

# INRAE

## ➤ Use of innovative and precision tools in research stations with small ruminants: the INRAE case

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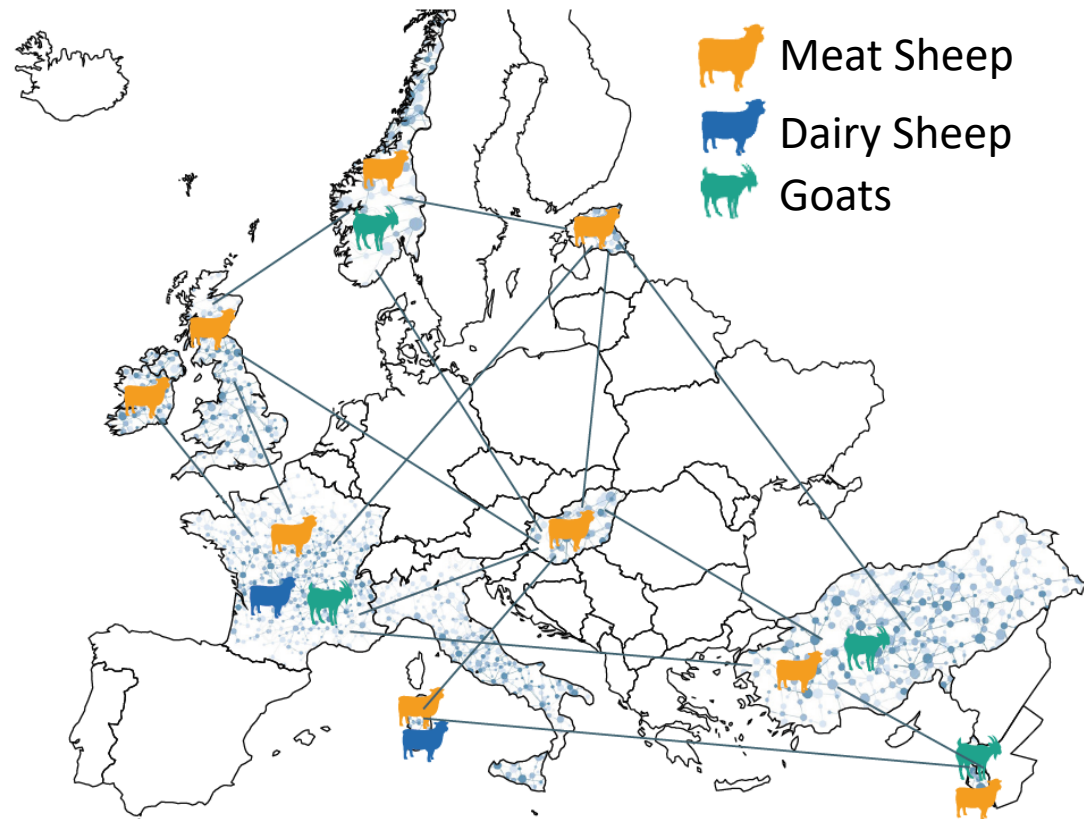


## > Context

- ✓ Numeric Revolution: We are assisting to the Precision Agriculture and Precision Livestock Farming Era
- ✓ What about the criteria of the day-to-day end-users?



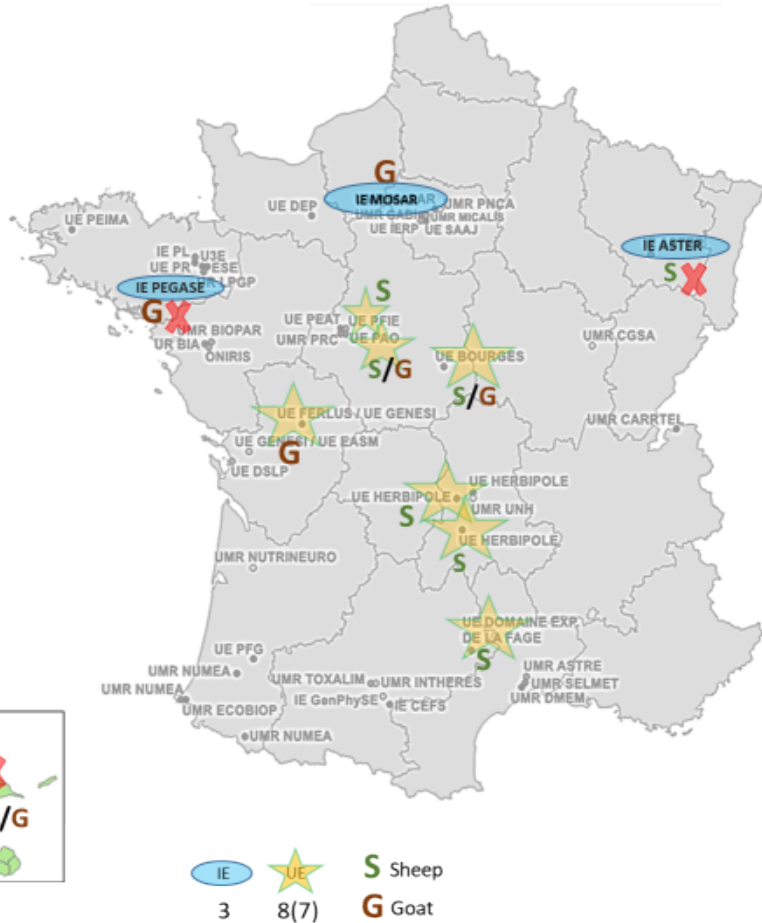
- ✓ An international **thematic network** around the use of **new technologies** for the **small ruminant** sectors (sheep, goats, milk and meat, etc.)





# ➤ Methodological procedure: a national survey was performed

✓ **Eight** from the **eleven experimental facilities** using SRs in INRAE (in France and overseas) **were visited** in 2022:



	IE & UE SRs at INRAE	Visited
<b>IE</b>	<b>3</b>	<b>1</b>
IE ASTER	1	X
IE1348 Pegase	1	X
UMR0791 MoSAR Chèvrerie expérimentale	1	1
<b>UE</b>	<b>8</b>	<b>7</b>
UE0321 La Fage	1	1
UE0332 P3R	1	1
UE1277 PFIE	1	1
UE1294 PTEA	1	X
UE1297 PAO	1	1
UE1373 FERLus	1	1
UE1414 Herbipôle_Laqueuille	1	1
UE1414 Herbipôle_Theix	1	1
<b>Total</b>	<b>11</b>	<b>8</b>

10 Breeds
<b>IE visited</b>
<b>UMR0791 MoSAR Chèvrerie expérimentale</b> Milk; G Alpine, Saanen
<b>UEs visited</b>
<b>UE0321 La Fage</b> Meat/ Milk; S/G Lacaune, Romane
<b>UE0332 P3R</b> Meat/ Milk; S/G Romane, Berrichon d'Indre Alpine
<b>UE1277 PFIE</b> Meat; S Préalpes du Sud
<b>UE1297 PAO</b> Meat/ Milk; S/G Ile-de-France Alpine
<b>UE1373 FERLus</b> Milk; G Alpine, Saanen
<b>UE1414 Herbipôle_Laqueuille</b> Meat; S Limousine, Romane, Suffolk
<b>UE1414 Herbipôle_Theix</b> Meat; S Romane, Texel

INRAE

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August 30<sup>th</sup> 2023 / EAAP Congress, Lyon, France / Llach et al.

# ➤ Methodological procedure: the Questionnaire

- ✓ A detailed, exhaustive **questionnaire** was prepared and shared before concerted visits for conducting in situ one-full-day semi-structured interviews

Characterization

department; contact details & location; species, sector; breed, flock size; production & feeding system, reproduction, health constraints...

Technology identification & Description

Origin (market or INRAE conception?) characterization [(year of acquisition, company, brand, model); purpose (farming, research or double); what for? (general management, feeding, reproduction, milking, etc.); principle of use (how, frequency, scale); photos and videos; required skills and support]

Overall viewpoints from end-users

recommendations for research or farmers; eventual required improvements

Debate in assembly

Brainstorming for contrasting viewpoints and consensus as a final step



## ➤ Methodological procedure: analytical approach

### A. The **Technologies** :

- a) **How many** identified?
- b) How many produced by **INRAE**, acquired from the **market**?
- c) Which ones for **system management**? For **research**? Double purpose?
- d) Classification according to the **technical item covered** (feeding and nutrition, reproduction, health...)
- e) The most **recent**?
- f) The **oldest**?
- g) Which ones **used** more **frequently**?
- h) The **most popular**?
- i) The **most recommended**? Why?
- j) The **less recommended**? Why?



## ➤ Results: census and classification

✓ A large set of technologies (n= 58) are present in the experimental facilities for SRs at INRAE, including:

- Those popular, globally adopted by farmers and commercially available (e.g. ear tags, static scales, weather stations...)
- Innovative, conceived (or co-) by the institute (e.g. DAC, DAF, test tubes *Gély*...)

✓ Most techs (35/58; **60%**) are mainly used for **feeding** operations (18; 31%); **shed environment** and **comfort** (9; 16%); individual **identification** and **behaviour** monitoring (8; 14%)

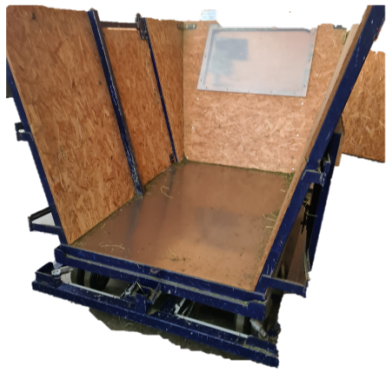
✓ Most techs (>**70%**) used both for **research** and **management**

Connectivity	Building and environmental sensors	Identification and behaviour monitoring	Feeding and Nutrition	Milk yield and milking	Animal weighing	Contention and sorting	Grassland, grazing	TOTAL
WIFI	Sensors (T°, HR, luxmeter, anemometer, etc.)	Ear tags	Barn dryer	Milk meter	Automaton weighing	Sorting gates	Movable shelters	
LoRa / LoRaWAN	Camera	Leg tag	Forage transport trolley with weighing system	Reader link milking & Pâtureon	Weighed bench scale	Mobile weigh cage	Mains energizer	
	Lighting for photoperiodism	Reading stick	Feed distributor	Milk tank scale	Walk-over-Weighing (WoW)	Rollover Cage	Herbometer	
	Water meter	Collar (accelerometer, GPS...)	DAL	Automatic lifter		Belt restrainer	Quad to install electric stakes	
	Automated rotating brushes	Personal Digital Assistant (PDA)	DAC	Rotatory milking parlour		Combi clamp		
	Ventilation system	Echographer	Feed weigher	Electric "dog"		Sheep Auto Drafter		
	Command frame with alert system	RFID Reading antenna	Rolling feed belt	Test tubes <i>Gély</i>				
	Weather station	Ruminal bolus with temperature sensor	Mixer / ration dispenser	Milking control centre				
	Automated basement cleaning system		Alfalfa dryer					
			DAF roll meter					
			Straw blower carried					
			Easyfeed (collective suspended DAF)					
			K2 Combicutter					
			DAF					
			DH2O					
			Electronic feed bins					
			Methane chamber					
			Automated troughs					
2	9	8	18	8	3	6	4	58



# ➤ Results: 14 conceived by INRAE (for research purposes)

**Forage transport trolley with weighing system (manual distribution)**



**Weight indicators/ Automaton weighing**



**Methane chamber**



**Herbometer**



**Sorting gates**



**DH20**



**DAC**



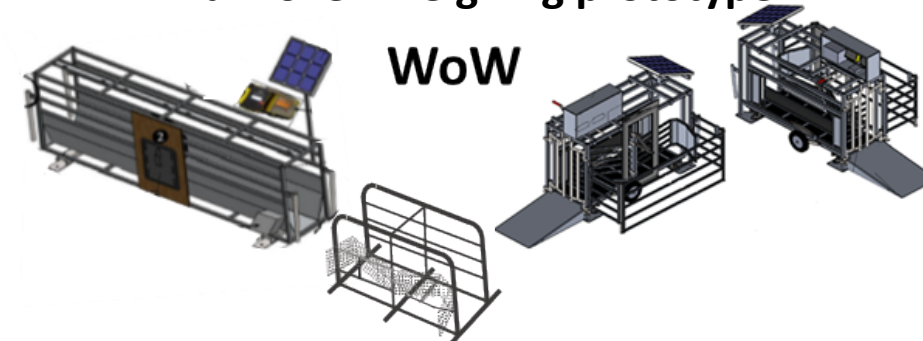
**DAF**



**DAL**



**Walk-over-Weighing prototype**

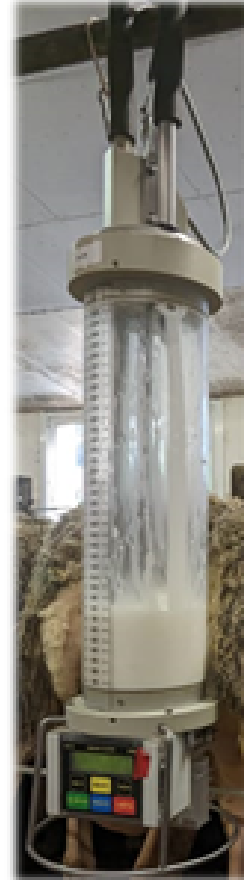


**WoW**

Electronic Feed bins (1990)



Test tubes Gély (1998)



Personal Digital Assistant (PDA) (2000)



Milking control centre



The most ancient technologies have been identified at **UE P3R** (Bourges), **UE La Fage** (Aveyron) and **UMR MoSAR Chèvrerie expérimentale** (Grignon-Thiverval)

# ➤ Results: a huge recent development

## 2023

LoRa / LoRaWAN  
Parc de tri à 3 sorties  
Système de ventilation

## 2022

Caméras  
DAC salle de traite

## 2021

Anémomètre  
Bolus ruminal avec capteur de température  
Brosse rotative automatisée  
Cage pesée mobile  
Chien électrique  
Collier accéléromètre / GPS  
Combi clamp  
Compteur à eau pour chaque lot (non individuelle)  
Compteur à lait  
Convoyeur  
DAC  
DAF  
DAF roulimètre  
Décrocheur automatique  
DH2O  
Easyfeed (DAF "collectif" suspendu)  
Eclairage pour le photoperiodisme  
K2 Combicutter  
Salle de traite rotative  
Station météo  
Tapis d'alimentation roulant avec chariot

## 2020

WoW\_Walk-over-Weighing

→ A dramatic increase during the last decade linked to the **Precision Livestock Farming (PLF)** development and **phenotyping** goals

→ Linked to the **emergence of WIFI and LoRa/LoRaWAN**, many environmental sensors have appeared

## 2019

Cadre de commandes avec système d'alerte  
Cage de retournement  
Capteur T° , HR et luxmètre  
capteur T° et HR  
Collier accéléromètre / GPS  
DAL  
herbomètre  
Parc de tri à 3 sorties  
Séchoir à luzerne  
Système de ventilation  
WIFI

## 2018

Balance de table pesée  
Cage de retournement  
Capteur T°  
Capteur T° , HR et luxmètre  
DAL  
Distributeur aliments  
Electrificateur sur secteur  
Indicateur de poids / automate de pesée  
Mélangeur / distributeur aliment  
Quad pour poser piquets électriques  
WIFI

## 2017

Bâton lecture avec PDA  
Bâton lecture boucles électroniques  
Capteur T° et HR  
Centrale de contrôle traite  
Chambre méthane  
Collier accéléromètre / GPS  
DAL  
Échographe  
Electrificateur sur secteur  
Indicateur de poids / automate de pesée pour les animaux  
Sheep Auto Drafter de Gallagher  
WIFI

## 2016

Balance de table pesée  
Bâton lecture avec PDA  
Cage pesée mobile

## 2015

Antenne lecture RFID  
Automate pesée à l'entrée de la salle de traite  
Balance de table pesée  
age pesée mobile  
Chariot transporteur fourrage avec pesage (distribution manuelle)  
DAL  
Eclairage pour le photoperiodisme  
Indicateur de poids / automate de pesée pour les animaux  
Module de saisie terrain (PDA)  
Tracteur avec fourche avant + godet distributeur

## 2014

Abris déplaçable  
Auges automatisées  
Electrificateur sur secteur  
Lecteur de barres  
Module de saisie terrain (PDA)  
Système de nettoyage du sous-sol automatisé  
WIFI

## 2013

Bâton lecture boucles électroniques  
Cage pesée mobile  
DAL  
Herbomètre  
Lecteur de barres  
Peson grand tank  
Tapis d'alimentation roulant avec chariot

## 2012

Bâton lecture avec PDA  
Compteur à eau pour chaque lot (non individuelle)  
Compteur à lait  
Couloir de tri manuel  
DAC  
DAL  
Décrocheur automatique  
Eclairage pour le photoperiodisme  
Indicateur de poids / automate de pesée pour les animaux

## ➤ Results: the most and less recommended to farmers

- ✓ **Automated weighing** at the entrance (or exit) of the milking parlor => because LW is key
- ✓ **Combi clamp** => because of significant impact on improving quality of working conditions of operators
- ✓ **PDA** => mobility, practical for IDE and in situ register modif...
- ✓ **Weather station** => easy and richness of information provided...
- ✓ **Environmental sensors** => easy of comfort and behaviour monitoring...

- ✓ There are a set of techs just adapted to research purposes, e.g.
  - Accelerometers (a lot of battery autonomy issues to improve; complexity data interpretation)
  - Methane chambers (maintenance and often required calibration)

## ➤ Conclusion & Remarks from consulted stakeholders

- The **connectivity** (WIFI and LoRa / LoRaWAN): basic aspect for adoption & functionality (not all facilities well connected)
- Need for a **platform of exchanges** between common users
- Critical reflection around **large diversity of tools** available in the market
- How far should the **limit** be placed on the **use of techs at the farm level? Optimal number of sensors** to install (avoid the "hospital farm"):
  - Avoid **over-complexity: Compromise** between monitoring systems and criteria related to e.g. animal welfare to avoid risks such as the density of waves per unit area
  - **Energy sobriety** (high performing tech and more frequent use = more data and more energy consumption)
  - The development of **applications and data analysis methods** is essential (with easy interpretation procedures)
  - The problem of **stocking large volumes of data** (including images)



## ➤ Conclusion & Remarks from consulted stakeholders: a Key debate

### Innovation for **autonomy** or **market dependency**?

INRAE, a relevant public institution, **continue to be dependent**, due to:

- **Lack of infrastructure** to support durability of inventions (i.e. guarantee replacement parts, updating/modernizing homemade techs; accompanying computer support)
- Such situation **weakens the system**, makes some technologies begin to become obsolete (performance stagnation)

**To continue with “homemade” technologies or turn to companies**, which implies advantages and disadvantages:

#### Benefits :

- **Speed** of technology development
- Simplicity in the access to already elaborated and processed data

#### Disadvantages:

- Intellectual **property**
- No **access** to raw **data** (required in the research process) with possible access in return for payment (i.e. subscription e.g. American GreenFeed)
- **Privatization** of our produced data. Who guarantees **data security**? Right of access to “third parties”...



# INRAE Thank you!

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