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Uses of precision farming in an arable crops-oriented region in northern France: diversity and perceived impacts by farmers

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Introduction

According to literature, the benefits of precision farming (PF) are multiple but mainly economic and environmental. In France the spreading of precision farming occurred within the last 10 years, mainly supported by the development of GPS –RTK technology, including GPS guidance (manual or assisted), section control and variable rate application. Local extension services need now information about the effects of these techniques at the farm level and their diffusion potential at territorial level, with a special interest on catchment areas. Our purpose was to assess what are the potential extent and the adoption drivers of these techniques.

Material and Methods

23 semi-structured interviews were conducted with farmers already using PF technology and located in the Oise NUTS 3 (Northern France), sampled from a database of 42 farmers known as PF users by the local Agricultural Chamber. In each farm, the general context and the use of every PF technique have been described, along with its perceived impacts by the farmer. The "use of a PF technique" has been defined as a set of descriptors, i.e. the technical characteristics of the equipment, the field operation(s) and crop(s) concerned, the objectives of the use, the adoption drivers of the technique, and the factors of the perceived impacts (fig. 1). The two latter descriptors have been assessed through a textual analysis of the interview.

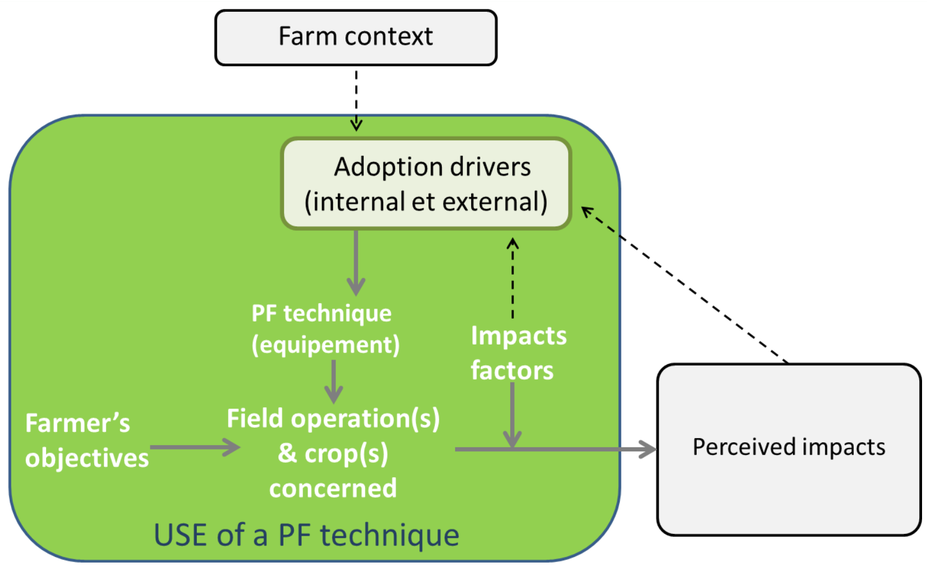


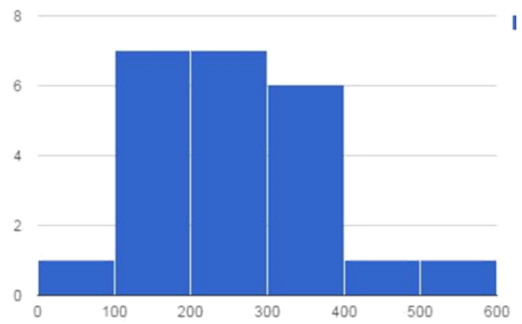
Figure 1: Analytical framework

Results

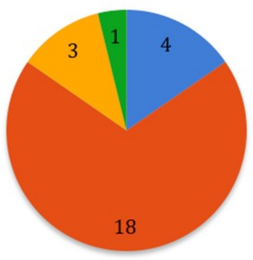
Farms caracteristics :

Arable crop oriented farms (mainly wheat, rape seed and barley, sugar beet) (22out of 23 farms)

Utilized agricultural area: mainly 100 to 400 ha

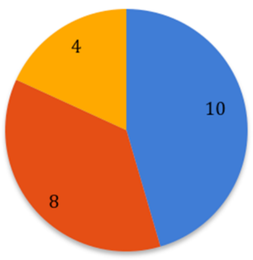


Observed PF techniques



- Guidance, section control & variable rate application
- Guidance & section control
- Guidance only
- Section control only

Guidance



- Assisted
- Assisted & manual
- Manual

Different degrees of implementation of PF in farms, by different combinations of techniques and uses

\- +

- Guidance and Section control of the sprayer
- Guidance and Section control of the sprayer, assisted guidance of the seeder
- Assisted guidance of most of the operations (sprayer excepted), sometimes section control of the sprayer (without guidance)
- Assisted guidance of most of the operations, section control of sprayer or solid fertilizer spreader, often with variable rate application of nitrogen or harvest guidance

Mainly three to five types of use defined for each PF technique

PF technique: Assisted guidance - 4 types of use

Type (number)	**Field operation(s) concerned**	**Main targeted impacts**
A (8)	Most of the operations (except spraying or harvesting)	well-being at work and worktime saving
B (3)	crops and cover crops seeding	well-being at work and technical efficiency
C (2)	crops seeding	well-being at work
D (4)	All operations	well-being at work and technical innovation

Several PF adoption drivers related to different techniques and targeted impacts

Main internal drivers of PF adoption	**Techniques**	**Main targeted impacts**
High size of cultivated land by one farmer	Guidance and section control	well-being at work and worktime saving
Constraining field properties (shape, slopes) or environment (watercourse)		
One (or more) element of crop management practices requiring higher precision(1)	Guidance and/or section control	well-being at work and technical efficiency
High soil heterogeneity	Variable rate application	Technical efficiency

(1) : spraying at night, crop and cover crop seeding in conservation agriculture, mechanical weeding of sugar beets

Among external adoption drivers:

Public subsidies for agri-environmental equipment on farms ; collective use of the machinery

Several perceived impacts related to different types of use

Perceived impacts of the type "Assisted guidance to seeding crops and cover crops "

Primary impact	**Induced impacts**	**Impact category**
Precision of seeding	Efficiency of seeding	Economic
Reduced stress to the driver	Well being at work	Social
Less overlapping	Work time saving Decreasing inputs	Social Economic

Conclusion

Social impacts (well being at work and decreased work time) are commonly perceived (except for variable rate application); they **seem to be strong drivers of the adoption of PF techniques**, ahead from the economic impacts. Agronomic, economic and environmental impacts are also perceived but almost never quantified.

Guidance and section control of spraying are the most adopted techniques, probably because of their multiple impacts and their multiple adoption drivers. In addition, the use of these equipment do not need additional information (application map). For these reasons, they will probably be adopted in the near future by most of the crop producers of the region following the machinery renewal in farms. The lower diffusion of the variable rate application technique could be explained by different reasons: no multifonctionnality, impacts not easily quantified vs higher adoption cost, only one main adoption driver (soil heterogeneity). Results should be strengthen by further interviews. Non PF– users should also be interviewed in order to identify the adoption obstacles.

Further research should also be implemented to assess the **PF evolution and adoption trajectories** along with the **medium-term impacts on cropping systems** at the farm level.

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