An aerial view of the DOK (biodynamic, organic and conventional) experiment (Tibor Fuchs)

Organic Agriculture (DOK Experiment) ( )

Biologischer Landbau/ Biologische Landwirtschaft

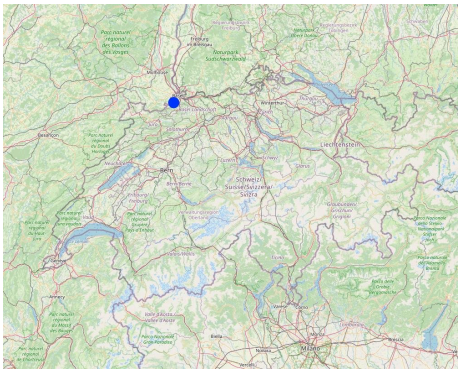
Organic agriculture is a system of crop cultivation that uses biological methods of pest control and organic fertilizer as substitutes for chemical fertilizers and pesticides. It targets sustainability, enhancement of soil fertility, and biological diversity by aiming to close nutrient cycles while generally prohibiting synthetic pesticides, antibiotics, synthetic fertilizers, genetically modified organisms, and growth hormones.

Organic agriculture is a globally applied technology practiced on agricultural land. It is carried out in 188 countries, with over 96 million hectares of agricultural land managed organically by at least 4.5 million farmers.

The main elements of this technology include the use of biological methods of pest control and organic fertilizer application, which replace chemical fertilizers and pesticides. It generally prohibits synthetic pesticides, antibiotics, synthetic fertilizers, genetically modified organisms, and growth hormones. The purpose of organic agriculture is to achieve sustainability in farming, enhancing soil fertility, increasing biological diversity and reducing the reliance on external inputs to agriculture, relying on nutrient recycling by applying manure and on biological nitrogen fixation from legumes. It also aims to provide a healthier and more environmentally friendly alternative to conventional farming practices. To establish and maintain organic agriculture, major activities include the application of organic fertilizers, crop rotation, and the use of pest-resistant plant varieties. Regular soil testing and monitoring of pest populations are also necessary. Certification of a farm as being officially organic is needed if the products are to be sold at a price premium.

Organic agriculture can improve soil health, reduce pollution of the surrounding environment, and contribute to biodiversity in the fields. Moreover, it can offer healthier food options and potentially higher income for farmers due to the premium prices of organic products. Land users appreciate organic agriculture for its environmental benefits and potential for higher income. However, some dislike the increased labour and time required, the 10-30% of reduction in yields, compared to conventional agriculture, as well as the need for a transition period before farms can be certified as organic and products sold at a premium price.

The DOK experiment presented here is representative of organic practices in the context of temperate regions (specifically, Switzerland and surrounding countries). It is jointly managed by the Research Institute of Organic Agriculture (FiBL), and by the Swiss Confederation's centre of excellence for agricultural research (Agroscope). The name "DOK Experiment" is derived from its main purpose, to compare three cultivation systems: Biodynamic (D), organic (O) and conventional (K) agriculture. These differ in terms of how they are fertilized (D: liquid manure, manure compost, biodynamic preparations; O: liquid manure, rotted manure; K: two variants, one with liquid manure, fresh or rotted manure, mineral fertilizer (CONFYM variant) and one with only mineral fertilizer (CONMIN variant)), as well as by plant protection (D and O: organic; K: chemical-synthetic). In addition to two fertilization levels of the three cultivation systems (half fertilization and standard practice fertilization), two controls are carried out, an unfertilized (N) and a purely mineral-fertilized variant (M). The experiment is spatially replicated four times. The results presented here refer to the conventional (K) and the organic (O) treatments at the standard practice fertilization level.



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Harvest of winter wheat stover (Thomas Alföldi)

Harvest of maize (Thomas Alföldi)

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Cropping system:
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SLM

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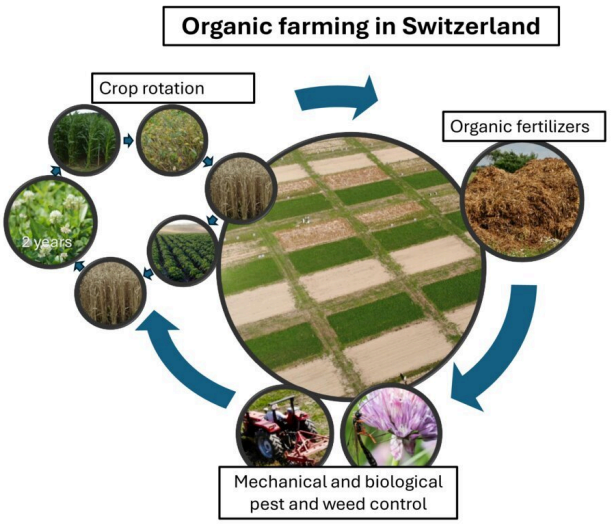
A summary of the principles of organic farming in Switzerland



Author: Moritz Laub

- (Reduced yield without price premium during transition period.
  ha =
  1 ha)
- **CHF**
- ( ) 1 USD = 0.91 CHF
- 160-240

1. Courses on the principles of organic farming (/ : Before transition)
2. Transitioning period (already practicing but not yet certified) (/ : 2 years)
3. Certification (/ : Start of year 3)

1. Application of manure (/ : At least yearly)
2. Application of slurry (/ : Usually twice a year)
3. Soil preparation by harrow or cultivator (/ : Yearly)
4. Weed supression by tine weeder (/ : At least yearly)
5. Biological pesticide application (e.g., Novodor) (/ : When needed, mostly in potato)
6. Planting of cover crop (/ : After wheat)
7. Mulching cover crop (/ : Before planting soy/maize)

			(CHF)	(CHF)	%
Labour requirements compared to conventional agriculture	%	113,0			

☐ < 250
☐ 251-500
☐ 501-750
☑ 751-1,000
☐ 1,001-1,500
☐ 1,501-2,000
☐ 2,001-3,000
☐ 3,001-4,000
☐ > 4,000

☑

840.0

Typical temperate climate. Rainfall is mostly evenly distributed throughout the year with slightly higher values in May, June, July and August.

☑ (0-2%)
☐ (3-5%)
☐ (6-10%)
☐ (11-15%)
☐ (16-30%)
☐ (31-60%)
☐ (>60%)

☑

☐ 0-100
☑ 101-500
☐ 501-1,000
☐ 1,001-1,500
☐ 1,501-2,000
☐ 2,001-2,500
☐ 2,501-3,000

☐
☐
☑

3,001-4,000
> 4,000

(0-20)
(21-50)
(51-80)
(81-120)
(> 120)

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(> 20
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(>3%)
(1-3%)
(<1%)

< 5
5-50
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SLM

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10%
10-50%
50%

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< 0.5
0.5-1
1-2
2-5
5-15
15-50
50-100
100-500
500-1,000
1,000-10,000
> 10,000

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irrigation not common

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SLM: Mean wheat yield of 5 t DM/ha
SLM: Mean wheat yield of 4 t DM/ha
Other mean yields of organic treatment (BIOORG2 with 1.4 livestock units):

Potatoes: 7.5 t DM/ha
Soybean: 2.8 t DM/ha

Other mean yields of conventional treatment with only mineral fertilizer(CONMIN2):
Potatoes: 10 t DM/ha
Soybean: 2.8 t DM/ha

SLM: Grass-clover: 13 t DM/ha
SLM: Grass-clover: 12.5 t DM/ha
Other mean yields of organic treatment (BIOORG2 with 1.4 livestock units):
Maize silage: 17 t DM/ha

Other mean yields of conventional treatment with only mineral fertilizer(CONMIN2):
Maize silage: 19 t DM/ha

Refers to overall organic agriculture in Switzerland (not DOK experiment)

Refers to overall organic agriculture in Switzerland (not DOK experiment)

Refers to overall organic agriculture in Switzerland (not DOK experiment)

Refers to overall organic agriculture in Switzerland (not DOK experiment)

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SLM: About 1.3% SOC in the mineral fertilizer treatment in 2020
SLM: About 1.6% SOC in the organic agriculture treatment in 2020
Organic treatment refers to BIOORG2 with 1.4 livestock units. Conventional treatment to the one with only mineral fertilizer (CONMIN2).

SLM: pH of 6.3 in the mineral fertilizer treatment in 2020
SLM: pH of 6.5 in the organic agriculture treatment in 2020
Organic treatment refers to BIOORG2 with 1.4 livestock units. Conventional treatment to the one with only mineral fertilizer (CONMIN2).

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Greenhouse gas emissions per land area

increased decreased

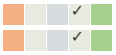
Based on a recent modeling study, emissions were between 0.5 to 1 t CO2 equivalent less per ha and year in organic compared to conventional agriculture in Switzerland (https://doi.org/10.1016/j.agsy.2020.102822).

Greenhouse gas emissions per calorie

increased decreased

In contrast to emissions per land area, it has been found that due to the lower yields there is little difference in terms of emissions per unit of food produced (https://doi.org/10.1088/1748-9326/aa6cd5).

The main establishment costs is that in the first years of establishment, farmers have to apply all organic principles and thus have lower yields. However, certification as organic produce, which receive price premiums, is only possible 1-3 years after establishment, depending on the farm type. Thus, there is a period in which the lower yields are not yet compensated by a price premium. Once the system is certified and a price premium received, gross returns, benefit/cost ratios, and net present values are significantly higher for organic crops compared to conventional crops (https://www.doi.org/10.1073/pnas.1423674112)



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1-10%
☑ 11-50%
> 50%

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0-10%
11-50%
☑ 51-90%
91-100%

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About 16% of all farms in Switzerland are currently organic. (BAFU; https://www.bfs.admin.ch/news/de/2024-0392)

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- Higher income due to price premiums
- Less dependance on external inputs

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- Better nutrient cycling and soil fertility.

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- Lower yields compared to conventional agriculture. Price premium. Eating less meat, which consumes most of the agricultural produce.

Moritz Laub

Editors

Jochen Mayer
Hans-Martin Krause

Rima Mekdaschi Studer
William Critchley

: 17 2024 : 27 2024

Hans-Martin Krause - SLM
Jochen Mayer - SLM

https://qcat.wocat.net/km/wocat/technologies/view/technologies_7138/

SLM

- ETH-Zürich (ETH-Zürich) -
- Forschungsanstalt Agroscope Reckenholz-Tänikon ART (Forschungsanstalt Agroscope Reckenholz-Tänikon ART) -
- Research institut for organic agriculture (FiBL) -

- Land Use Based Mitigation for Resilient Climate Pathways (LANDMARC)

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