INRAE HOLOFLUX Metaprogramme

Holobionts and microbial flux within agrifood systems

RÉPUBLIQUE FRANÇAISE
Liberté
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INRAE
HOLOFLUX Metaprogramme

emmanuelle.maguin@inrae.fr

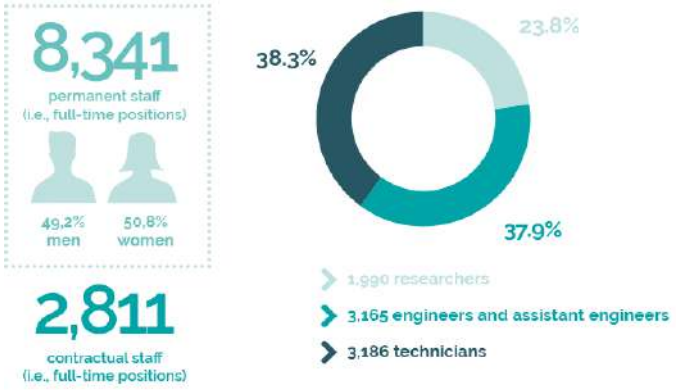
INRAE - French national research institute for agriculture, food & environment

Science for people, life & earth

Tackling scientific challenges related to **agriculture**, **food** and the **environment** requires an integrated approach:

- Ecological transition
- Sustainable production of healthy food for all
- Complementary uses of bioresources, the bioeconomy
- Biodiversity and adaptive resource management

Key figures



Budget of more than **€1 billion**

- Public subsidies from the French government 78.3%
- External revenue 21.7%

A world leader

3rd in the agricultural sciences*
4th in the plant and animal sciences*
4th in food science*
10th in ecology and the environmental sciences*

*International rank based on scientific publications

Metaprogrammes at INRAE

Implemented by INRAE in the last 10 years

Metaprogrammes are scientific programming tools

designed to boost systemic and interdisciplinary research

on major scientific issues and societal concerns

in line with the INRAE strategic agenda

- To develop **state-of-the-art interdisciplinary research**
- To generate and to **consolidate a scientific community on these issues**
- To increase the **impact** of INRAE at the **international level**
- To enable **new international collaborations on given strategic issues**

Metaprogrammes at INRAE

2010-2018: **8 MP** launched, developed and positively evaluated by international scientific experts

Since 2019: new scientific themes have been defined and the programming tool has been improved : **10 MP** gradually introduced ➔ **HOLOFLUX launched mid-2019**

Means and incentives:

- Projects : risky **exploratory projects** (2 years) & **Flagship projects** (3-4 years)

  -> scientific and societal impacts
- Scientific **networks** (1,5 year) to support cross-disciplinary communities
- OTHERS: **Workshops and training** sessions, one or two **PhD students** funded per year

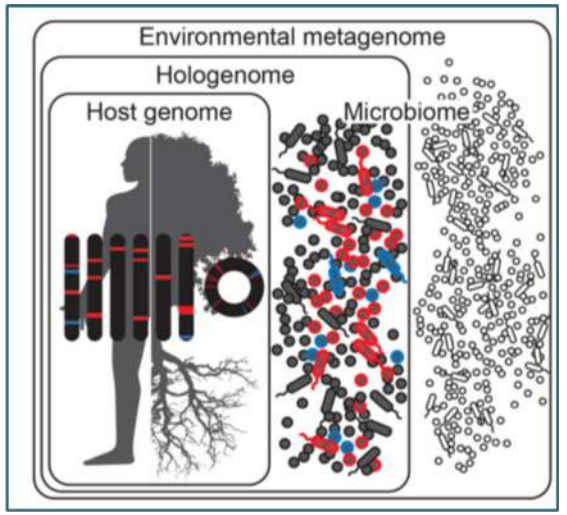
**complementary to INRAE division funding*

HOLOFLUX

- **Microbiomes are enablers to transform food systems towards sustainable** (performance and efficiency, short circuits, GHG reduction, maintaining biodiversity...) and **healthy** (reduction of fertilizers, antibiotics, pesticides, microbiomes use to fight pathogens...) systems.

Source: European Commission

- There is a paradigm shift associated with the Holobionts concept.
  - Holobiont: a host (plant, animal, human) and its associated microbial communities
  - Individual phenotypes result from the combined expression of host and associated microbes genomes



Theis et al. mSystems 2016

HOLOFLUX Objectives and scientific areas

OBJECTIVES

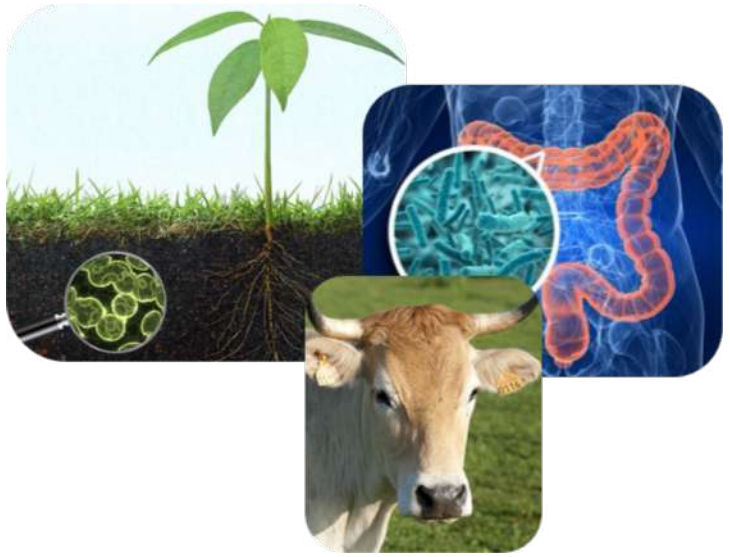
Understand, predict and control the functioning of holobionts and microbiomes as well as their interactions with the environment, in various agronomic contexts, taking into account the issues of sustainable food and health preservation.

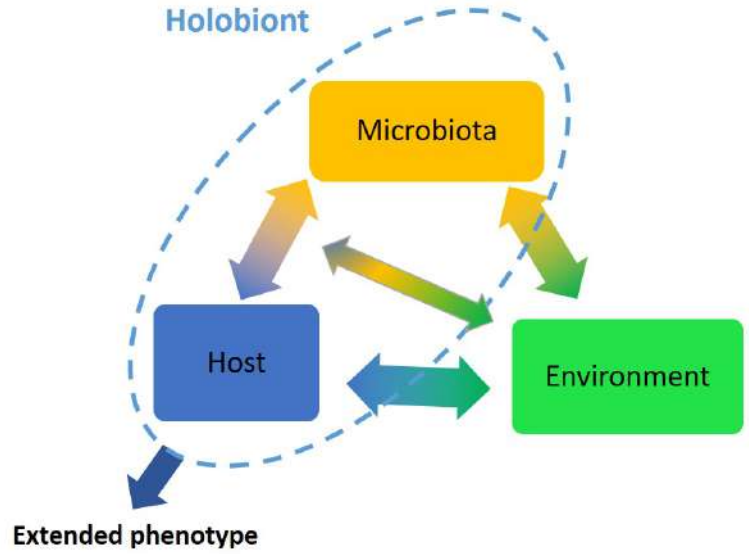
SCIENTIFIC AREAS

- Mechanisms underlying assembly and interactions within holobionts
- Microbial flux and dynamics within an agrifood system
- Control and management of microbial fluxes

Mechanisms underlying assembly and interactions within holobionts

- Determinants of holobiont assembly
- Host-microbiome interaction mechanisms
- Microbiome stability within the host: evolution and transgenerational transmission
- Impact of the microbiome and microbiome-host symbiosis on the holobiont phenotypes
  (e.g., health, performance, ...)





Mechanisms underlying assembly and interactions within holobionts

6 Exploratory projects launched in 2020 for 2 years

❖ Determinants of holobiont assembly

Enterotypig. Enterotypes of the intestinal microbiota in pigs: characterisation and influence of the host genetics to assemble the holobiont. *Claire ROGEL-GAILLARD*

❖ Host-microbiota interaction mechanisms

HOLOPIG. To elucidate the role of metabolites derived from the gut microbiota in neonatal programming of intestinal epithelial cells by primary colonizing bacteria in piglets. *Martin BEAUMONT & Gaëlle BOUDRY*

❖ Microbiota stability within the host: evolution and transgenerational transmission

HOUSE. Microbial communities in the rhizosphere: a selection unit? *Manuel BLOUIN*

HOLOBROM. Maternal effects and environmental filtering on microbial flux from mother plants to their descendants. *Céline LEROY*

MicroWean. Alteration of microbiota vertical transmission due to early weaning and its effects on host health *Rebecca MARTIN ROSIQUE*

❖ Impact of the microbiota and microbiota-host symbiosis on holobiont phenotypes (e.g.,health, performance)

MicroFlyAdapt. Role of plant-microbiota interactions in the adaptation of a pest insect to its host. *Christophe MOUGEL*

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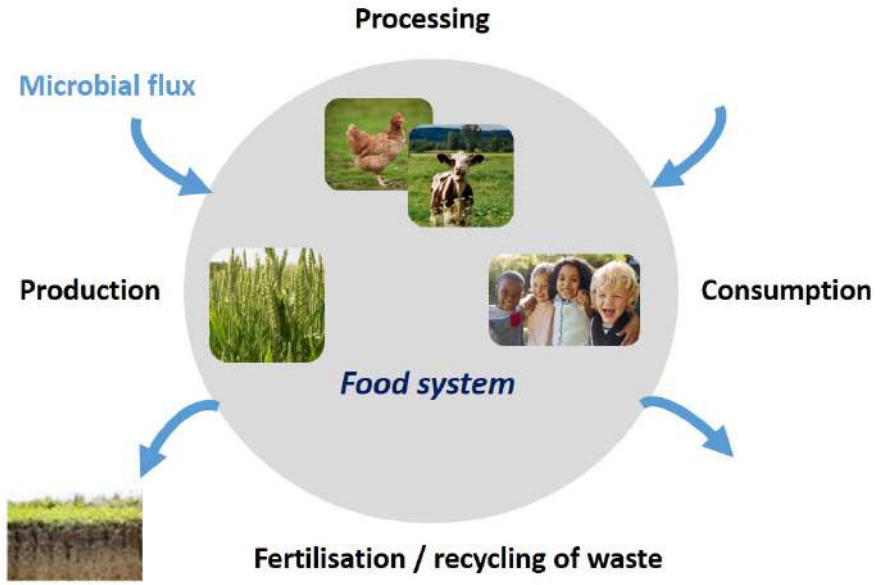
Microbial flux and dynamics within an agrifood system

- Microbiota establishment in agrifood systems
- Dynamics and evolution throughout the system: how do holobionts react to microbial fluxes and disturbances?
- What is the impact of different production systems (changes of practices / decrease in inputs, ...) on the agrifood system?
- What are the critical steps (identification of biomarkers) for the sustainability of the agrifood system?



Microbial flux and dynamics within an agrifood system

1 Exploratory project and 1 flagship project selected in Nov. 2020

TANDEM (Flagship). Tranfers in dairy system *Céline Delbès*

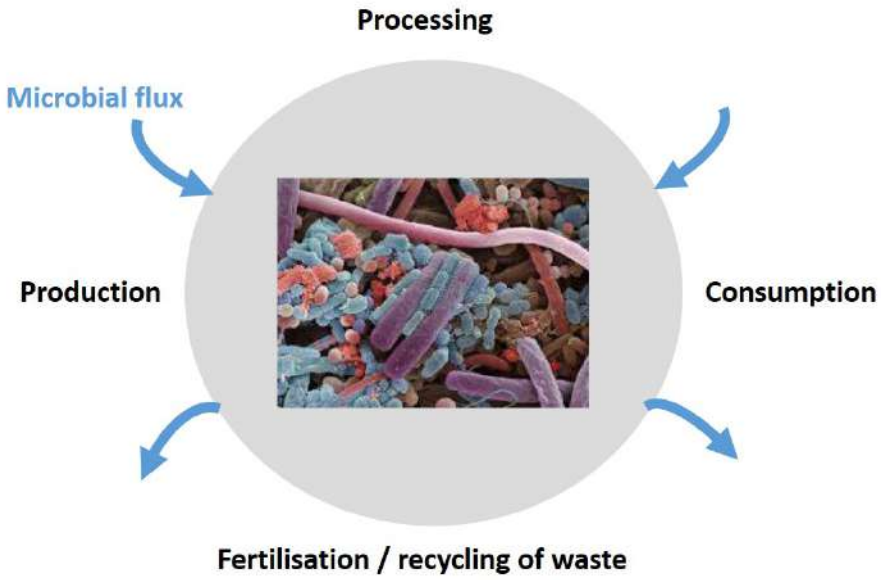
Microbial flux at the heart of the agroecological transition of dairy systems: Evaluating their impacts on the functioning of the dairy system using an interdisciplinary approach

EGG TO MEAT (Exploratory). Transfers in the entire production chain for broiler, comparison of different practices *Monique Zagorec*

Impact of the broiler flock environments on microbial flows and consequences on chickens health and food products quality.

Control and management of microbial fluxes and how they impact performance, sustainability and health

- Identify levers to modify microbial ecosystems and assess the impact on the whole system
- Is it possible to sustainably modify the host phenotype by managing its microbiotas?
- Evaluate the cost/benefit impact of microbial flux management approaches



Covered areas

Scientific forefront domains: animal and plant production, agrifood system, ecological engineering, human health, predictive biology and cost-benefit assessment

Interdisciplinary: mathematics, microbiology, microbial ecology, genetics, genomics, animal, plant and human physiology, humanities and social sciences.

International

- International Scientific Advisory Board
- Possibility to joint funded projects or to develop new ones
  (INRAE will support only INRAE teams)
- Creating and supporting international networks with keys partners in these areas
- Joint training or summer camps,
- …

Sylvie Dequin
Director

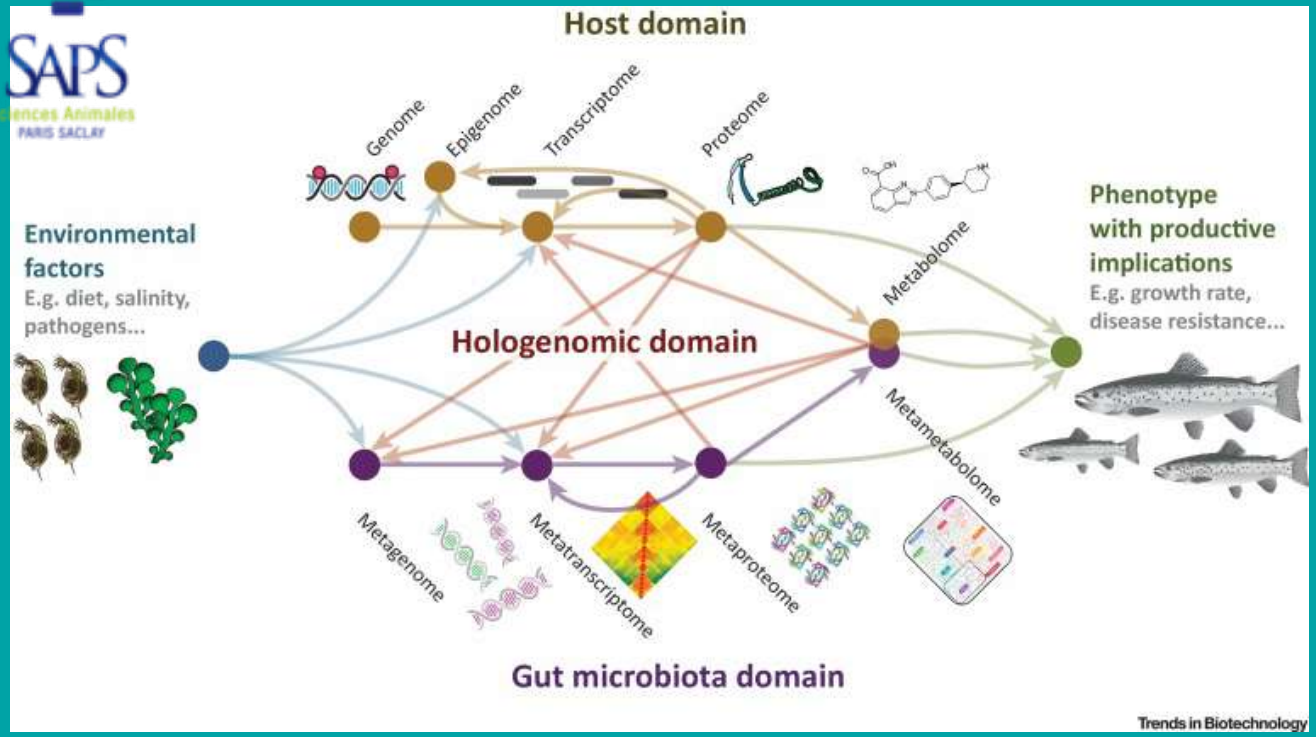
Emmanuelle Maguin
Co-pilot & International

Gema Herrero Corral
International

Danielle Canceill
Project manager

holoflux@inrae.fr

Thank you for your attention!



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Director

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Danielle Canceill
Project manager

Holoflux holoflux@inrae.fr

House manuel.blouin@agrosupdijon.fr

Enterotypig claire.rogel-gaillard@inrae.fr

http://saps.paris