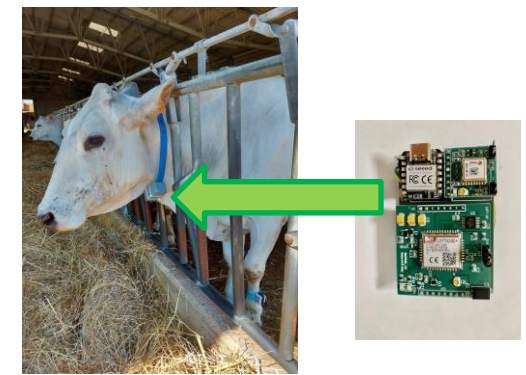
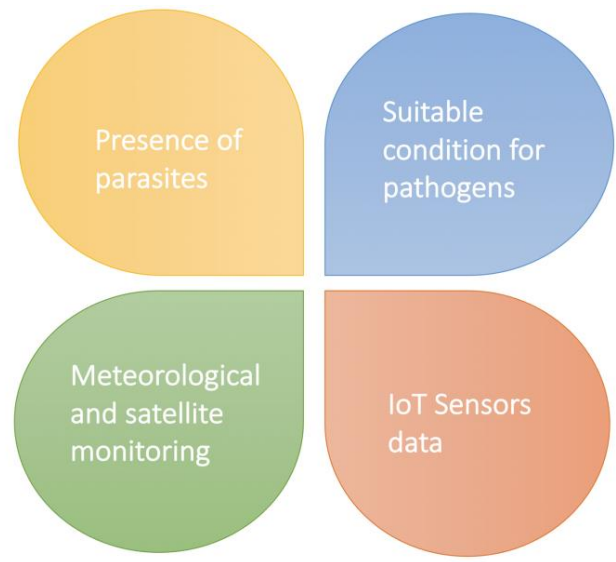
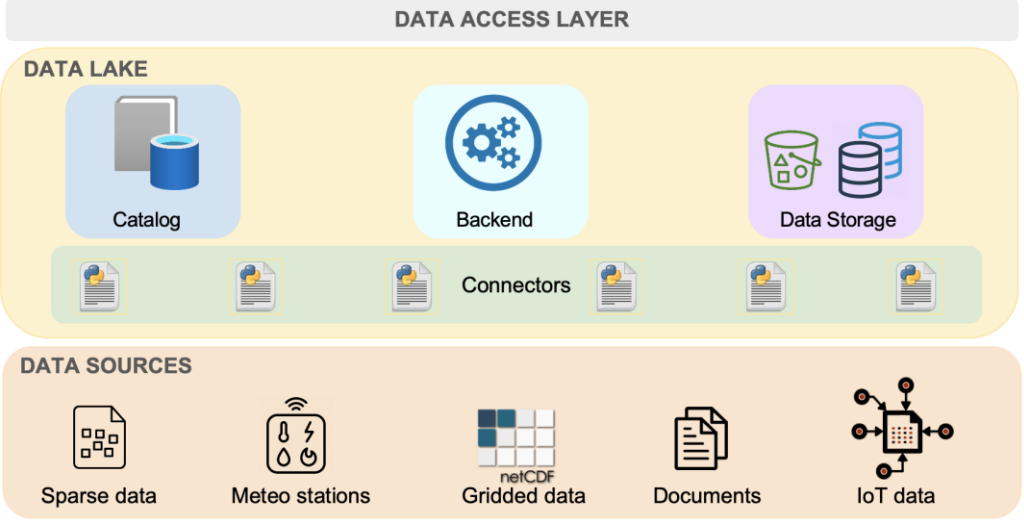
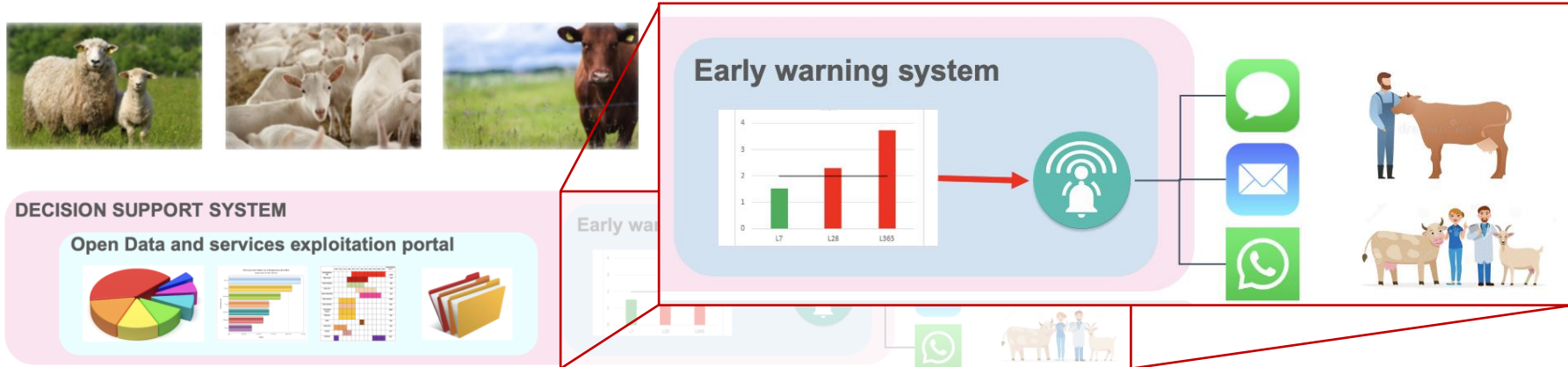




An early warning decision support system for disease outbreaks in the livestock sector

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 1. Centro Euro-Mediterraneo sui Cambiamenti Climatici, Lecce, Italy | 2. University of Tuscia, Viterbo, Italy | 3. CINECA, Bologna, Italy
 4. Associazione Italiana Allevatori, Rome, Italy | 5. Università Cattolica del Sacro Cuore, Milan, Italy



Environmental temperature and humidity + GPS + movement

An early warning decision support system for disease outbreaks in the livestock sector

Paola Nassisi, CMCC Foundation

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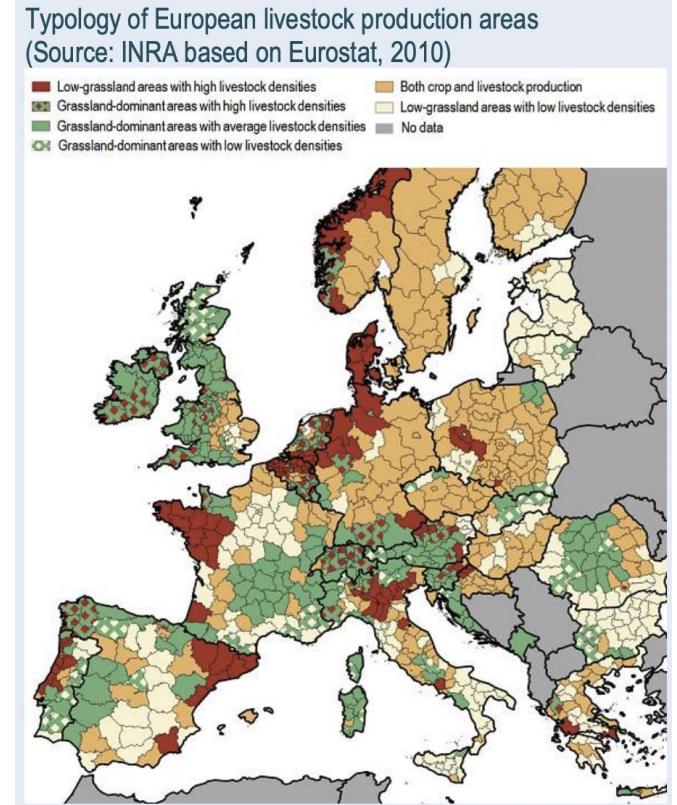
Some figures...



The livestock sector in 2017:

- 168€ billion annually
- 45% of the EU agricultural activity
- Wide diversity of production system
- 4 million of employees
- 400€ billion European industries linked to animal production

Animal Task Force (ATF. 2017a) Why is European animal production important today? Facts and figures



What is stress?



Stress

[stres] noun

Biological response elicited by the organism when perceiving a threat (stressor) to its homeostasis.





Sharing is encouraged

Chronic stress



SEBASTIEN Data Sources



Observations

- E-OBS Gridded Observations

Climate Reanalysis

- ERA5
- ERA5-Land
- UERRA
- CERRA

Seasonal Forecasts

- C3S Seasonal forecast data

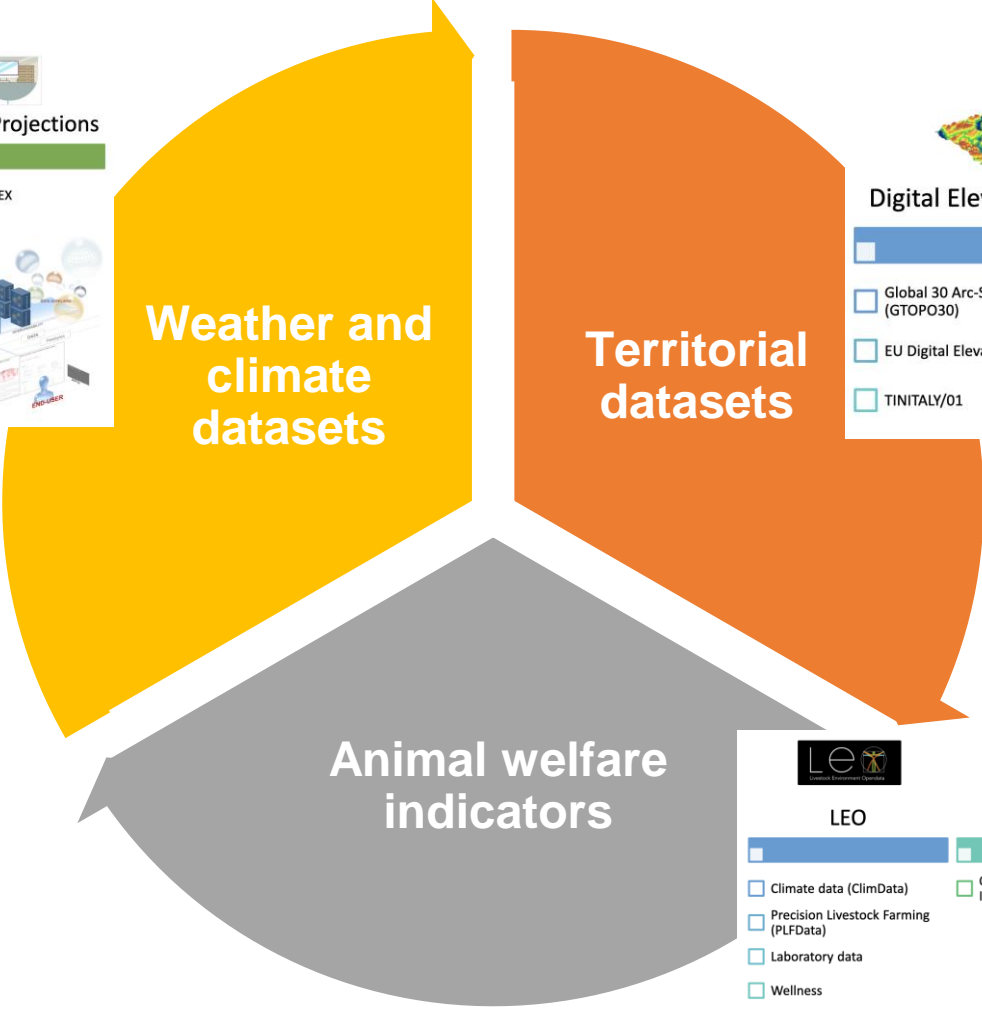
Climate Projections

- EURO-CORDEX

Access via API

ecmwf/cdsapi

Climate Change Service
climate.copernicus.eu



Digital Elevation Model

- Global 30 Arc-Second Elevation (GTOPO30)
- EU Digital Elevation Model (EU-DEM)
- TINITALY/01

Soil Type

- Harmonized World Soil Database v 1.2 (HWSD)
- European Soil Database v2.0
- SoilGrids250m

Land Cover

- CORINE Land Cover (CLC) 2018
- ESA CCI Land Cover map
- Land Use/Cover Area frame statistical Survey (LUCAS)



LEO

- Climate data (ClimData)
- Precision Livestock Farming (PLFData)
- Laboratory data
- Wellness
- Genetic data
- Collected data

OIE-WAHIS

- OIE World Animal Health Information System

SENTINEL datasets

- Sentinel - 1
- Sentinel - 2

IoT datasets

- Highlander datasets
- Sebastien IoT sensors

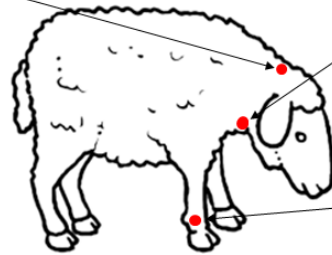


Animal Talker sensors



Main device

- **SIM7020**: allows to communicate the data of the buttons to a server using NB-IoT technology (**LoRa** module is the alternative);
- **GNSS module**: provides the position of the animal.
- **Accelerometer**: registers the movement of the animal's neck
- **Air temperature and humidity**



Skin temperature Air temperature and humidity

They can provide a measurement of the animal's core temperature if the data are properly related.

Accelerometer

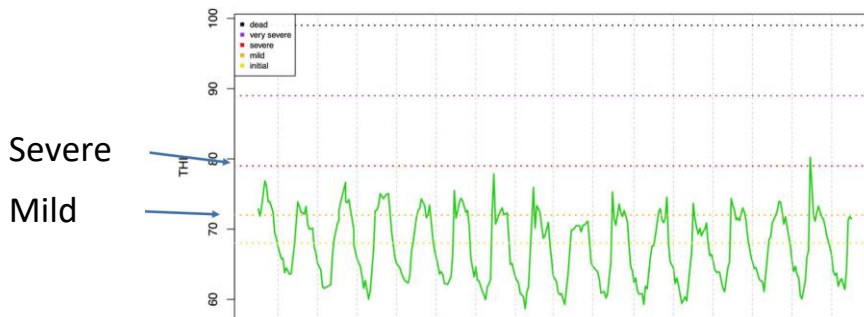
Powered by a button cell and located on the leg or the ankle of the animal. It can provide information about the movements of the animal that are related to its behaviour and wellbeing.



Movement



Environmental temperature and humidity + GPS + movement



Datasets for animal welfare indicators



Data exchange through LEO project –
Livestock Environment Opendata
(<https://www.leo-italy.eu/>)



OUR NUMBERS



45
Goat Breeds



54
Sheep Breeds



67
Cattle Breeds



1
Buffalo Breed



3194146
Monitored Animals



30507
Farms



49675403
Acquired Data



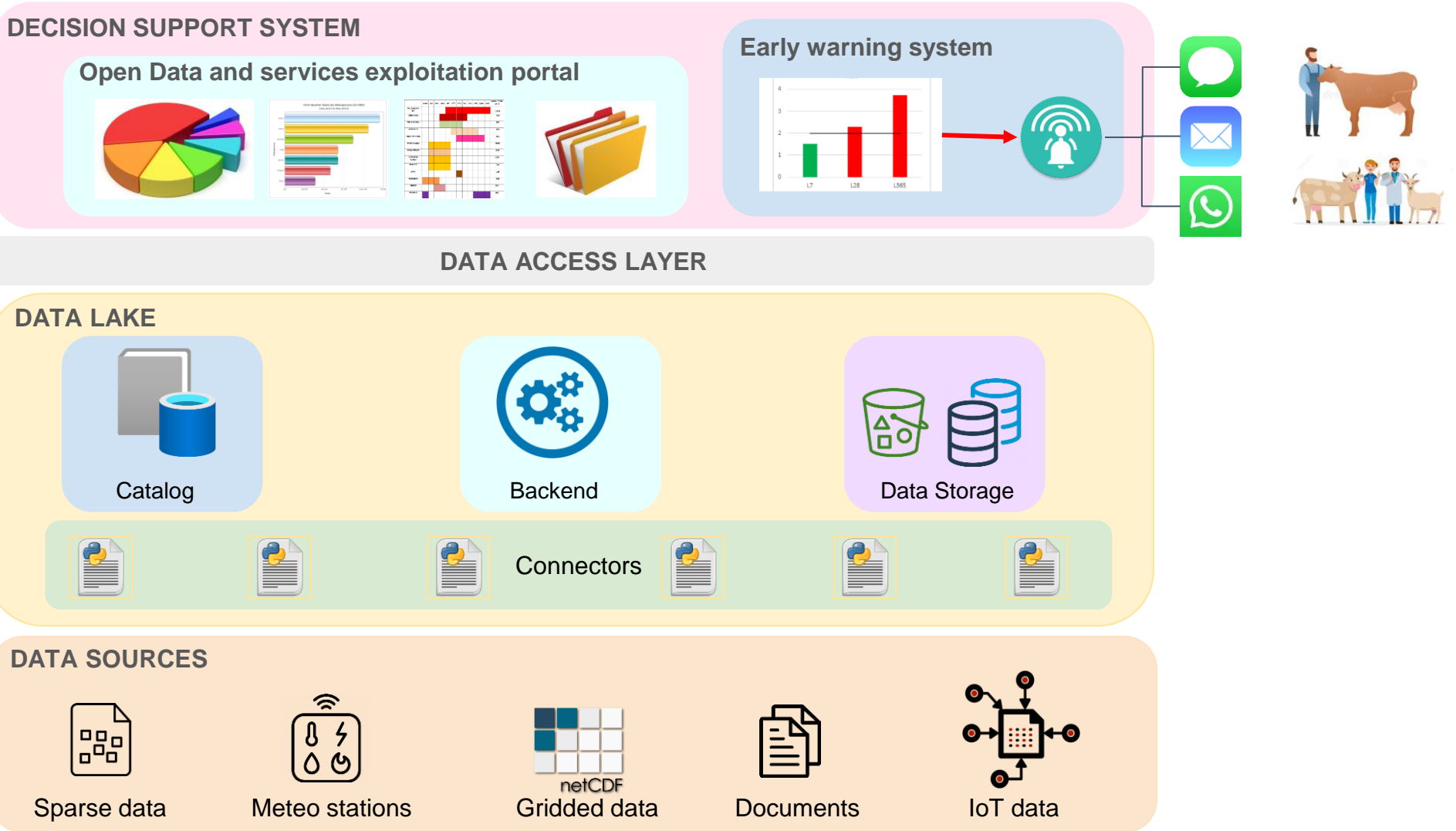
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Acquired Analysis



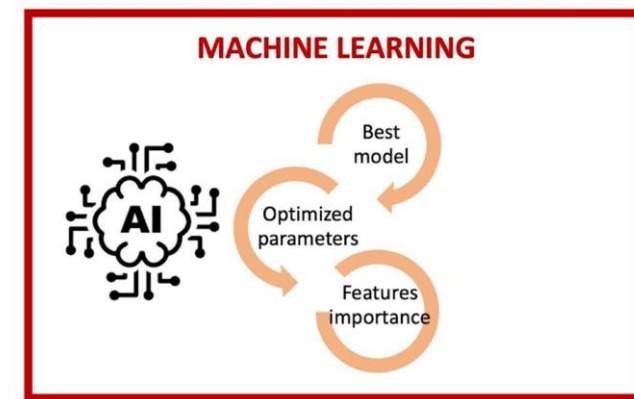
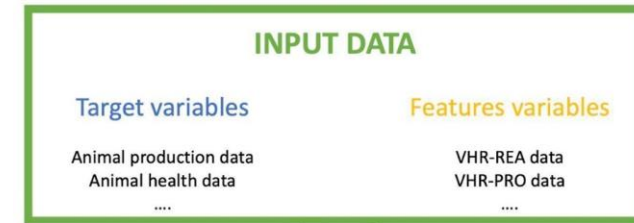
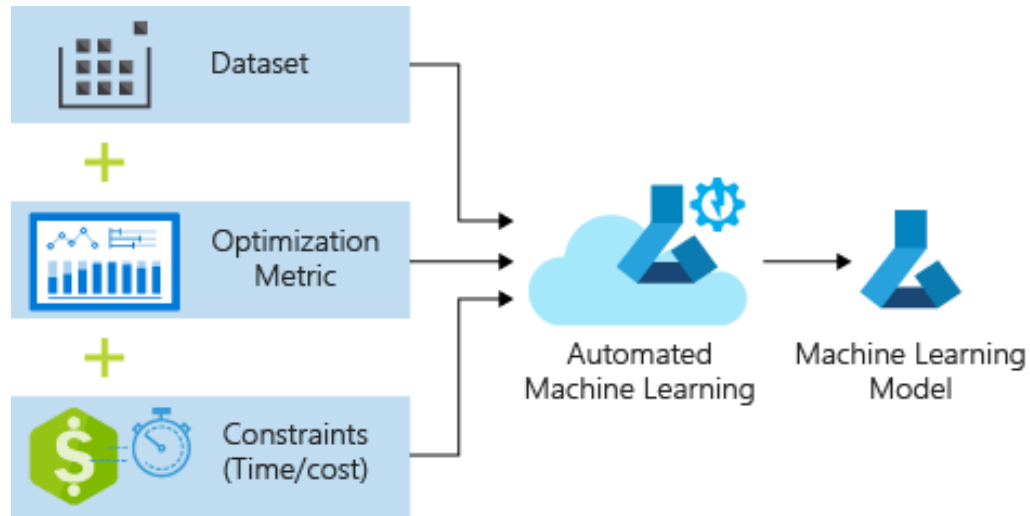
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Samples Gathered



SEBASTIEN architecture



Machine Learning & Artificial Intelligence approaches



Objectives



Provide early warnings related to data on the risk of infection with transmissible diseases determined on the basis of epidemiological, ecological and climatic data.

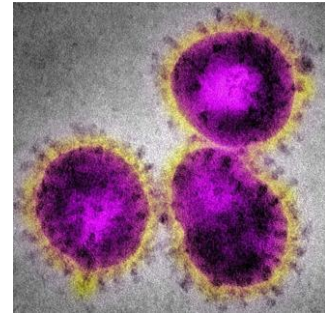
Initial targets:

- Visna maedi lentivirus in sheep and goats in Sardinia region
- Bluetongue RNA virus, transmitted by culicoides insect vectors, for sheep and goats in Sardinia region.
- predict the risk of infection to stimulate attention and anticipate prevention actions (e.g., culicoides control, vaccinations, quarantine, reform of animals at the first symptoms)
- model transfer to other vector born diseases
- Potential extension of the service to monitor West Nile virus distribution in Emilia Romagna region.

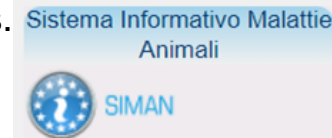


Maedi – Visna (MV)

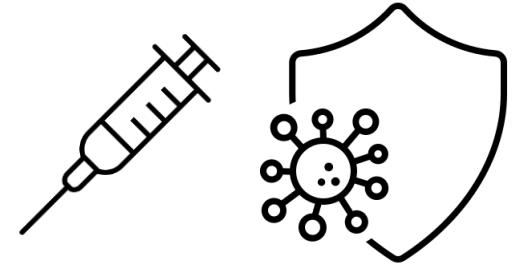
Maedi-Visna (MV) is a sheep disease characterized by respiratory (Maedi, determined by interstitial pneumonia) and nervous (Visna, progressive inflammatory disease of the central nervous system) clinical signs and occasionally of the joints and/or mastitis.



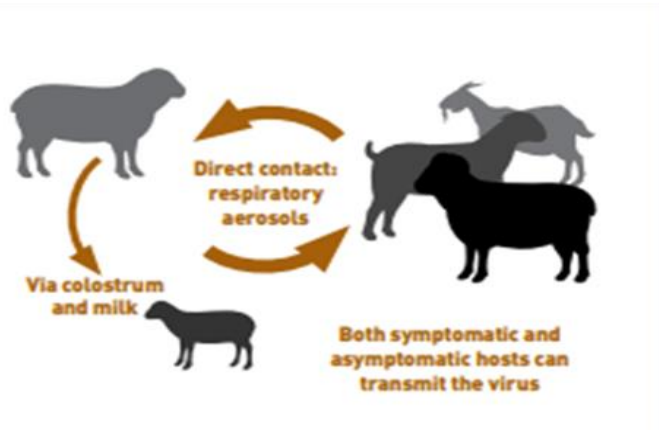
As Visna Maedi is a disease that requires surveillance, **it is subject to notification**. Veterinarians and laboratories must notify the cases of epizootic disease and suspicious symptoms.



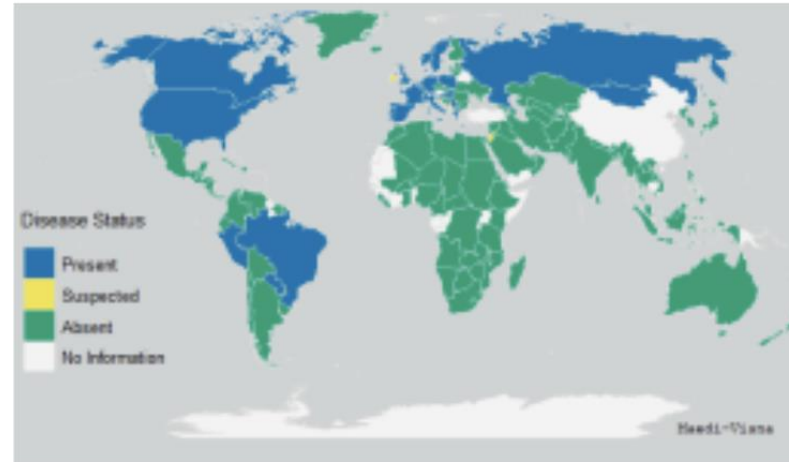
There are no effective preventative vaccines available against MV.



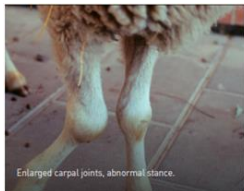
The Route of Transmission



Global distribution

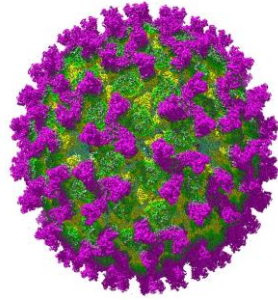


MV causes a **progressive, degenerative inflammatory disease** that affects many tissues, leading to economic losses in small ruminant production through culling, reduced birth weight and weight gain, and reduced milk yield.



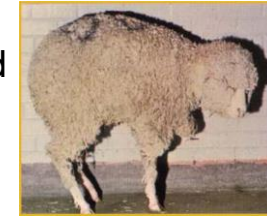
Bluetongue (BTV)

- Bluetongue (BTV) is an insect borne viral disease of domestic and wild ruminants, especially sheep.
- BTV is the type-species of the genus Orbivirus in the family Reoviridae.
- The name refers to the blue discoloration of the tongue and mucous membranes, due to cyanosis.

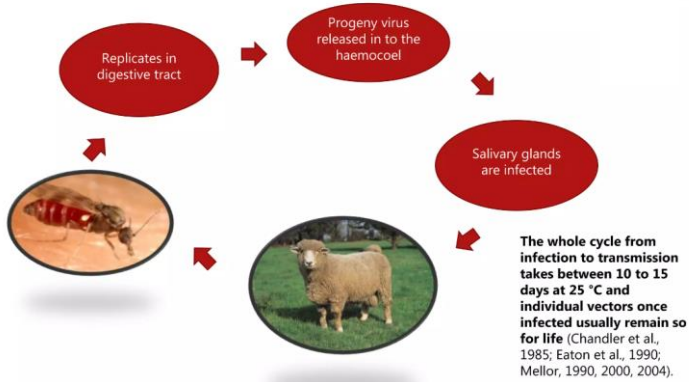


Clinical signs:

- Most asymptomatic
- Oral erosions and ulcerations
- Tongue: Swollen, protruding, Cyanotic = “blue-tongue”
- Reproductive failure
- Coronitis: Inflammation of coronary band
- Lameness: Painful hooves

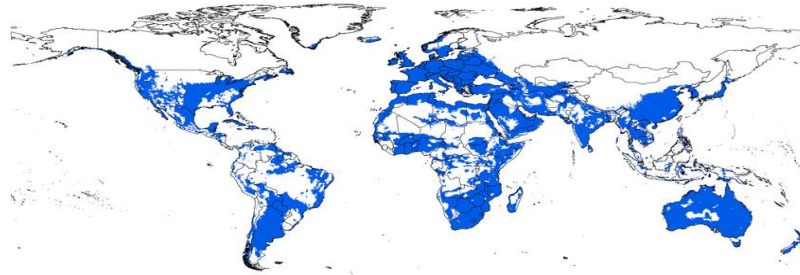


The route of Transmission

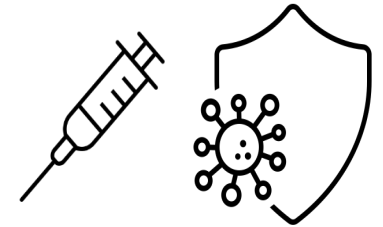


Map of distribution: Infection with bluetongue virus (BTV) is common in a broad band across the world.

The geographic restriction is in part related to the climatic and environmental conditions necessary to support the Culicoides vectors.



There are inactive vaccine available but not live attenuated vaccines.



BTV is classified as an **OIE list A disease/multiple species** and is therefore notifiable



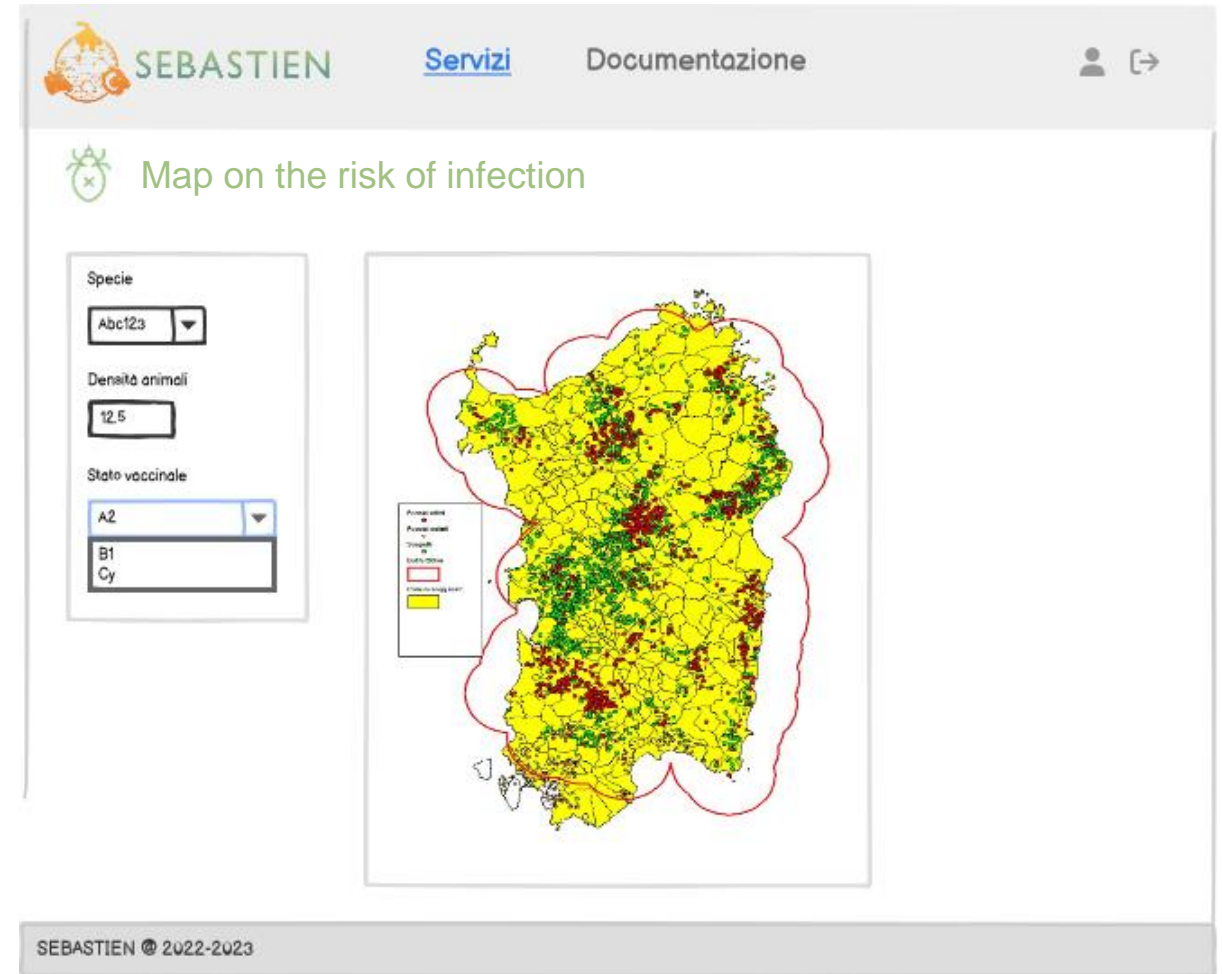
Map on the risk of infection



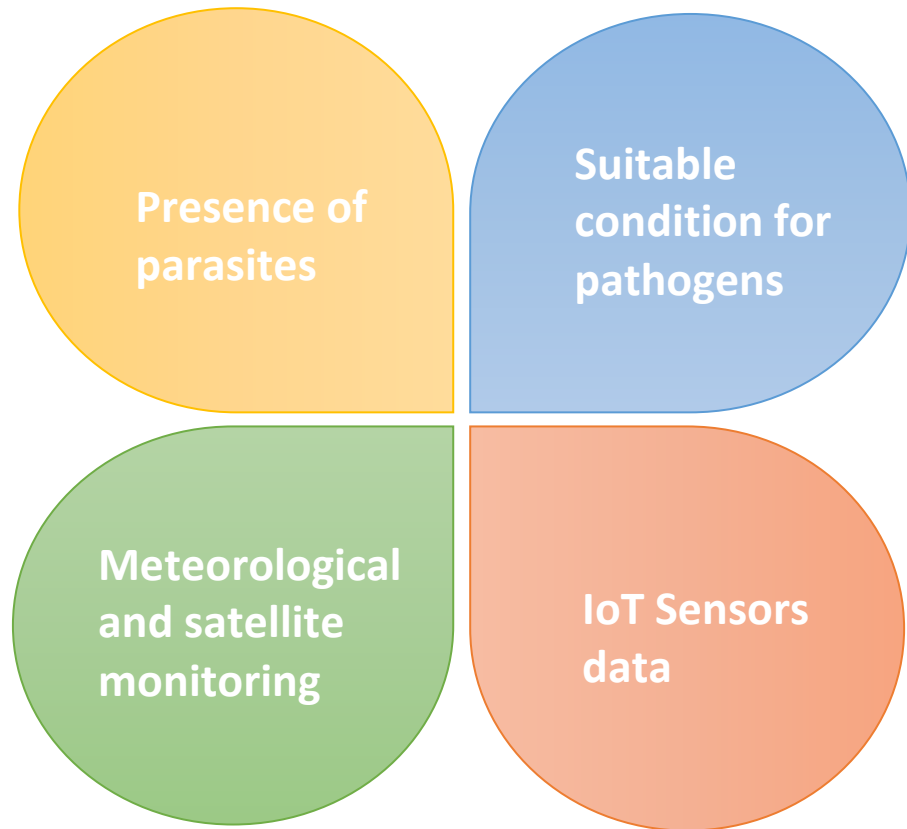
Parasites and pathogens

Maps on the risk of infection from communicable diseases determined on the basis of epidemiological, ecological and climatic data on Sardinia

INPUT	1. User : species, animal density, vaccination status 2. Data lake : climate data
OUTPUT	Short and medium term risk maps in Sardinia
Data to create the model	Epidemiological, ecological and climatic data

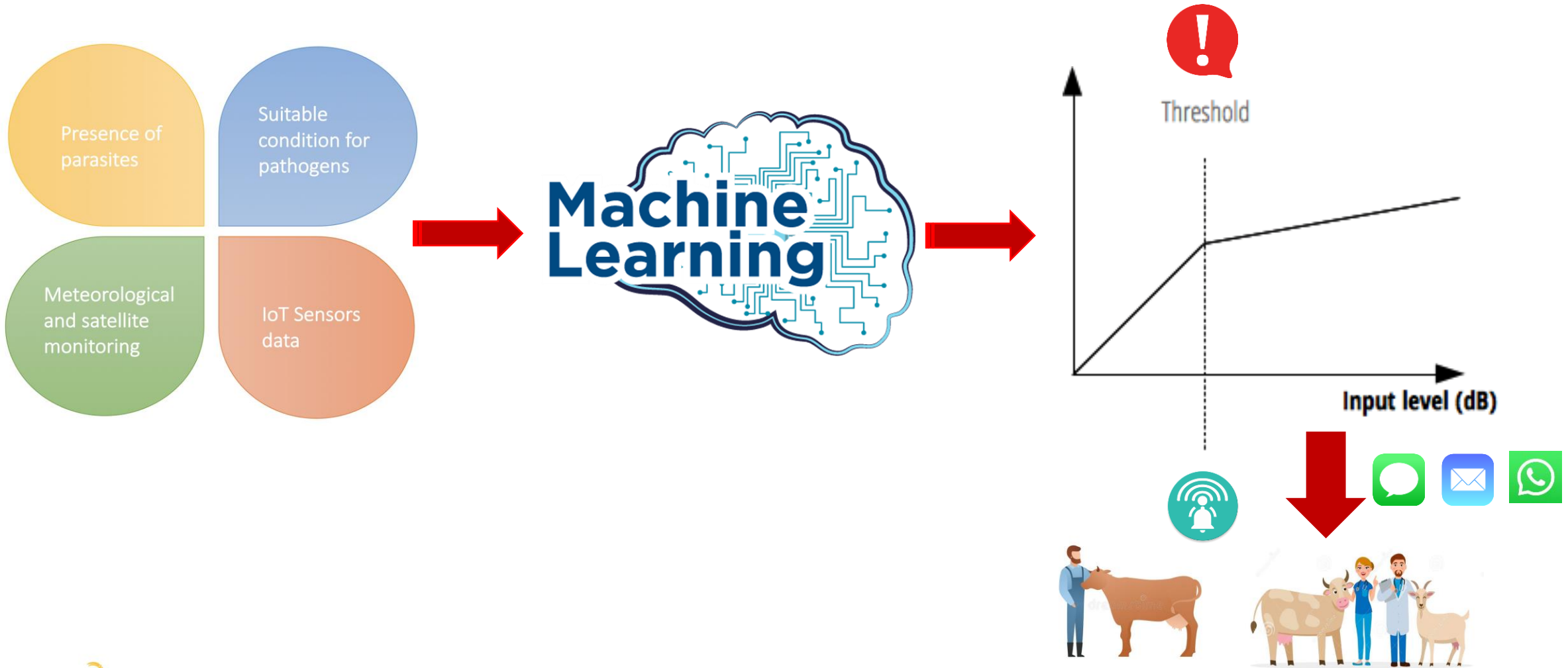


Data sources for early warning system

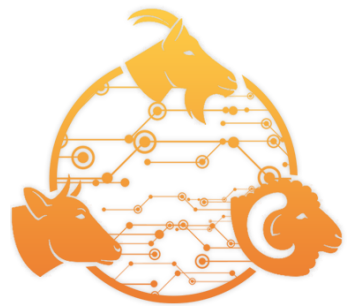


- Presence of parasites (outbreaks and spread of related diseases)
- Literature information about suitable conditions for pathogens
- Meteorological and satellite monitoring of wide areas
- AnimalTalker sensors data monitoring the animal wellbeing

Early warning system workflow



SEBASTIEN in a nutshell



SEBASTIEN



CINECA



Coordinator: Fondazione Centro Euro-Mediterraneo sui Cambiamenti Climatici (CMCC)

Topic: Public Open Data (POD) – Type of action: CEF-TC-2020-2

Duration: 30 months – Starting date: Jan 2022

Total budget: € 1.338.553,18

Total CEF Contribution: € 1.003.914,89

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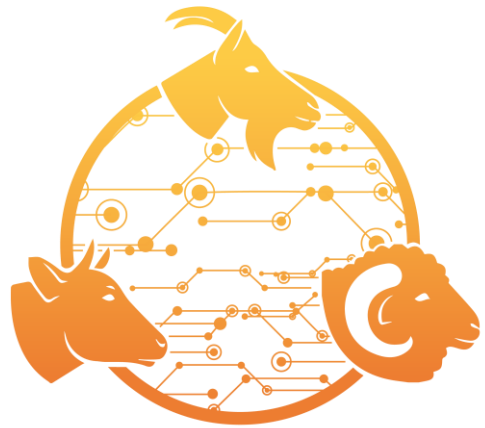


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Co-financed by the Connecting Europe Facility of the European Union

Thank you!



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