How to monitor welfare issues on sheep and goats farms with innovative technologies?

Eliel González García, Germain Tesnière

TECH CARE

Integrating innovative TECHnologies along the value Chain to improve small ruminant welfARE management

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https://meetings.eaap.org/webinar/innovative-technologies-for-welfare-management-in-sheep-goats-systems/

How to monitor welfare issues on sheep and goats farms with innovative technologies?

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1) Introduction and objective

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TechCare project, a step-by-step methodology

Prioritisation of the most important **welfare issues** for sheep and goats in the EU

How to monitor welfare issues on sheep & goats farms with innovative technologies?

Identification of main **methods** that could be used to assess each of these welfare issues by conventional **data collection methods of animal-based assessment**

Prioritisation of appropriate and available PLF tools and digital technologies that can potentially be used to assess these welfare issues

→ Tools available on the market
Tools under development, prototypes → On farm tests

Presentation objectives

1. Reminder of the Welfare issues on which the pilot and experimental farms of the project are working
2. Presentation of tool categories and their contribution to the study of WI
3. Presentation of 3 examples of technologies used in the project to study the welfare of sheep and goats

2) Animal welfare issues studied in TechCare

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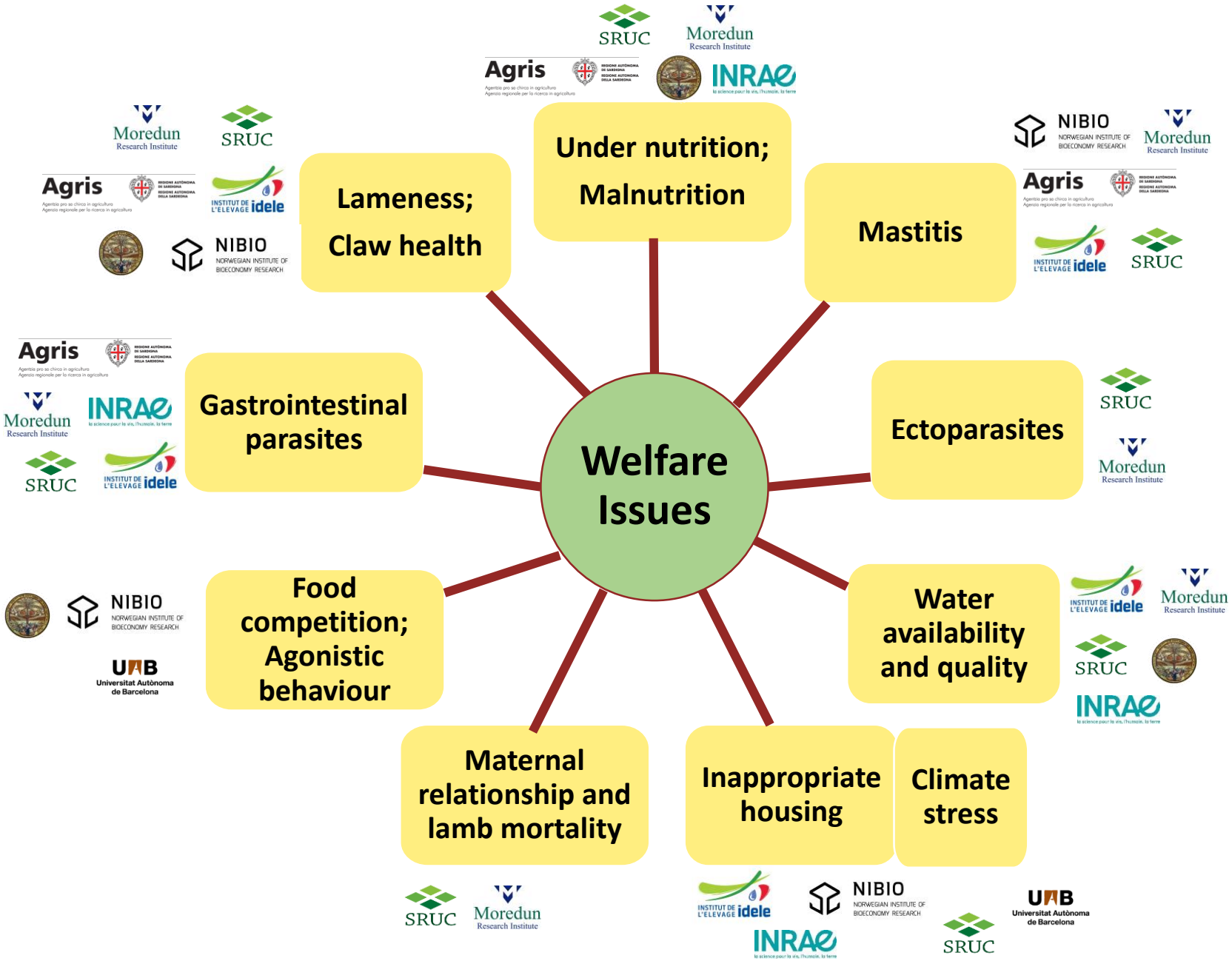

From various welfare issues to 4 main welfare indicators categories

- **Behavioral change** – activity, food, and water intake, contact patterns between animals, especially mothers and offspring (animal-based)
- **Weight loss or change in body state** (e.g., condition/fatness) (animal-based)
- **Milk yield and quality** (animal-based)
- **Environmental indicators** (resource-based)

3) PLF for AWE: five PLF families

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1 **Identification, location, proximity & activity**

2 **Liveweight**

3 **Water consumption**

4 **Milk yield & quality**

5 **Environment** (indoor & outdoor)

FIVE PLF FAMILIES

TECHNOLOGIES, TOOLS, SENSORS...

3.1) Five PLF families:
Identification, location & proximity, activity

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Individual identification	Location & proximity	Activity
✓**RFID** (radio frequency identif.) ✓Low frequency (**LF**) EID readers ✓Ultra-high-freq. (**UHF**) readers	✓ Bluetooth Low Energy (**BLE**) ✓ **GPS** tracking ✓Global Navigation Satellite System (**GNSS**) ✓**WISP**, **LoRA**…	✓ **GPS** ✓ Accelerometers ✓ Virtual fences ✓ Thermal cameras ✓ Automatic feeders
		
○ **The basis for using other tools** ○ Flock control, presence/ absence (e.g. predation, mortality…)	○ Individual or social **behaviour** ○ Travelled distance ○ **Access** to **resources** (feed blocs, water troughs) ○ Ewe/lamb **bonds** -> mismothering issues ○ Grassland/ rangeland/ **surfaces management**	○ Feeding, drinking, grazing **behaviour** ○ **Tracking** spatial, movement patterns ○ Resource **exploration** ○ Behavioural organization ○ **Social** integration ○ Body **temperature** ○ **Health** issues (lameness, mastitis, parasites) ○ **Predation/stress** sources…)

3.2) Five PLF families:
Liveweight

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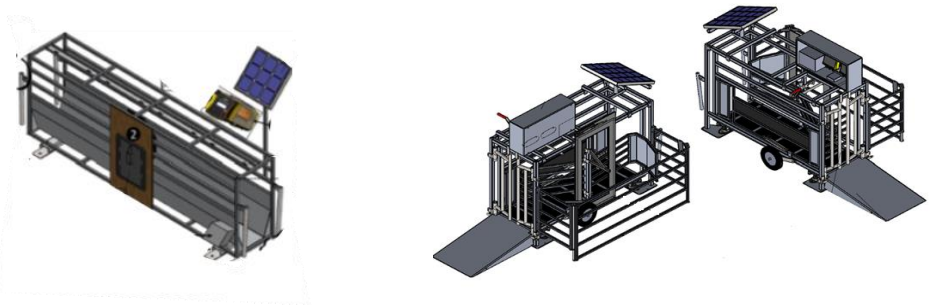
Static weight platforms (with RFID readers)	**Walk-over-Weighing (WoW) platforms**
	

- Individual and flock liveweight (**LW**) monitoring
  - **Growth** rate and body **condition**

3.3) Five PLF families:
Water consumption

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Water meters	Water flowmeters
  	 

- **Water intake** (frequency and quantity, individual patterns and/or collective motions)
- Heat and hydric **stress**

3.4) Five PLF families:
Milk yield & quality

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Milk meters	**Milk composition** (NiRS & MiRS)
 	 

- Milk **yield** & **composition**
- **Udder health** status (e.g. indirect assessment mastitis)

3.5) Five PLF families:
Environment (indoor & outdoor)

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Indoor	Outdoor
✓ **T°C** and **humidity** sensors ✓ [Particles] ✓ **Gazes** detectors [ammonia, CH_4, CO_2] ✓ Thermal and video surveillance **cameras**	✓ **Weather** stations
  	   

- Housing **comfort** and quality
- Quality and **cleanliness** of flooring/bedding
- **Air** quality
- **Climatic** conditions and management (performance, decision makings…)

How to monitor AWE with **environmental sensors**?

Example: using **T°C** and **humidity sensors** for **THI indoor**

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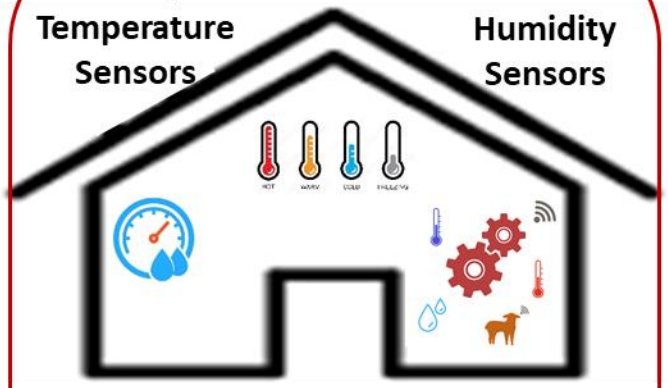
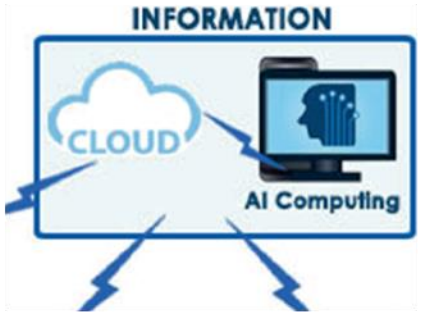
1) Data on T°C and RH% are **produced**



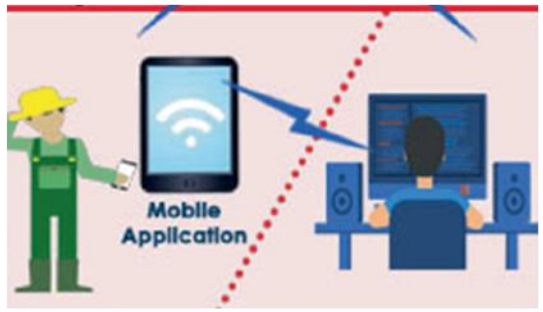
- ✓ **Temperature** (°C) and
- ✓ Relative ambient **humidity** (%) at different points of the shed

2) Data are **collected & processed**



✓ **THI** are **calculated**

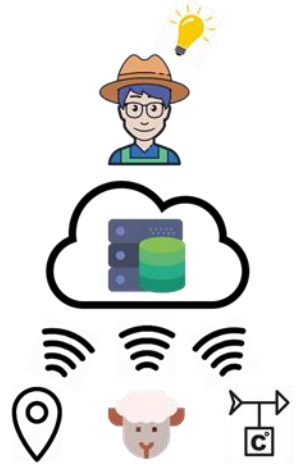
3) EWS produced -THI thresholds **analysed-**



With regard to:

- ✓ Stocking density
- ✓ Year season
- ✓ Physiological stages
- ✓ Daily routines changes
- ✓ Data from other PLF tools (*e.g.* heart & respiratory rates, rectal temperature)

4) Farmers' decision makings around:



- ✓ **Comfort**
- ✓ **Quality** of indoor **environment** and **housing** conditions
- ✓ Stocking **density**

How to monitor AWE with a **Walk-over-Weighing (WoW) platform**?

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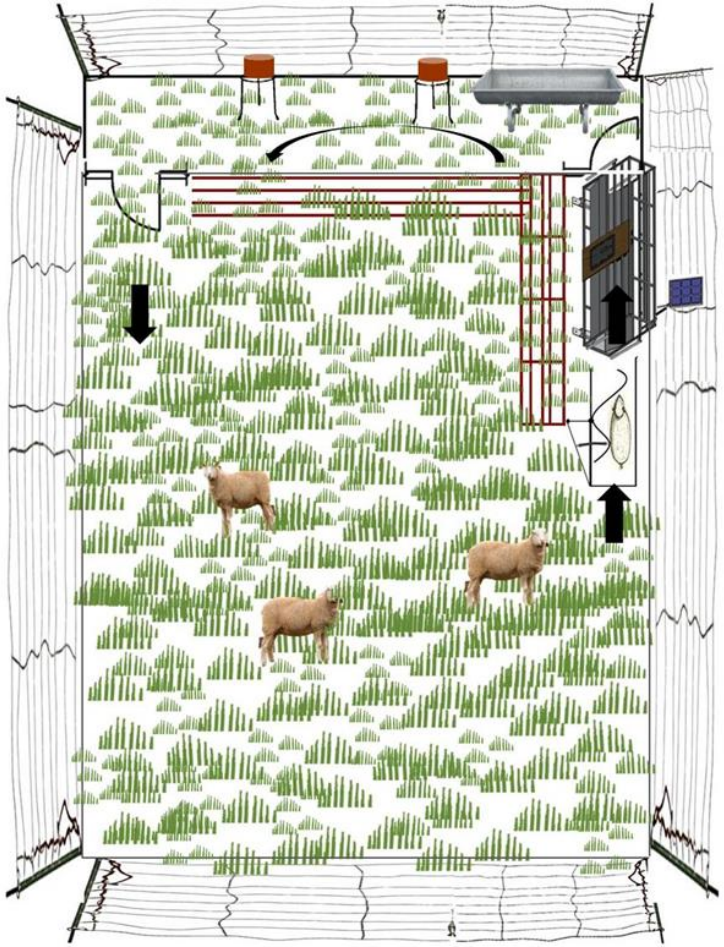
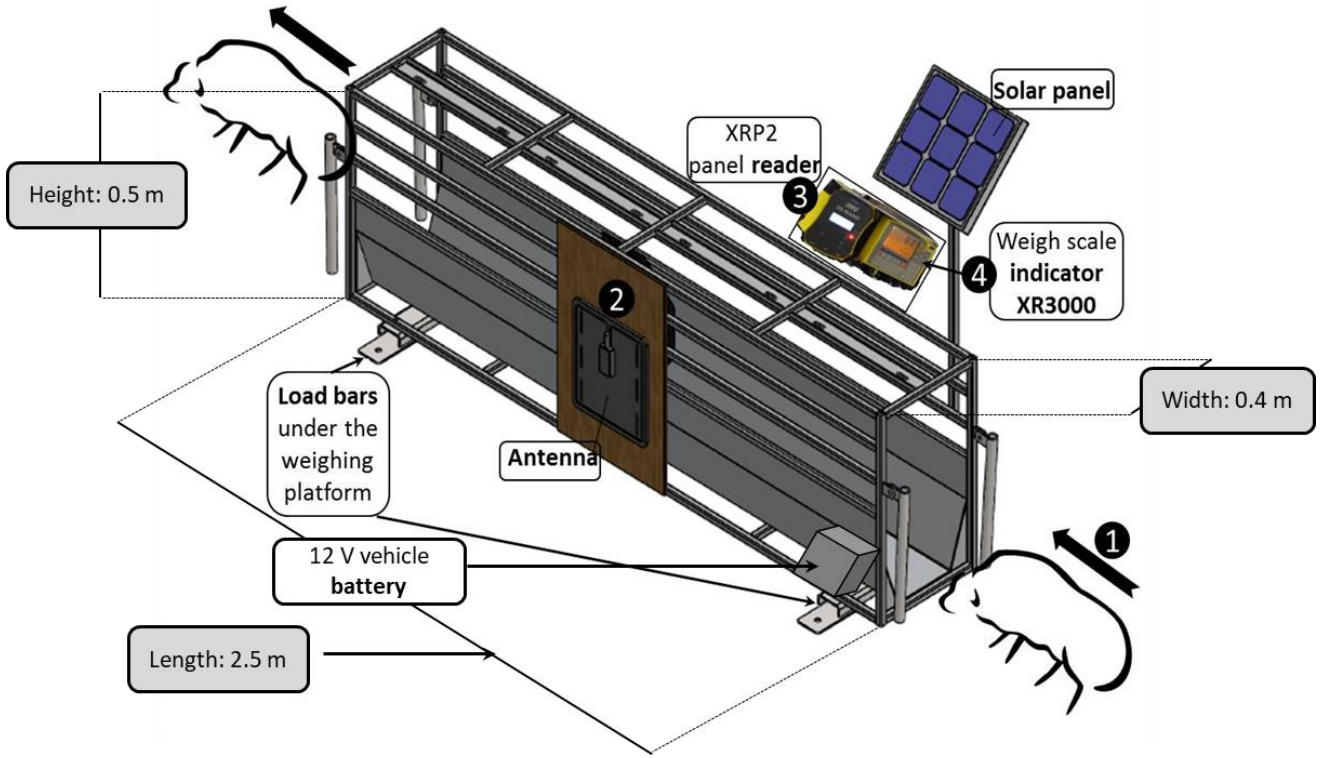
- **Monitoring LW**:
  - Time and labor consuming,
  - Stress source for animals and operators
  - Difficult task in outdoor conditions



- An **automated WoW system** for remote LW monitoring of sheep in a range of systems was developed

Liveweight is collected when the animal **voluntarily crosses** the **WoW platform**, strategically placed in a mandatory path, combined with a “attraction" area to stimulate passage



Feasibility of using the WoW **demonstrated** in a **range** of farming **conditions**

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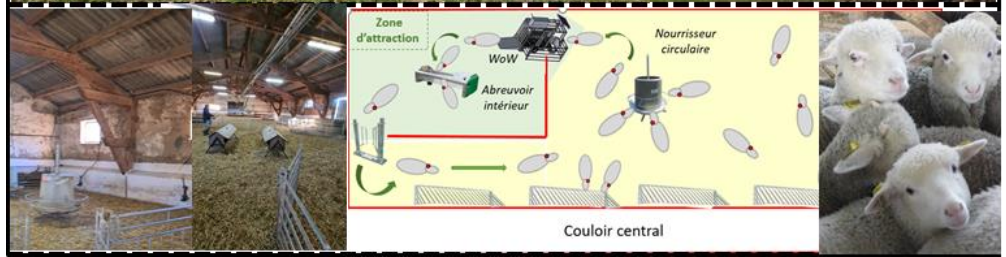
Indoor: adult ewes (*Romane* breed)

Outdoor (spring): rotational **grazing** (*Romane* ewelambs)

Outdoor (winter): extensive **grazing** (rangeland; adult *Romane* flock)

Indoor: dairy ewes (*Lacaune*) at exit race of **milking parlour**

Outdoor (spring): rotational **grazing** (*Mérinos d'Arles* ewelambs)



Indoor: fattening lambs (*Mérinos d'Arles* breed)

More information:

doi:10.1016/j.compag.2018.08.022
doi:10.1017/S1751731117002609.
doi: 10.3168/jds.2020-19075.
doi.org/10.1016/j.anopes.2022.100032
https://arxiv.org/abs/2208.00961
https://www.youtube.com/watch?v=te0mXY3Yum0&t=19s

How to monitor AWE with a **Walk-over-Weighing (WoW) platform**?

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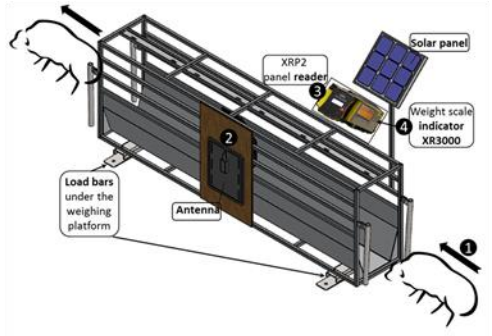
Body condition; nutritional status; health; behavior

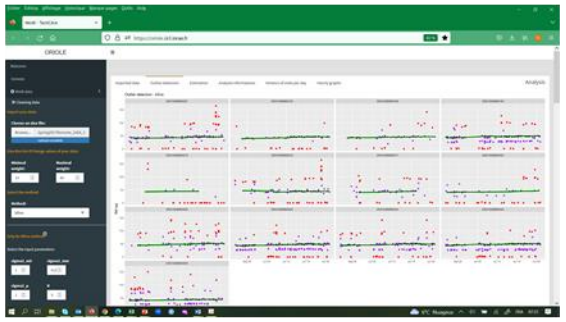
1) **Data** on individual **LW** are **produced**



✓ Progress on **individual LWs** are constantly and automatically collected

2) **LW** data **processed automatically**

https://oriole.sk8.inrae.fr/

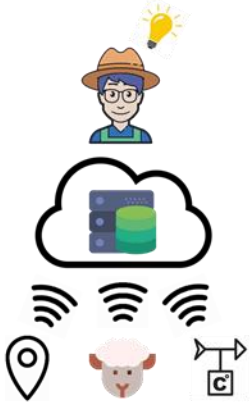


✓ **Outliers** are detected and **removed**

3) **EWS** are produced around:

✓**LW gains** or **losses** (*i.e.* undernutrition/ malnutrition events)
✓**Growth** rates (ADG) in lambs & yearlings
✓**Health** status (*e.g.* GIP)
✓Lambing **events**
✓**Behaviour** progress (*e.g.* through kinetics of visits to be related to weather or other events…)

4) **Farmers' decision makings** around:



✓**Feeding** and **nutrition** management
✓Grazing & supplementation **strategies**
✓**Veterinary** assistance
✓**Labour** planning
✓Slaughtering **schedules**

How to monitor AWE with **RFID UHF tags and antennas**?

Behavioral change, use of key resources; Health

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RFID Low frequency vs. High Frequency

Main characteristics and differences

UHF tag →

EID Tags – RFID :	Low-Frequency (LF)	Ultra-High Frequency (UHF)
Water effect	NO	YES
Read range	Up to 80 cm	Up to several meters (~6m.)
Adjustable Read range	NO	YES
Multiple readings	NO	YES

How to monitor AWE with **RFID UHF tags and antennas**?

Behavioural change, use of key resources; Health

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Multiple readings in large corridors

Wood fences

Metal fences

UHF waves reflect on metallic surfaces : « Tunnel effect » of metal fences

- **Install UHF tags on each animal, antennas inside/outside of the shed, record data with**
- **Count animals during batching (entrance/exit of an area/shed)**
- **Follow the order of individuals**
- Identify missing individuals identify animals that are lagging behind
- suspect potential lameness

How to monitor AWE with **RFID UHF tags and antennas**?

Behavioural change, use of key resources; Health

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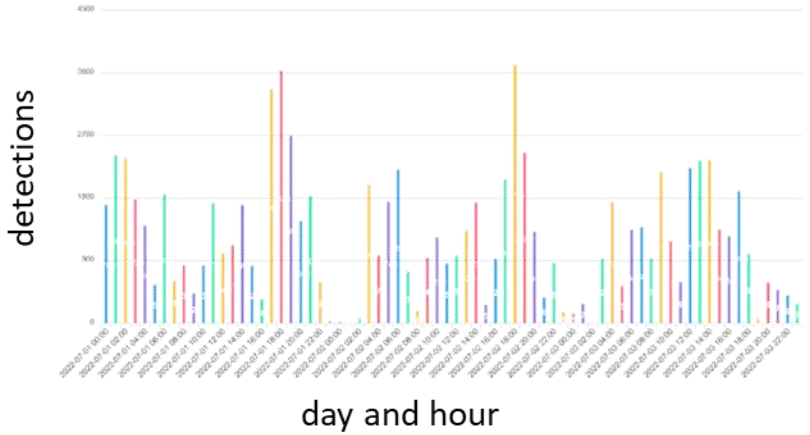
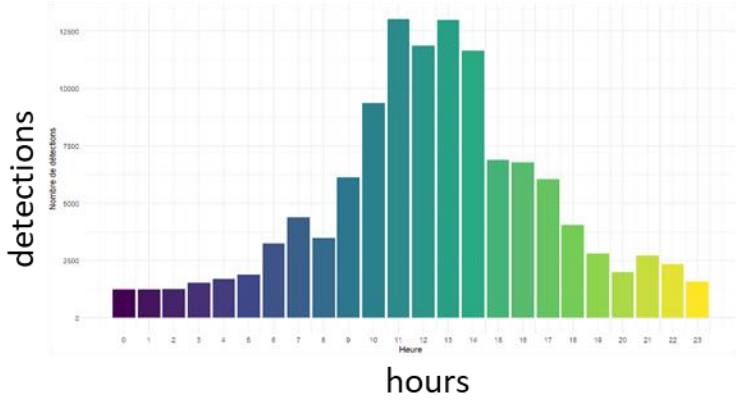
Track attendance of individuals at a point of interest (water trough)



Example: Detections of a lambs' group for 3 consecutive days
01/07/2022 to 03/07/2022



Example: cumulative detections per hour, for 1 lamb, over a period of 2 months
01/06/2022 to 31/07/2022

- **Install UHF tags on each animal, antennas inside/outside of the shed, record data**
- **count the number of visits (habits)**
- **Follow attendance, duration over time**
- **Identify breaks in habits, drops in attendance, absences**
- **Suspect health, lameness, or hydration issues**

Conclusions

Making the right choice

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✓ A project to **test, adapt and evaluate** a fairly wide range of technologies, for **small ruminant farming systems**
✓ Advance knowledge and the state of the art for these sectors

GPS and proximity sensors, weight platforms, video cameras, EID UHF tags, Accelerometers, GNSS (Global Navigation Satellite Systems) etc.

→ **highly frequent in a diversity of situations:** ***the question to address makes the difference!***

✓ **Some essential points to help make the right choice and continue to improve and adapt the solutions**

- **High TRL** score (availability in the market… or almost…), for pilots and large-scale farms
- **Acceptability** and **economic affordability** by the end-user (purchases and subscriptions)
- **Ease of use**, maintenance
- **Genericity**: able to cover a range of conditions & situations (e.g., indoor, outdoor, animal category & status)
- **Combining** techs and applying **EWS *ad hoc*** (according to the specific local priority): a good "umbrella" approach to detect potential health issues?

Follow the project on our networks to discover the next results