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The role of advisory services in the adoption of precision farming tools

The case of crop input modulation tools for fertilization

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Outlines of the presentation

- Main objective : Understand the adoption process of precision farming tools by farmers and the role of advisory organizations

Introduction

- **Interest of precision farming development in the transition towards sustainable agriculture**

- Mainstream agriculture is being challenged. It exists several crisis directly linked to farming practices.
  - *Example: the contamination of water by nitrogen is linked to a miss use of fertilization*

- A solution to overcome those challenges would be farming innovation, including digital innovation
  - *Precision farming is part of the global trend of digitalisation of agriculture. Precision farming tools are supposed to help farmers to have more « precise » fertilisation practices.*

- Precision farming is supported by several public policies and had recognized legitimacy in legislation
  - *Precision farming tools recommendations are recognized as valid by nitrogen regulation*

Problem statement

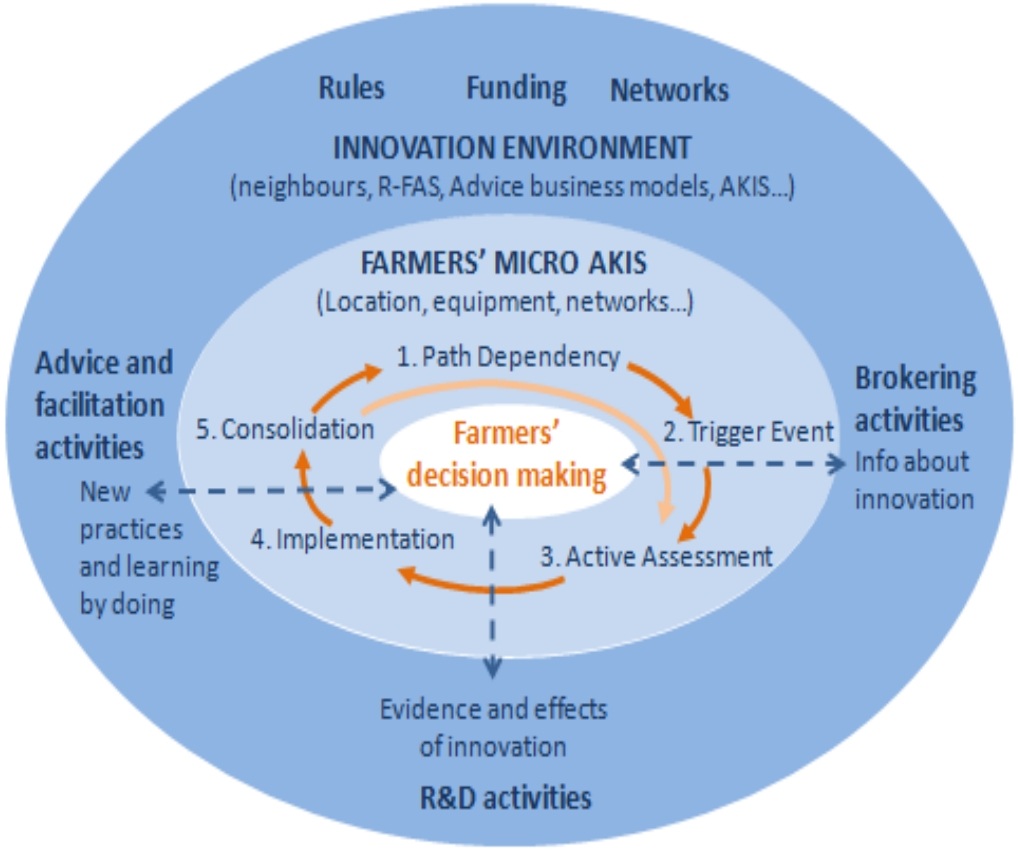
- But there are still **controversies** about precision farming tools
  - controversies about their accurancy
  - controversies about their impact on the farming system sustainability (Wolf and Buttel 1996 ; Bronson and Knezevic, 2016 ; Rotz et al, 2019)

- To reduce these uncertainties, there is a **need of creation and diffusion of knowledge in the farming system.**
  - Research and Development activities can not be led at the level of the farm because farms are too small entities. To answer this issue, farming sector organized itself around **intermediaries** that are supposed to be the link between farmers and knowledge about innovations.

- **What role do advisory organizations play in the adoption of precision farming innovation ?**

Concepts and Methods (1)
- Conceptual framework

- Focus on the adoption process of an innovation by farmers



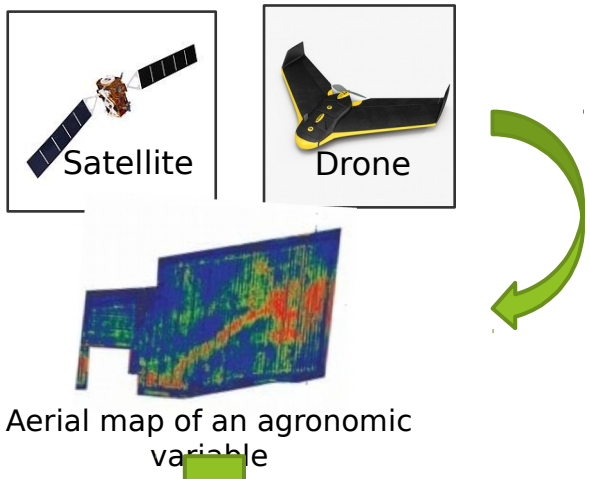
- This model considers the decision-making as the result of several steps (from the Triggering Change model, Sutherland, 2012).
- This process is iterative and strongly embedded in a multi dimensional environment.
- Advisory environment can influences farmers' decisions.

Sources : AgriLink Project conceptual framework

Concepts and methods (2)
- Case study : the use of crop input modulation tools

- Precision farming tools that advice farmers about the « optimal dose » of fertilizer to put on each part of the land

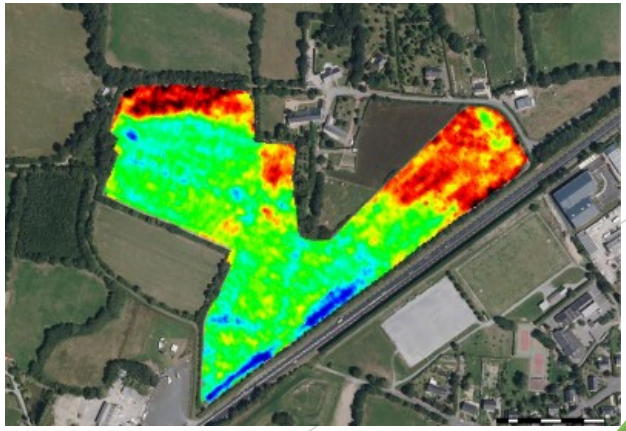
Software



Hardware

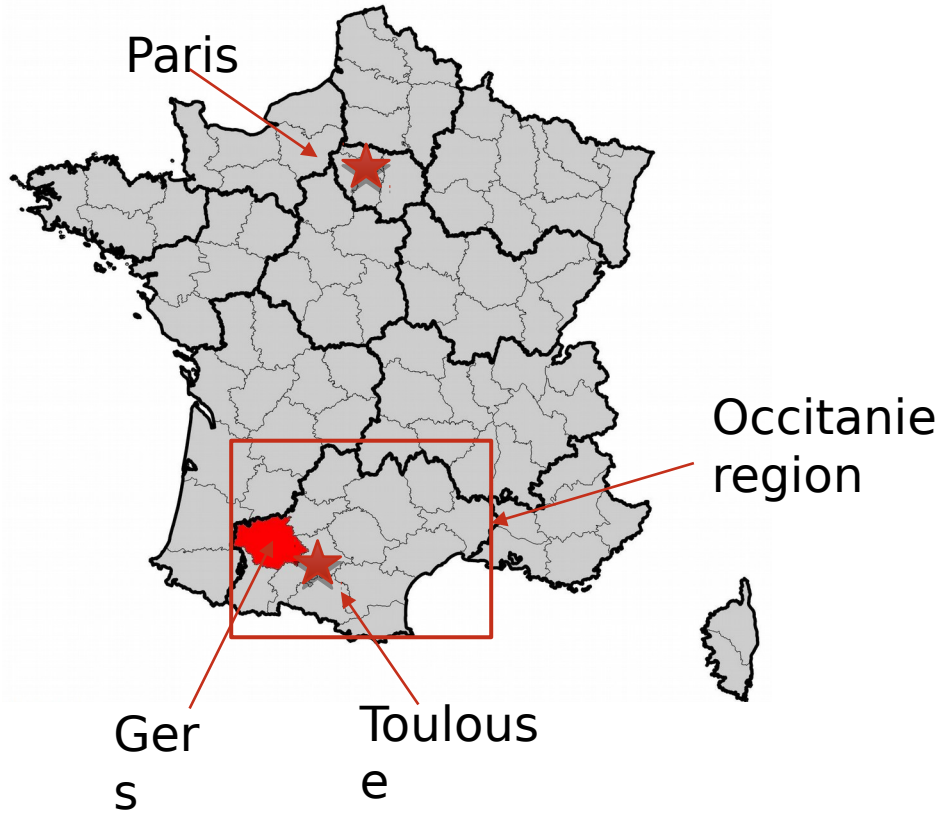
Automatic modulation console

Upload via USB key



Concepts and Methods (3)

- Focus region : Le Gers



- Rural department with a high level of crop diversity
- Farming sector represents 12% of jobs of the department (3 times more than in Occitanie)
- Stratigically positionned next to Toulouse aerospace cluster
- Several gatherings and fairs to show the willingness to be at the head of precision farming development

Concepts and Methods (4) – survey details

Interviews with farmers	Interviews with key actors	Participant observations
33 interviews (about 2h) 20 adopters 5 « droppers » 8 non adopters Semi directive interviews based on the AgriLink questionnaire and additional open-ended questions Sampling method : snowball technique (first contacts obtnaied via main advice organizations that are selling tools)	*7 personal interviews (about 1h)* *Agricultural Chamber (Person in charge of precision farming) *John Deere (product leader) * Cooperative (innovation team) *Start ups : Sigfox (innovation project leader), start-up Airinov (ex CEO) *Regional agricultural innovation cluster(person in charge of the drone project) *INRA (person in charge of drones experimentations)	*Training day for farmers at John Deere on precision farming. *Innovation day for crop advisors *Agricultural events : *Printemps d'Agri Sud Ouest Innovation (annual meeting of the regional agricultural innovation cluster), FA2D (Forum of digital and sustainable agriculture)* *Agricultoral fairs : *les culturales, FIRA (International Forum of Agricultural Robotics), SIMA (Paris International Agribusiness show)*

Results (1)

- **Mismatches between precision farming ecological stated aim and adopters' motivations**

- ***Paradoxical farmers' discourses*** in terms of total amount of fertilizer applied on the land.

- ***Main motivations:*** In farmers speeches, economics aspects overtake environmental considerations (main motivation of adoption is to have better yields).

- ***Main perceived effects:*** Many farmers say that tools have a positive effect on the "local community". Indeed, the use of tools is contributing to an image of an environmentally friendly farmer.

Results (2)

- **Paradoxical adoption patterns**

- Not a total adoption of the technology : some farmers adopt the software (the tool) without the hardware(the automatic modulation console)
- These paradoxicals situation don't seem to be linked to the farm scale, farmers' age nor farmers education level

	Number of farmers	Including droppers	Agricultural land (mediane in hectares)	Age >55 years old	Education > highschool diploma
No technologies	6	0	102,5	16,7%	16,7%
Both hardware and software	17	0	150	47,1%	47,1%
Hardware without soft	3	1	120	100%	0%
Software without hardware	7	5	200	14,3%	71,4%

Table 1 : Farmers' characteristics regarding their attitude towards innovation

 Sub-optimals situations : what is the role of advisory organizations? How do they adress these situations?

Results (3)

- **Advisory organizations have a key role in triggering the adoption**

- ***Awareness*** : Farmers are already aware of the existence of crop input modulation tools before speaking with advisors

- ***Trigger*** : Adoption is « supply driven », but in an indirect way. Advisors propose to to adopt the innovation through suscribing to a drone or satellite service.

- Farmers who recieved the offer tend to be the one advisors know more and that are well integrated in local professionnal groups

	Member of a cooperative board	Member of a farm union	Total
Farmers who receive an offer from advisors	5	10	27
Farmers who did NOT receive an offer from advisors	1	0	6
Total	6	10	33

→ Every farmer who received the offer tried it

→ Farmers who did not received any offer do not adopt the tool

Table 2 : Main local responsabilities of farmers

 Advisors are embeeded in a commercial relationship with farmers

Results (4)

- **Extension and advisory services are less requested by farmers for evaluation and implementation of the tool**

- ***Evaluation*** is closely linked to the general micro-AKIS of the farmer. Farmers who have diverse source of advice tend to assess more. In general, farmer is very quick and the result is always positive.

- ***Implementation*** : Traditionnal advisors are less present during implementation. Machinery dealers appear to be more competent to help farmers solving difficulties (because they are linked to machines and compatibility)

Discussion (1)

- **About farmers' decison making**
  - **Difficulties to use the Triggering Change Model (Sutherland, 2012) in our case study**

- Difficulties to differenciate the stages of the decision making process
- No specific trigger events. Adoption of the innovation is « pushed », but by traditional advisors (not by the manufacturers).

Discussion (2)

- **About precision farming innovation**

  - **Adoption of precision farming tools is not disruptive : the result of path dependence ?**

- Traditional advisors « trigger » the adoption but they tend to target mainly farmers that are already integrated in professionnal local groups doing mainstream agriculture.
- → Are precision farming tools reinforcing main industries and actors already present in the mainstream agrofood system (Bronson and Knezevic, 2016) ?

- Farmers using precision farming tools are seen as « good farmers » by their neighbours
- → What role does farmers' reputations plays in the development of precision farming?

Discussion (3)

- **About digitalisation and new business models of advisory services**

  - **Changes in the structure of traditional advisory organizations**

- Growing differentiation between organizations that are exclusively doing front office activities and organizations that are doing exclusively back office
- → Risk is that advisory organizations loose contact with new knowledge and are less able to assess innovations (Klerkx, 2010).

  - **Other organizations enter the advisory landscape**

- Organizations that produce precision farming tools provide advice, in an indirect way
- Machinery dealers are key actors of the implementation (other competences than traditional advisors)
- → What will be the relations (cooperation or competition) between traditional advisors and new actors? And how it will affect knowledge creation and diffusion ?

Conclusion

- **Key findings**
  - Mismatches between precision farming theoritical environmental goal and real farmers practices.
  - Farmers have paradoxical adoption patterns
  - Advisory organizations push the adoption of precision farming innovations but they are less present to evaluate it.

- **Interrogations**
  - Precision farming may be the result of path dependence and reinforcing the mainstream model
  - In what extend can social representation be a driver for the adoption of digital technologies ?
  - However, precision farming development may have effects on the structure of advisory organizations and landscape

- **Research opportunities**
  - How precision farming affects business models and R&D investments of advisory organizations ?

Thank you for your attention !

Appendix (1)

	Adopters	Non-adopters	Droppers
Number of Farmers	19	8	6
Agricultural land (mediane, in hectares)	150	200	102,5
Aged of more than 51 years old	9	3	1
With at least a high school diploma	14	6	3
Using at least one farming software	14	6	3
Using at least one farming app	8	3	1

Table : Characteristics of farmers in the sample

Appendix (2)

	Number of farmers	Including droppers	Agricultural land (mediane in hectares)	Age >55 years old	Education > highschool diploma	Responsabilities within a cooperative board	Responsabilities within a farmer union
No technologies	6	0	102,5	16,7%	16,7%	0%	0%
Both hardware and software	17	0	150	47,1%	47,1%	29,4%	47,1%
Hardware without soft	3	1	120	100%	0%	0%	0%
Software without hardware	7	5	200	14,3%	71,4%	14,3%	28,6%

Table 1 : Farmers' characteristics regarding their attitude towards innovation

Appendix (3)

- Distinction front office / back office

A fuzzy range of intermediaries actors between coexists in the farming innovation system.

- ***Front offices activities*** are made directly between farmers and intermediaries and aim to guide farmers in their adoption of practices and tools. This service relationship is also social and
- ***Back office activities*** are RD activities