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Digital innovations for sustainable agriculture

Policy Implications of Research

1 Digital infrastructure needs to be more broadly established in agriculture.

2 Knowledge of new technologies has to be promoted. This means training for farmers and dialogue in farming networks.

3 Since large investments are not appropriate for all farms in Switzerland, there is a need for inter-farm perspectives and co-operation.

4 Political measures should not be geared to specific technologies, but explicitly to reducing the environmental footprint while maintaining production.

Swiss National Science Foundation

The InnoFarm project

As part of the InnoFarm project, we investigated the potential of precision agriculture for Swiss farming. Our interdisciplinary research focused on technologies that permit more selective use of inputs such as nitrogen. In particular, doing so will increase the precision of fertiliser application in fields (only where necessary) and over time (only when necessary). Adapting application techniques can reduce negative environmental impacts while maintaining or even increasing yields. It could also contribute to the establishment of more comprehensive smart farming approaches in Swiss agriculture.

Using sensors to make precision measurements in fields

The field trials conducted as part of the project show that sensors can measure exactly how nitrogen requirements are distributed as well as measuring nitrous oxide emissions very accurately. For example, satellites or drones can supply data that help to significantly reduce Swiss farms' nitrogen use without affecting yield.

Optimising N_2O and CO_2 exchange in arable farming

High-resolution measurements of soil-atmosphere exchange of greenhouse gases such as nitrous oxide (N_2O) and carbon dioxide (CO_2), show that crop rotation with high year-round soil coverage lessens negative environmental impacts. In addition, gearing the timing of fertiliser application more closely to the development stage of the crop and thus to its nitrogen requirements, could reduce nitrogen loss through nitrous oxide.

Precision agriculture is still (too) expensive

Implementing precision agriculture – for example the selective use of fertiliser – often involves substantial investments however. An economic analysis shows that while farmers can certainly derive additional value from precision agriculture, that value is often too small to justify the investments involved. However, rising fertiliser prices are making precision agriculture a more attractive proposition. Its benefits are also enhanced if farms work together and state support is available. A survey shows that Swiss farmers are willing to adopt precision agriculture if the technology, such as area-specific nitrogen fertiliser application, is reliable and technical support is available.

Conclusions

Our results suggest that a holistic view of the political environment for precision agriculture is needed in Switzerland. There are five key aspects:

— Digital infrastructure needs to be more broadly established, which will make it easier for farmers to gain access to new digital technologies and data;

— Knowledge of new technologies and their benefits needs to be promoted by means of training and dialogue in farming networks;

— Coherent data-use rules are required to create synergies with existing agricultural policy measures and digital recording tools;

— Overarching perspectives and/or incentives are needed since it would not be sensible for all farms to make major investments.

— There must be an explicit focus on reducing the environmental impact of agricultural production (e.g. avoiding carbon and nitrogen losses) rather than on the promotion of specific technologies. This will mean embedding (digital) technologies, such as those used in precision agriculture, in holistic political approaches.

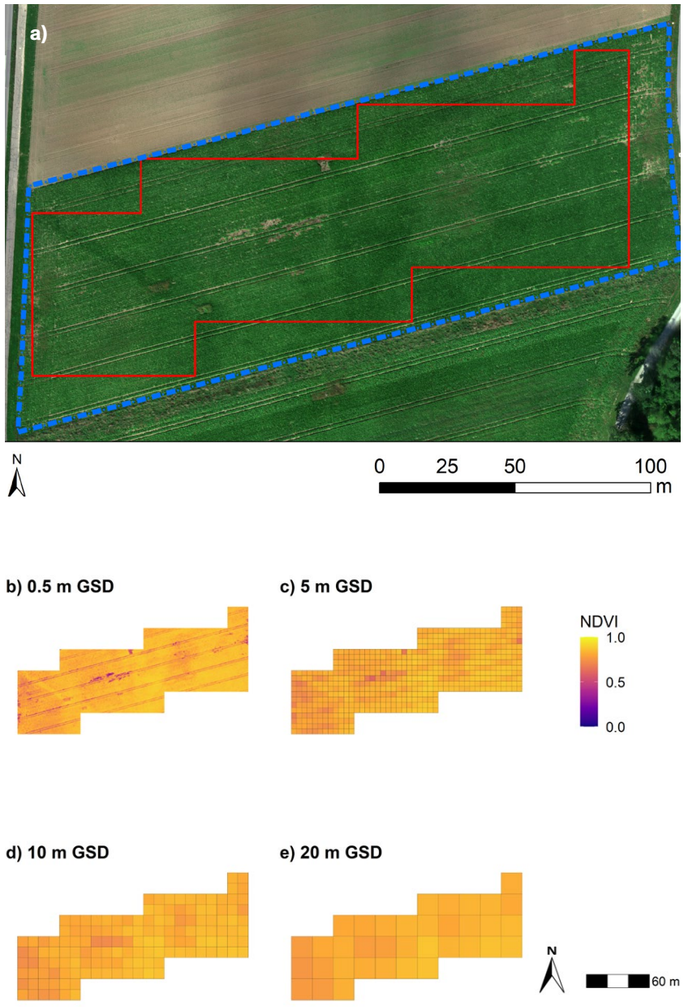
Key Messages

Precision agriculture is capable of reducing the environmental footprint of the agricultural sector without decreasing food production. Government must provide a coherent framework within which Switzerland's small-scale farms can exploit the potential of precision agriculture. Targeted promotion of digital infrastructure, interdisciplinary knowledge of precision agriculture and coordinated data management combined with financial incentives to reduce negative environmental impacts could enhance the sustainability of Swiss agriculture.

What is meant by…

Precision agriculture: Agricultural processes that use digital technologies to provide cultivation options that differ as a function of time and location

Smart farming: Holistic perspective, such as using digital technologies in agriculture or reducing negative environmental impact. The aim is to harness new technologies in a way that takes account of natural and farm-based diversity while also promoting cooperation between farmers and along the value chain. Smart farming also involves defining clear data management rules.



Colour image (a) and computed maps (b-d, right) of the normalised difference vegetation index (NDVI), showing several spatial resolutions (ground sampling distance, GSD). Drones are required for a GSD of 0.5 m; a GSD of 20 m can be obtained with freely available satellite data. The spectral index NDVI is a metric for the greenness of vegetation and can be used to measure and to determine nitrogen fertilisation in specific areas if certain conditions are met.
Source: Quirina Merz, ETH Zurich.

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Further articles on this subject can also be found on the agricultural policy blog website https://agrarpolitik-blog.com/

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About NRP 73

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The National Research Programme “Sustainable Economy” (NRP 73) was launched by the federal council with a global budget of CHF 20 million for five years of research starting mid-2017. It funded 29 research projects in different thematic areas such as Circular Economy, Finance, Building & Construction, Cities & Mobility, Forestry, Agriculture & Food, Supply chain, Sustainable Behaviour and Governance. NRP 73 aims at generating scientific knowledge about a sustainable economy that uses natural resources sparingly, creates welfare and increases the competitiveness of the Swiss economy.

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