Big Data in Agriculture

To debate:

- **Chances and risks implied by smart technologies in the agricultural sector**
- **The societal, ecological, political and economic implications of smart farming**
- **Big Data in agriculture as a geographical research topic**

Smart technologies are transforming farming today. Think of automatic tractors, robots that can carry out weeding, underground infrastructures with inbuilt sensors or drones and satellites offering image analysis from the air. What these applications have in common is that they work through the accumulation, transfer and analysis of data. It is estimated there will be an average of 4.1 million data points per day per farm generated by 2050.

«Smart technologies shape the rural just as much as the urban. Smart farms are just as fashionable as smart cities.»

Francisco Klauser
is professor in political geography at Neuchâtel University and president of the Association Suisse de Géographie (ASG).

There are many opportunities arising from this evolution in terms of increased productivity, profitability and sustainability. Critical issues, in turn, include increased techno-dependency and rising concerns about the loss of privacy, data security and the vulnerability of the systems deployed. Smart farming raises both hopes and fears.

Yet, to date, little is known about exactly how smart technologies transform agricultural practices and processes. How are smart technologies lived and perceived by the farmers themselves? What technical and organisational challenges do they suggest? In addition, what are their wider societal, ecological, political and economic implications?

In Human Geography, as elsewhere, existing literatures on Big Data remain overwhelmingly urban centred and, therefore, miss an important part of the picture. Smart technologies shape the rural just as much as the urban. Smart farms are just as fashionable as smart cities. In some cases, agriculture might even be a particularly promising field in which to deploy technology. For example, the Association for Unmanned Vehicle Systems International expects 80 per cent of the future drone market to lie in the agricultural sector.

The present focus of GeoAgenda is on the driving forces behind current evolutions in the field of smart farming, the actual functioning of particular smart farming solutions and on the opportunities and risks arising thereof. The field of geography is invited to address this focus in more empirical detail. Such a research agenda should, in turn, aim to better inform citizens, farmers and policy makers about the various dimensions of smart farming to engender more informed decision-making and, furthermore, to contribute to broader debates on sustainability, land management and food security.

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Swiss Future Farm. Image: Francisco Klauser

What's new?

Despite the current hype about smart farming, we should not forget that the use of digital technologies in agriculture is nothing new. From the early 1980s, the term "precision agriculture" was used to refer to sensing technologies that monitor and manage the practices and sites of food production. More recent advances in technology have further increased the computerisation of agriculture, whilst also spawning a number of novel terms, such as "smart farming" and "big data in agriculture". These convey two novel ideas.

First, the "smartness" of farming or its "Big Data" aspect is set in relation to the increased connectivity of farming enterprises, as opposed to the management of isolated technological concerns or fields, as in precision agriculture. This means that smart farming is associated with the combination of various tools, sites and databases that imply ever-increasing data gathering and ever-wider circuits of data flow. Second, smart farming is seen to convey novel forms of data processing and analytics, which are directed at the automated management of agriculture. At their core, efforts towards smart farming are portrayed as relying on the coding of agricultural processes and practices into software.

By way of example, consider John Deere's online platform myjohndeere.com, which offers farmers access to real-time data generated from sensors attached to their own machines and, in addition, aggregated data from other farmers, as well as external datasets including weather and financial information, with a view to generating automated recommendations and working processes. In sum, the farm of the future is presented as a software-driven system of connections, processes and flows, based on carefully orchestrated techniques of data gathering, transfer and analysis.

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Relevance for Switzerland

Switzerland's tradition of high-tech research might well provide a particularly fertile ground for innovation to occur and for novel start-up companies to emerge in the smart farming sector. Current examples include AgroFly in Sierre, which offers the first authorised system for the automated application of pesticides by drone in Europe, and Ecorobotics in Yverdon, which specialises in the conception and development of robotics in relation to weeding. Many others could be named. Agroscope, the Swiss centre of excellence for agricultural research, which is associated with the Federal Office for Agriculture, defines smart farming as a "strategic research field" for its 2018–2021 work programme on the challenges facing the agriculture and food sector of the future. On Agroscope's former test site in Tänikon (Thurgau), a high-profile experimental farm for the development of novel smart farming solutions, which is called the "Swiss Future Farm", was launched in mid-September 2018.

Image: Guillaume Perret/Lundi13.

Swiss Future Farm. Image: Francisco Klauser.

Yet, smart farming in Switzerland might also encounter special challenges and problems in relation to the country's highly patchworked agricultural system, which raises major challenges with regard to the cost of renting high-tech machinery for individual farmers. With this in mind, it will be particularly interesting to see what farming associations say about Big Data, and what novel organisational structures and co-operative mechanisms it produces.

This reiterates the need for more research on the topic, also in human geography. In turn, this offers a welcome opportunity for the discipline to rediscover its rural-geographical tradition, from the perspective of the digital age.

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Fliegende Bauern:

Chancen und Herausforderungen von Drohnen in der Landwirtschaft

Die zivile Drohnennutzung hat in den letzten Jahren stark zugenommen und macht auch nicht vor der Landwirtschaft halt. Ganz im Gegenteil: Drohnentechnologie ist fester Bestandteil einer rasant fortschreitenden Digitalisierung des Agrarsektors. Welche spezifischen Anwendungen der Drohnennutzung für die Landwirtschaft gibt es und was sind ihre Potenziale, Chancen und Herausforderungen?

Zur Debatte:

- **Drohnennutzung ist fester Bestandteil einer digitalisierten Landwirtschaft**
- **Drohnen werden vor allem zu Transportzwecken oder vertikale Visualisierung eingesetzt**
- **Drohnen können zur Effizienzsteigerung, Ertragsoptimierung und Risiko-und Kostenreduktion beitragen**
- **Drohnentechnologie und die angewandte Software sollte kritisch auf neu entstehende Abhängigkeiten, Datenschutz und ungleiche Wettbewerbsbedingungen untersucht werden**

Durch Drohnentechnologie ist der Luftraum in den letzten Jahren zu einem gesellschaftlichen Phänomen geworden. Die leichte Zugänglichkeit, die einfache Bedienung und die relativ erschwinglichen Preise haben zu einer starken Verbreitung der Fluggeräte geführt. Hierdurch hat besonders die zivile und kommerzielle Nutzung von Drohnen stetig zugenommen und vielen Unternehmen neue Arbeitsbereiche ermöglicht. In der von uns 2017 durgeführten Studie zur professionellen Drohnennutzung in der Schweiz geben 79% Prozent der befragten Drohnennutzer von privaten Unternehmen an, dass sie ohne die Technologie den Luftraum nicht nutzen würden. Dies kommt besonders in Bereichen wie der Filmindustrie oder der Kartografie zum Ausdruck. Drohnen sind aber auch Mittel der Wahl für sehr spezifische Anwendungen in einer immer stärker digitalisierten und automatisierten Landwirtschaft. Doch was für Anwendungsbereiche gibt es überhaupt und welche Chancen und Herausforderungen stellen sich für die Landwirtschaft?

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Die Anwendungsbereiche für Drohnentechnologie in der Landwirtschaft kann man in zwei Hauptbereiche teilen: Erstens den «Transport von oben» und zweitens «den Blick von oben». Beim Transport geht es um Drohnen, die Pflanzenschutzmittel versprühen, Saatgut aussäen, Objekte transportieren oder fähig sind, Nützlings- und Düngerabwurf zu gewährleisten. Beim Blick von oben kommen Drohnen in Verbindung mit Kameratechnologie zum Einsatz. Hier können Spektralkameras, 3D-Technologie oder Wärmebildkameras mit entsprechender Software Wildzählung-, Rettung- und Beobachtungen durchführen, Bodenanalysen liefern, Gebietsvermessungen präzisieren und Pflanzenzustände, Wasser- und Nährstoffdefizite oder Schädlingsbefälle melden.

So geht es bei der Drohnennutzung in der Landwirtschaft zum einen darum Dinge schneller zu transportieren und zum anderen, Dinge aus der vertikalen Perspektive zu visualisieren. Bei diesen zwei Anwendungen geht es den Herstellern und Endverbrauchern vor allen um die Effizienzsteigerung, die Ertragsoptimierung und eine Kosten- und Risikoreduktion für landwirtschaftliche Betriebe. Ein konkretes Beispiel aus der Schweiz zeigt, wie einige dieser Faktoren tatsächlich zum Tragen kommen können.

Das Unternehmen AgroFly aus dem Kanton Wallis hat eine Drohne entwickelt, die zum Versprühen von

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