE interactions or animal responses to environmental variations.

LIPH4SAS: what extra-value ?

Access to a large genetic diversity and original genetic resources

Diverse genetic resources

- Different cattle breeds (HO, NO, JE …)
- Different sow breeds (LW, MS) and growing pig genotypes
- Several experimentally selected lines (RFI, mastitis resistance, Microbiota composition, longevity …)
- Trout isogenic lines
- Genome edited livestock

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LIPH4SAS: what extra-value ?

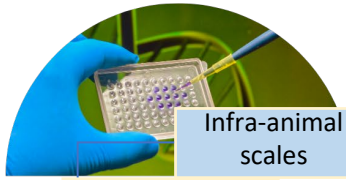
A wide range of state-of-the-art phenotyping services

Horizontal phenotyping

Vertical (deep) phenotyping

Large nb animals

Small nb animals



Infra-animal scales

Herd/population scale

Individual animal scale

Genome scale

Phenotyping of a large nb of traits

Investigate genetic variability of biological functions, trade-offs, farming systems …

Longitudinal Phenotyping over long periods

Interest of long chronicles to investigate biological functions, trade-offs, modelling …

PIXANIM platform

PIXANIM

Phénotypage par Imagerie in vEX vivo de l'ANImal à la Molécule

External platforms

abridge

ISC Infrastructure Scientifique Collective

MIMA2 MICROSCOPY AND IMAGING PLATFORM

External research Infrastructures

Genome annotation G to P studies …

CRB ANIM

FRANCE GENOMIQUE

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LIPH4SAS: what extra-value ?

Technological development and innovation
Some examples

Phenotyping tools

- Automatic feeders to phenotype concentrate, fodder and water intake and feeding behaviour in small ruminants
- Automatic measurement and management of environmental information
- Use of artificial intelligence for automated image and video analysis (collab. with research units (RU))
- Outdoor characterization of cattle and sheep behaviour using accelerometers, GPS (collab. with RU)

Data management – Fair data

- Strong integration of information systems (same methods and similar tools to manage data from different species
- Important work on the interoperability (Within LIPH4SAS databases, but also external databases (genomic, environmental information …)

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LIPH4SAS: what extra-value ?

Various other missions / services

Ethics

Promote the harmonization of Quality practices and approaches to guarantee the highest level of expertise and ethics in terms of experimentation and animal welfare.

3R rules

Contribute to Reduce, Replace, Refine (3R) the use of animals for scientific purposes through innovation, optimization of experimental devices and reuse of animals and data.

Quality

Ensure data quality in line with the values of science (integrity, trust, professional conduct, ethics) and promote the availability of the data produced.

Training

Offer high-level training to promote the emergence of a new generation of scientists capable of meeting the challenges ~~in terms~~ of agroecology.

Data & ressources

Facilitate the access to data and infrastructure resources by setting up common, simple and transparent access rules.

Diffusion

Promote the dissemination, exploitation and transfer of technology by developing partnerships with the various actors in the agricultural and agri-food sectors.

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LIPH4SAS: what extra-value ?

Increased visibility

For scientific communities

LIPH4SAS > UEP, PAO, UEF, Herbipole, P3R, 3P, …

For stakeholders / funding agencies

European level

TEF agrifood

National level

FRANCE 2030 – PROGRAMME DE RECHERCHE – AGROÉCOLOGIE ET NUMÉRIQUE

PATASEL project

Regional level

REACT-EU

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LIPH4SAS: our ambition

Contribute, through cutting-edge services, to high-quality and useful science that contributes to the development of sustainable livestock, agricultural and agri-food systems. In particular, this means intensififying our actions on :

- Improving LIPH4SAS services
- Open science and open data
- Technological development and innovation (including 3R and altenratives
- Ethical considerations (science, animal experimentation,
- Impact

Helping to strengthen of a high-performance livestock research ecosystem at the European level

- LIPH4SAS has to more widely open to European livestock research community
- LIPH4SAS should be seen as the French node of a European research infrastructure (ESFRI) on livestock sciences
- An attempt to work towards this obective was recently made through Pheno-Live project, whose objective was to prepare an ESFRI project.
  Pheno-Live was unfortunately not selected, but the ESFRI project has to remain a strong priority.

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