Taking advantage of responsible digital for sustainable livestock farming systems

Ludovic Brossard

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Ludovic Brossard (FR) - Deputy head of joint research unit PEGASE at INRAE

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This Project has received funding from the European Union's Horizon 2020 research and innovation programme, *through an Open Call issued and executed under the project SmartAgriHubs (Grant Agreement No 818182).*

Challenges for livestock farming systems

- **Economic and political context**
- **Increasing demand for animal products (in the world)**
- **Intensification of production**
  - Larger farms -> more animal / farmer and less time available / animal
  - Increasing productivity of animals and work

- **Environmental impact**
  - Energy consumption
  - Feed production
  - Excretion / emission of pollutants

- **Increasing concerns about animal health and welfare**
- **New demands and views of livestock farming by consumers and society**
- **Social expectations of farmers (workload, attractiveness)**

Evolution of livestock farming system

- **Growing importance of agroecology**
  - aims to stimulate natural processes to design agricultural systems that are weakly artificialized, productive, environmentally friendly, and less dependent on chemical inputs (Dumont et al., 2018)

- **Five principles to extend and apply agroecological concepts to livestock farming systems (Dumont et al., 2018):**
  - adopting management practices aiming to improve animal health,
  - decreasing the inputs needed for production,
  - decreasing pollution by optimizing the metabolic functioning of farming systems,
  - enhancing diversity within livestock farming systems to strengthen their resilience,
  - preserving biological diversity in agroecosystems by adapting management practices

- **"One Health/One Welfare" concepts**
  - Animal health and welfare considered in a holistic approach integrating animals, humans, and their environment, and across scales (local, national, and worldwide)

General digital evolution

- **Revolution in digital new technologies**
  - In society in general
  - In agriculture

pixnio 

frandroid 

autofou 

- **More and more advances electronic systems (wearable, autonomous, reactive)**
  - IoT, connected objects
  - Robotic / cobotic
  - Virtual / augmented reality
  - Data and information flow / Big Data

boutmatic 

guide-drone 

- **Methods for data analysis (high throughput , dynamic, AI, machine learning…)**

myeasyfarm 

“

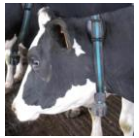
How to combine these concepts and technologies for sustainable livestock farming systems?

Decreasing the inputs needed for production

- Importance of environmental impact of animal feed production
  ➔ improve efficiency of feed utilisation to reduce inputs in livestock systems

- Identification (RFID), connected weigh scales, milking robots, automatic feed dispensers… as support for precision feeding
  = individual and daily adjustment of feed quantity and / or composition to individual nutritional requirements

www.allflex.global



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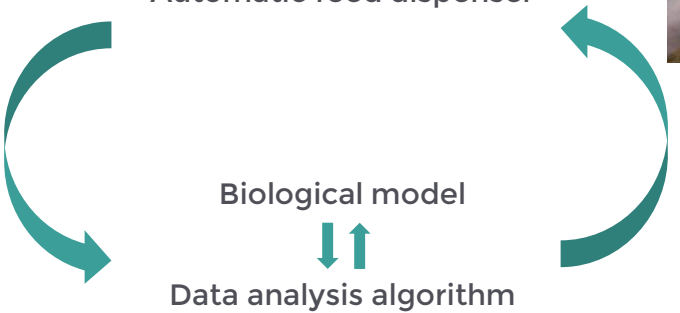
Decreasing the inputs needed for production

Example of precision feeding in sows



- **Adaptation of feed composition depending on reproduction performance, feed intake, body composition… in gestating or lactating sows**

➔ *reduction of 18.5 and 9% of nitrogen and phosphorus excretion and of 4% of feed cost per gestation*

Gaillard and Dourmad, 2022

Integrated management to improve animal health and welfare

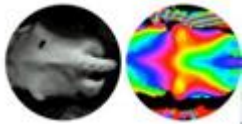
- **Integrated management of farm animal health:**
  - ➔ needs knowledge on
    - local environment
    - physiology and behaviour of animals

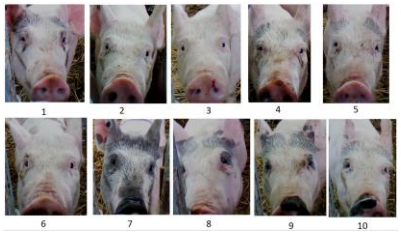
- **Digital tools, based on a combination of various sensors, can be used to improve the acquisition, management, processing, and sharing of a complex information (different criteria, scales) in support to action, depending on algorithm quality**
  - Assistance to improve prophylactic and curative treatments
  - Early detection of disease or welfare issues
  - Improvement of quality, quantity, targeting of treatments

Integrated management to improve animal health and welfare

- **Panel of digital solutions to acquire measures to be aggregated**
  - automates such as feeders, scales, milking robots…
  - wearable sensors (accelerometers, internal sensors…)
  - machine vision
  - sound analysis







- **To be adapted to purposes and characteristics of livestock system**
  - for all systems: concerns on disease, heat stress…
  - pasture based systems: undernutrition, parasitism…
  - indoor production: postures, interactions between animals…
- **While avoiding overmedication and ensuring confidence in tools**

Well-being of farmers

- One health / One Welfare includes wellbeing of farmer
- Automates, robots and sensors can allow farmers to save time by replacing physical tasks, simplifying monitoring while bringing flexibility and reducing stress through anticipation




www.acofunki.fr

www.pellon.fi

www.octopusrobots.com

www.tibot.fr

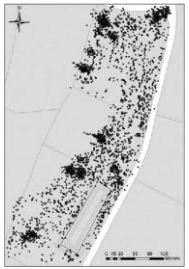
- Changes in relationships with animals positively or negatively depending if saved time is reported to animal care
- Changes in the farmer's job
  - More attractive (new tools and skills, modern image)
  - Mental load regarding complexity, alerts, breakdowns
  - Loss of some skills and content if less close to animals…

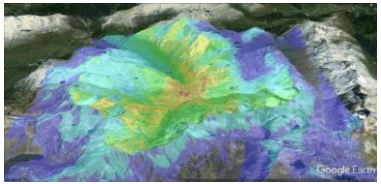
Digital for a diversity of livestock farming systems

- More freedom for animals with outdoor access in livestock farming systems changing towards agroecological concepts

  ➔ *digital can help to continue to monitor animals and to understand effects of this evolution on welfare, health… (e.g., accelerometers, GPS, pedometers)*

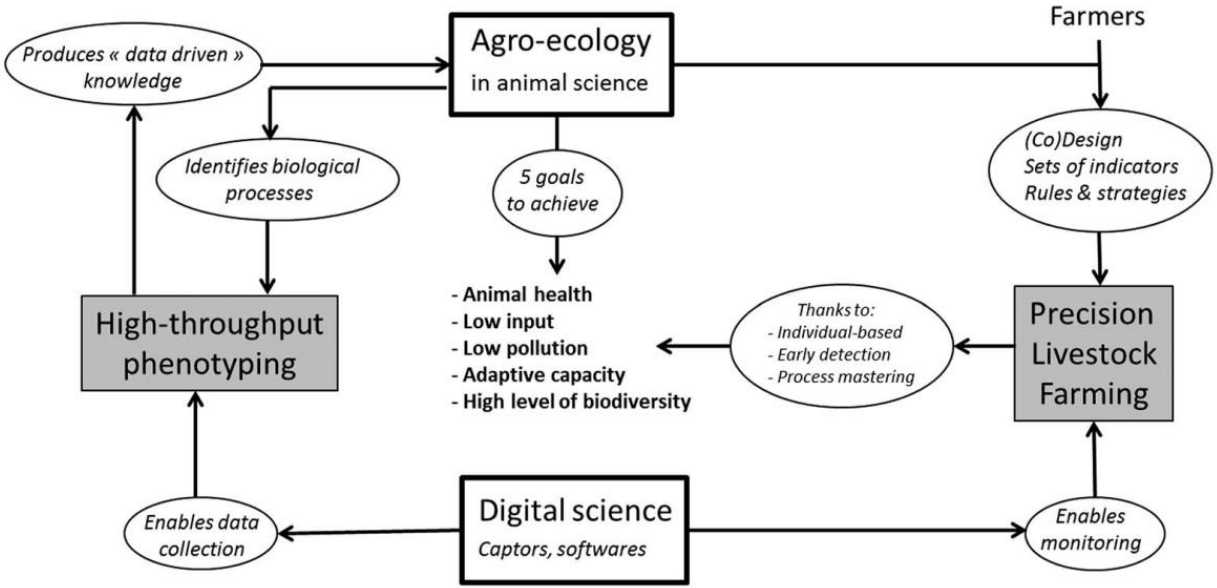
- Mountain farming, pastoralism can benefit from such devices to help simplifying labor, monitoring and protect animals, managing resources (e.g. virtual fencing), traceability of products





Conclusion

Digital as a support but not a driver for agroecological transition in livestock farming systems



Ingrand et al., 2018

Conclusion

Digital within agroecological livestock farming systems: a balance to find between positive internalities and negative externalities

- **Possible limitation of sustainability of digital solutions**
  - lack of interoperability, risk of standardization (technics, animals…)
  - negative environmental impacts (extraction, waste management…)
  - resource consumption (electricity…) and limitation of resources (raw materials for plastic, electronic components)
  - costs/benefits for farmers

- **Potential for effective use to assist inputs and management at different scales (animals, waste production, market…) while being compatible with agroecology concepts)**

➔ *The integration of digital tools within agroecological livestock farming systems should be considered by taking into account this balance*

Thank you!

And thanks to Clément ALLAIN (Idele, FR) and Jean-Baptiste MENASSOL (Institut Agro, FR)