DESIRA POLICY BRIEF

Weed control in Swiss organic vegetable farming

The Swiss DESIRA Living Lab (LL) focuses on how digitalisation and the use of robots and other digital tools can support Swiss organic vegetable farming, with a particular focus on weed management. Weed control in organic vegetable farming encounter several challenges like the decreasing availability of manual workers. The future remains uncertain as to how weed control could be shaped by digitalisation.
To address this, the following scenario question was elaborated and discussed with stakeholders during workshops: **How will weeds be managed in Swiss organic vegetable farming in the increasingly digitalised age of 2031?**
As a result of two main scenarios developed with stakeholders, a positive and a negative one, five central policy options were elaborated: (1) Communicating about the advantages of digitalisation; (2) developing an environment that allows for more open innovation; (3) integrating digital specialists in teaching, consulting and agricultural journalism; (4) improving the economic conditions of digitalisation; and (5) encouraging a further diversification of rotations and agricultural activities.

CONTEXT

The Swiss DESIRA Living Lab (LL) focuses on how digitalisation and the use of robots and other digital tools can support Swiss organic farming, with a particular focus on weed management. In organic farming, weed control is a major issue and determines the yield potential of crops.
In 2019, vegetable production (open field) in Switzerland covered a surface of around 12'000ha. With 23% of the total vegetable production area, organic open-field vegetable production reaches a higher share than organic agriculture as a whole.
The vegetable market is well protected by tariffs limiting imports, particularly during the growing season of Swiss produce. The organic vegetable market, on a per capita consumption basis, is continuously growing, with a share of 23% of turnover of vegetable sales for organic in 2019. Policy and consumer demand push vegetable production to a higher sustainability level. A major challenge is that it becomes increasingly difficult to find sufficient workforce for the arduous work in vegetable farming.

Robots need to suit local conditions such as dealing with slopes, rocks, and heavy soils. They also need to be user-friendly and economically efficient. In addition, it was identified that robot safety issues and data legal issues need to be clarified and secured, respectively.
Currently, no fully automated system is operating in Swiss vegetable production. Such weeding robots are currently in a testing phase.
What is already being used in practice, however, are camera- and GPS-controlled chopping modules that can be attached to and pulled by tractors. All relevant autonomous models for organic production are embedded with GPS and cameras, allowing the robot to move autonomously and precisely without human intervention. However, the robot's performance may strongly depend on natural parameters such as the presence of rocks.

Figure 1. Dino weeding robot (autonomous).
Source: www.naio-technologies.com.

RESEARCH APPROACH

The future remains uncertain as to how weed control might be shaped by digitalisation. To address this, a scenario question was elaborated with stakeholders (e.g. farmers, researchers) and discussed during workshops in terms of the practical implications.

LOOKING INTO THE FUTURE ALLOWS STAKEHOLDERS TO REFLECT ON LIKELY CHANGES, THUS FACILITATING THE ELABORATION OF STRATEGIES AND POLICIES ACCORDINGLY.

The question is as follows: **How will weeds be managed in Swiss organic vegetable farming in the increasingly digitalized age of 2031?**

Two workshops were conducted end of 2021 to address this question. The first workshop intended to select possible scenarios, whilst the second workshop intended to further develop the scenarios and discuss possible policy options that could either support or mitigate the scenarios. Here, we only focus on both a plausible positive and negative scenario.

SCENARIOS DEVELOPED

The positive scenario is called "Small is beautiful!" because it supports primarily the smaller farms. The negative scenario is named "Back to dairy industry" due to the relative decreased profitability of the vegetable sector.

In the positive scenario, the opinion of the society on robots will be significantly more positive. This will happen by making people aware that less pesticides will be needed when using robots for weed control.

People will also be more open to robots as it will become clear that digitalisation in agriculture brings advantages in other areas of life, e.g. in autonomous driving. This will influence farmers' decision to adopt robots as well as investments on the development and testing of robots. The robots developed will be small and more effective than today. The small size of the robots will make them easy to manipulate and more reliable than bigger robots.

In addition, there will be more qualified workers available, which will be useful to the tech sector and also help farmers to digitise weed control operations. At the same time, there will be a political pressure to further reduce the use of synthetic pesticides in the conventional sector, which may indirectly affect the organic sector. In fact, it could lead conventional farmers towards using (more) digital tools.

Furthermore, the legal terms regarding the use of digital tools will be clearer. This forecast was supported by the fact that the Swiss legislation is based and/or inspired from the legal situation that applies in the EU, which will likely become stricter. Then, robots will be more affordable, thus making investments in robots more profitable. Organic farmers will also benefit from the further development occurring in conventional production.

Moreover, both the selling prices and the market pressure for organic vegetables will remain stable.

Finally, weeds will be more resistant to pesticides, leading conventional farmers to look for alternative solutions. This could positively affect the organic sector.

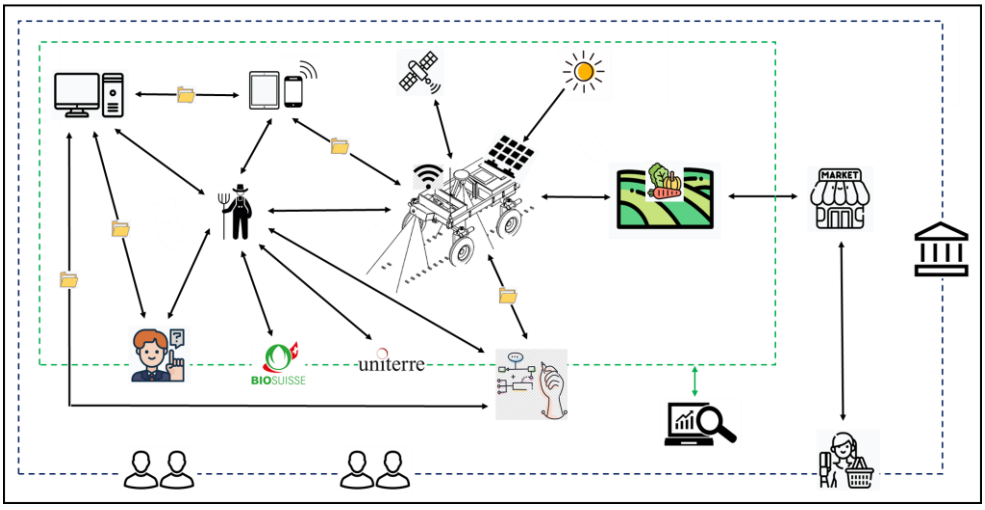

Figure 2. Visualisation of the digitised system related to the introduction of weeding robots

These changes will support the development of robots and digital tools as well as their adoption by farmers, especially for smaller ones as they suffer from a limited financial capacity.

In the negative scenario, fewer drivers of change were selected and discussed, as wished by the participants. In this scenario, there will be fewer qualified workers available in the future, which will make very difficult the further development of robots and other digital tools requiring specific skills. In addition, the ratio cost-efficiency/performance of digitised weed control will remain unchanged, meaning that investments by farmers, especially smaller ones, will still be an important barrier to adoption. Furthermore, the market pressure will increase, possibly due to a further liberalisation of the markets.
This scenario implies that robots and other digital tools used for weed control will not be further developed, making digitised weed control on a large scale impossible. It is also implied that the vegetable sector will be relatively less profitable and that farmers may return to (more) dairy production instead.

POLICY RELATED DISCUSSION

In the positive scenario, farmers will produce better quality products (due to fewer competition from weeds) using less manual labour, which will also increase their economic return. In addition, their work will be less tedious, among other positive impacts. These advantages should be better communicated to the farmer community and to the society as a whole.
That said, there will be a significant investment cost for farmers, especially smaller ones. One way to alleviate this problem is to share robots or other technologies between farmers. Another way is to favour the option of renting or leasing, in the same way as for cars. The farmers choosing this option will likely be smaller ones. At the same time, it will increase the dependency of those farmers. This problem should be further reflected by policy-makers and agricultural actors.
The issue of dependency also applies to the question of data protection. Farmers wish to have data sovereignty i.e. that data remains with them. It was discussed that policies should foster the public debate on the issue of data protection and that policy related goals should be made clearer to all.
In addition, the hacking of digital tools could be disastrous. Devices must be secure to avoid this. Big robots will always have to be monitored. Furthermore, the technical development is uncertain because the conditions (weather, soil, etc.) can vary widely, which means that robots have to be very adaptable.

In the negative scenario, as the robots and other digital tools will not be performant enough, it will open opportunities for alternative innovations and combined processes (e.g. electricity, remote sensing, forecast models, etc). The potential for innovation in agriculture will thus be stimulated, which should be actively supported by public policies while taking account of the specific Swiss conditions (e.g. slopes, etc) that make it challenging for robots to operate in the fields.
This will also revive more traditional practices: Going back to the 'roots', the question will be: "*How can I mechanically control the weeds?*" In fact, this is an opportunity to gain knowledge or 'technical know-how' that vanished over the past decades due to the use of herbicides that does not require much of this knowledge. But answering this need will require to invest further in specialised training related to crop management.
Moreover, the market pressure may undermine the viability of the vegetable sector and will primarily affect smaller farmers. This will need to be mitigated. Stakeholders expressed the wish that price support mechanisms are maintained and they also mentioned that efficiency should be increased. At the same time, there will be an opportunity for an optimal allocated use of the landscape, thus increasing efficiency. It is also believed that this situation will lead to a certain specialisation "in niche", specialty and high-priced products. This will require developing policies that encourage diversification.

POLICY OPTIONS

Communicating on the advantages of digitalisation

- Communicating to farmers and the society as a whole on the advantages of digitalisation in agriculture (e.g. fewer workers, higher domestic production due to gain in competitiveness, decreased use of pesticides, etc.).
- Making agriculture more visible to others in terms of digitalisation, including through advertisements.

Developing an environment that allows for more open innovation

- Promoting innovation further, especially in the area of technology; promoting innovations while taking account of the specific Swiss conditions (e.g. slopes, etc).
- Making (more public) issues related to data protection; encouraging public discussions on data protection and make clearer the related policy goals.
- Devices must be secure to avoid hacking; and the development of a legal framework would help in that respect.
- Reducing further the use of pesticides, e.g. by banning the most toxic ones and/or develop a specific tax system, thus encouraging innovative alternatives.

Integrating digital specialists in teaching, consulting and agricultural journalism

- Developing further training for optimised crop management for farmers.
- "Selling" the attractiveness of agricultural robotics, e.g. in the frame of training, internships, etc.

Improving economic conditions of digitalisation

- Reducing the economic burden on small farms, e.g. by encouraging robots contracting (renting, leasing) that would be particularly attractive for small businesses.
- Supporting an increase in efficiency to maintain Swiss competitiveness, e.g. through implementing subsidies for specific investments, including in the area of digitalisation.
- Supporting organic vegetable prices to maintain the viability of Swiss vegetable farms.

Encouraging a further diversification of rotations and agricultural activities

- Small businesses that do not want to digitise should orientate themselves differently (e.g. gastronomy, tourism, direct marketing, etc.).
- Promoting a further diversification of farms, e.g. with direct payments both to reach more diversified rotations and encourage 'extra activities' such as agrotourism.

This policy brief is published in the frame of the EU-funded DESIRA project and aims to provide recommendations for policy-makers on how to support digitalisation in the context of weed control on vegetable organic farms in Switzerland.

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