Greenresilient case study of Economic Performance

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https://www.greenresilient.net/index.html

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1. Introduction

Greenhouse cultivation is becoming increasingly important in the food supply throughout Europe, even under organic production conditions. Organic greenhouse soils are often used very intensively, which often results in one-sided, short crop rotations geared toward cash crops, as well as a high use of inputs such as fertiliser, water, energy or plant protection measures.

In the Greenresilient research project, eleven research institutes from eight European countries aim to test possible solutions to the challenges in organic greenhouse production. Over a period of two years, alternative cultivation systems were investigated at five test sites in different climate zones in Europe with regard to energy efficiency, soil fertility, reduction of external inputs and diversification of greenhouse crop rotations.

In Switzerland, an experiment has been carried out in the greenhouses at the Agroscope research station in Conthey (Valais). Four different crop rotations were compared. One rotation (BAU1) was heated according to organic standards in Switzerland and represents the standard crop rotation in organic greenhouses, namely tomato from March to mid-October, lambs lettuce in the winter and lettuce in the spring. This business as usual cropping system was compared with three other systems combining different methods in frost-free conditions: BAU2, an innovative crop rotation (INN1) and an innovative crop rotation with an agricultural service crop (ASC) during wintertime (INN2). BAU2 has the same rotation as BAU1. INN1 contains the following crops: purslane, radish, melon, plantago, spinach, tomato and lamb's lettuce. INN2 contains Kohlrabi, ASC, melon, spinach, ASC, tomato and lamb's lettuce (Table 1).

For this report, profitability calculations were made for the different crop rotations at the Swiss trial site. The aim was to estimate how the different methods perform economically. Using the ProfiCost calculation tool, a production cost calculation was carried out for each crop in the crop rotations, taking into account the different heating, fertilisation and crop protection methods.

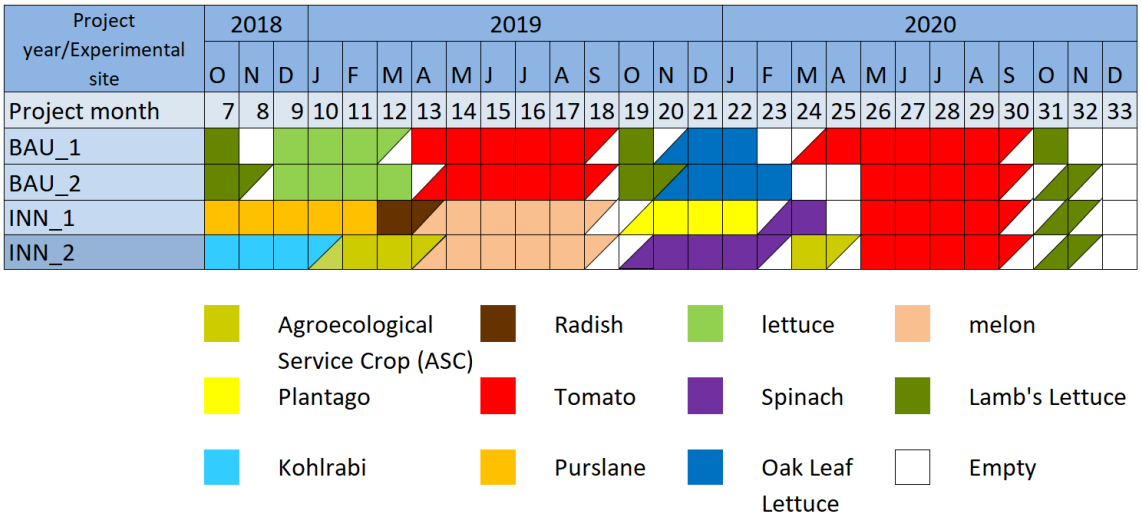
2. Material and Methods/Procedure

2.1 Experimental basis

In Switzerland, the experiment has been carried out in the greenhouses at the Agroscope research station in Conthey (Valais). Two identical compartments of a Venlo type greenhouse were used: one for the business as usual (BAU) cropping system (lamb's lettuce, lettuce and tomato) in heated conditions (BAU1) and the other to test the three systems combining different methods in frost-free conditions: BAU2, innovative crop rotation (INN1) and innovative crop rotation with ASC (INN2). BAU2 has the same rotation as BAU1. INN1 contains the following crops: Purslane, radish, melon, plantago, spinach, tomato and lamb's lettuce. INN2 contains following crops: Kohlrabi, ASC, melon, spinach, ASC, tomato and lamb's lettuce (**Error! Reference source not found.**). For the last seven month of the trial, the same crops were planted in all four crop rotations (tomatoes, lamb's lettuce).

The basic layout of the trials is a randomized complete block with four repetitions. The first compartment (BAU1-heated) is heated from March to September to keep the temperature between 16°C and 18°C. The rest of the year it is kept frost free. The second compartment is only kept frost free throughout the year (heating temperature 5°C)

Table 1: Trial schedule



The experimental layout enables a comparison between:

- heated and unheated rotation (BAU 1 and BAU 2).
- Less diverse (BAU 2) and high diverse crop rotation (INN 1 and INN 2).
- With ASC (INN 2), without ASC (but incorporated silage; INN 1) and with neither (BAU 2).
- With (BAU2) and without plastic mulch (INN1 and INN2 with organic mulch).
- Commercial organic fertilizers, like feather meal or vinasse (BAU2) compared to ASC (INN2), organic mulch and incorporated silage (INN1) as alternative fertilizers.

- Standard organic pesticide application including copper, sulfur or spinosad (BAU2) compared to limited pesticide use (only pesticides with a low effect on natural enemies such as potassium bicarbonate, potassium fatty) (INN2, INN2).

Table 2: Comparison of the four different variants.

	BAU_1	**BAU_2**	**INN_1**	**INN_2**
Heating	Frost-free; between March and September temperature stabilisation 16-18°C (according to Bio Suisse regulations)	Year-round frost-free > 5°C	Year-round frost-free > 5°C	Year-round frost-free > 5°C
Crops	Standard: lamb's lettuce, lettuce and tomato	Standard: lamb's lettuce, lettuce and tomato	Innovative: purslane, radish, melon, plantago, spinach, tomato and lamb's lettuce	Innovative: Kohlrabi, ASC, melon, spinach, ASC, tomato and lamb's lettuce
Fertilisation	N-fertilizer + compost	N-fertilizer + compost	Incorporated gras-clover & transfer mulch	IncorporatedASC & transfer mulch
Plant protection	Biological control and approved disease/pest control products	Biological control and approved disease/pest control products	Biological control and approved disease control products; no sulfur and copper; only soap and Neem for pest control	Biological control and approved disease control products; no sulfur and copper; only soap and Neem for pest control
Mulch film	Plastic	Plastic	No	No

2.2 Economic efficiency calculation

In order to calculate the profitability of the individual crops, the agricultural tool ProfiCost from SZG (Schweizerische Zentralstelle für Gemüsebau und Spezialkulturen, Koppingen, Switzerland) (www.proficost.ch) was used.

In most cases, the collected trial data were used to evaluate the individual crops. It should be taken into account that the trial data were collected on very small trial plots (82m^2) and then scaled up to 1ha per crop for the calculation. Small differences in procedure (e.g. ½ hour more or less weeding per procedure) can thus have a large impact on the results of the cost calculation.

For this reason, the collected values were compared with standard values and replaced by standard data from ProfiCost in the case of major deviations. For the yield, producer wholesale prices from the last two years were taken from the Swiss Centre for Vegetable Growing (SZG). These can fluctuate greatly depending on the calendar week and year.

3. Results

3.1 Income statement

In table 3, the profits determined by ProfiCost are shown.

The INN1 system with its innovative crops achieved the greatest profit of 366,603 CHF/ha compared to the other three systems. The second highest profits were achieved by the unheated BAU2 with a profit of 206,328 CHF/ha. The normally heated BAU1 achieved a profit of 156,208 CHF/ha. The least profitable system was INN2 with integrated green manure, which generated a loss of 121,561 CHF/ha during the trial period.

Table 3: Economic assessment calculated by ProfiCost. Profit per crop and trial method.

	BAU1	**Profit per ha**	**BAU2**	**Profit per ha**	**INN1**	**Profit per ha**	**INN2**	**Profit per ha**
2018	Lamb's lettuce	16028	Lamb's lettuce	44794	Purslane	272062	Kohlrabi	-2026
2019	Lettuce	-17400	Lettuce	-14838	Radisch	12700	ASC	-73470
2019	Tomatoes	-30487	Tomatoes	-2990	Melons	-200022	Melons	-182447
2019	Lamb's lettuce	17300	Lamb's lettuce	29674	Plantago	4220	Spinach	20607
2020	Oak leaf lettuce	-50422	Oak leaf lettuce	-26186	Spinach	92994	ASC	-48868
2020	Tomato	146603	Tomato	73028	Tomato	68464	Tomato	65993
2020	Lamb's lettuce	74586	Lamb's lettuce	102846	Lamb's lettuce	116185	Lamb's lettuce	98650
	Profit per ha	**156208**		**206328**		**366603**		**-121561**
	Profit per m2	**15.7**		**20.6**		**36.7**		**-12.2**

The crops purslane (272,062 CHF profit/ha), lamb's lettuce (average 62,508 CHF profit/ha), spinach (average 56,800 CHF profit/ha) and tomatoes (average 53,435 CHF profit/ha), proved to be particularly lucrative. Melons (average -191,234 CHF profit/ha), ASC (average -61,169 CHF

profit/ha), oak leaf (average -38,304 CHF profit/ha), lettuce (average -16,119 CHF profit/ha) and kohlrabi (-2026 CHF profit/ha) proved not to be lucrative.

3.2 Production costs

Table 4 shows the production costs per method and crop calculated in ProfiCost.

The highest production costs were seen in the INN1 system with 1,895,693 CHF/ha, followed by BAU1 with 1,786,317 CHF/ha. The lowest production costs were generated by the INN2 system with 1,328,535 CHF/ha, and the second lowest was BAU2 with 1,621,839 CHF/ha.

Table 3: Profitability analysis calculated by ProfiCost. Production costs per crop and process.

	BAU1	**Profit per ha**	**BAU2**	**Profit per ha**	**INN1**	**Profit per ha**	**INN2**	**Profit per ha**
2018	Lamb's lettuce	160134	Lamb's lettuce	192963	Purslane	584561	Kohlrabi	147526
2019	Lettuce	197925	Lettuce	178995	Radisch	89603	ASC	73470
2019	Tomatoes	459384	Tomatoes	377668	Melons	284785	Melons	274461
2019	Lamb's lettuce	171719	Lamb's lettuce	179832	Plantago	210666	Spinach	244118
2020	Oak leaf lettuce	177919	Oak leaf lettuce	160729	Spinach	114623	ASC	48868
2020	Tomatoes	484278	Tomatoes	379555	Tomatoes	402179	Tomatoes	390389
2020	Lamb's lettuce	134958	Lamb's lettuce	152097	Lamb's lettuce	157647	Lamb's lettuce	149703
	Costs per ha	**1786317**		**1621839**		**1844064**		**1328535**
	Costs per m2	**178.6**		**162.2**		**184.4**		**132.9**

Particularly cost-intensive crops are purslane (584,561 CHF/ha), tomatoes (average 416,999 CHF/ha) or melons (average 279,623 CHF/ha). Low-cost crops are ASC (61,169 CHF/ha), radish (89,603 CHF/ha), spinach (179,370 CHF/ha) and lamb's lettuce (162,382 CHF/ha).

3.3 Cost breakdown

Figure 1 shows the most relevant costs of three example crops in the BAU1 and BAU2 systems. For all three example crops, infrastructure (incl. heating), planting costs (seed and labour) and the costs for harvesting and containers were the main cost drivers. In the case of tomatoes, the cost of maintenance and weed control are also significant, which is mainly due to the weekly pruning. The costs for fertilisation/soil preparation and plant protection play less of a role in the listed crops, as do the costs for irrigation. The category "Infrastructure" includes in particular the costs for greenhouse rent, cold storage/cooling, electricity costs and other infrastructure costs. The heating costs are also listed under infrastructure in the calculation tool (see Appendix 1), but were listed separately for Figure 1.

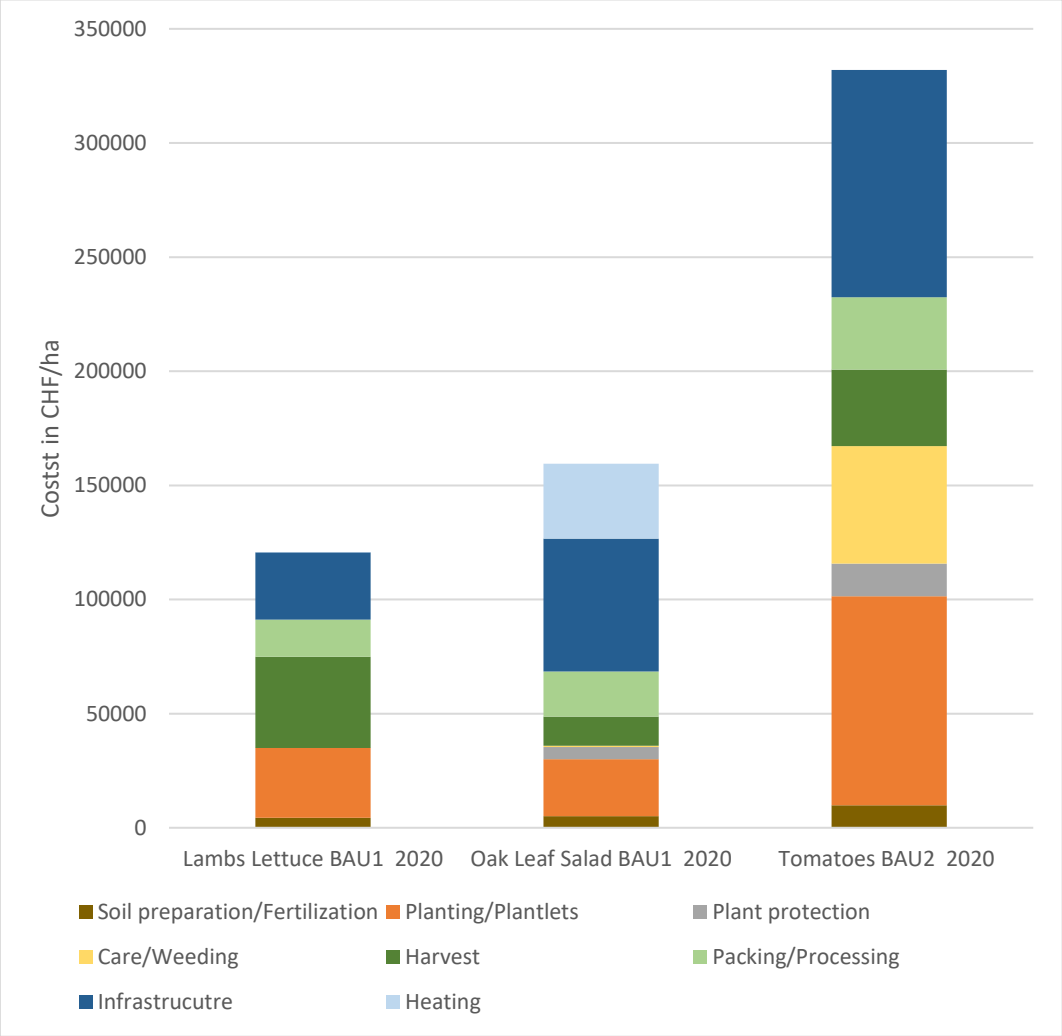


Figure 1: Detailed cost breakdown of three example crops

4. Discussion

4.1 Economic efficiency of the individual crops

Lamb's Lettuce

Lamb's lettuce was profitable in all methods and cultivation periods. Although the production costs are relatively similar in all methods, the profits per unit of area differ significantly in some cases. This can be explained on the one hand by the producer prices (12.70 CHF/kg in 2018 and 2019, 19.30 CHF/kg in 2020) and on the other hand by the yield or cutting time. For example, the lamb's lettuce in BAU1 was cut 1 week earlier than in BAU2, which resulted in significantly larger leaves in BAU2 with a correspondingly higher yield. The lower yields in BAU1 are probably not determined by the different crop rotations, but could probably have been avoided with a slightly longer cultivation period.

Oak Leaf lettuce and lettuce

Lettuce (lettuce in spring 2019 and oak leaf lettuce in spring 2020) scored notably poorly in the profitability assessment. This can be explained in particular by the comparatively high infrastructure costs for the greenhouse rent or heating energy in the BAU1 method. For example, the infrastructure costs for lettuce account for about 50% of the total production costs, and about 60% for oak leaf lettuce. In comparison, these are between 20-25% of the total production costs for lamb's lettuce. This is due to the long field occupancy (100 and 117 days for lettuce, 76 and 97 days for oak leaf lettuce) and thus high rental costs (lettuce: BAU1 = 62000 CHF, BAU2 = 70000 CHF; oak leaf lettuce BAU1 = 50000 CHF, BAU2 = 62000 CHF). The costs for heating oil were significantly higher for BAU1 (lettuce 25000 CHF, oak leaf lettuce 33000 CHF) than for BAU2 (lettuce 1700 CHF, oak leaf lettuce 2300 CHF).

Tomato

In the case of tomatoes, the profit/loss varies depending on the year and the method. Losses in BAU1 in 2019 are striking, resulting from a significantly lower yield with similar production costs as 2020. The reason for this is, on the one hand, the lower price (2019: 2.8 CHF/kg, 2020:3.27 CHF/kg), and on the other hand a planting delay of about 2 weeks (2019: BAU1=169 days, BAU2 152 days; 2020: BAU1= 180 days, BAU2= 145 days), which resulted in yield losses (2019: BAU1=15.8kg/m2, BAU2 13.8kg/m2; 2020: BAU1= 19.9kg/m2, BAU2= 14.3kg/m2). In reality, the cultivation time in the BAU systems is likely to be somewhat longer, as the tomatoes are usually planted in heated greenhouse on 1 March and not on 18 March or 1 April as was the case in the trial. This means that the heating costs for the months of March and April can be recouped even faster than in the trial. The yield values for the trial comparison in 2020 are therefore more likely to correspond to reality than those in 2019.

Purslane & Plantago

At first glance, purslane appears to be a very profitable crop. A very high yield (from four cuts) at a high producer price is offset by relatively low production costs (relatively low costs for planting, hardly any weed control, no plant protection). However, it must be taken into account

that sales are very limited and the producer price is only so high because it is a niche crop that is produced on a small area. In fact, purslane was the only crop at the trial site in Conthey, which could not be sold to local purchasers. If large-scale cultivation would take place, prices and margins would fall. The situation is similar with plantago, although the yields per area and cultivation period are significantly lower than with purslane.

Kohlrabi

For Kohlrabi, corrected yield data were used. In the trial, the desired calibre was not achieved in most cases due to somewhat late planting. For the profitability calculation, a harvest rate of 70% of high quality goods was assumed. Nevertheless, the crop balance is slightly negative. In frost-free cultivation, the crop is certainly risky and should be planted by mid-September at the latest for a targeted harvest at Christmas.

Radish

The production costs of radishes were sometimes the lowest in the trial due to the short cultivation period and the low costs for sowing and maintenance. However, the profit is also rather small due to the low producer margins.

Melons

Melon cultivation in greenhouses are a loss-making business in Switzerland. The low producer prices due to the lack of import protection are the main factor. Swiss greenhouse melons cannot compete with the significantly lower production costs of field-grown melons abroad.

Spinach

The spinach in the INN2 trial in autumn 2019 had to be replanted after 6 weeks because the selected variety was not bolting-tolerant. For the profitability calculation, two successive spinach crops were therefore assumed, with two plantings and two harvests. For this reason, the production costs in INN2 are twice as high as for spinach as INN1 2020. Under normal conditions, spinach cultivation in a frost-free greenhouse seems to be quite profitable, as in INN1 2020.

ASC

Since the ASCs are not harvested, the balance is of course negative. The infrastructure costs for the glass greenhouse, which are correspondingly higher depending on the duration of the green manure (2019: 88 days, 2020: 49 days), are particularly significant here.

4.2 Cost points of the individual crops

4.2.1 Crop differences

As can be seen in Figure 1, the main cost drivers for all three example crops are infrastructure (incl. heating), planting costs (seedlings and labour) and the costs for harvesting and containers. This constellation is also likely to apply to the remaining crops in the trial, regardless of the

cultivation method. Only the heating costs (listed separately in Figure 1) differ significantly between BAU1 and the other methods. For leafy vegetable crops such as lamb's lettuce, purslane or plantago, the harvesting costs are significantly higher compared to vegetables that grow in one piece (lettuce, kohlrabi). Also for summer crops (tomatoes, melons), labour costs for harvesting are proportionally much smaller, but are compensated by cultivation work such as pruning and defoliation. In general, cultivation costs increase with increasing cultivation duration. This is in particular due to the cost category "infrastructure", which includes the costs for greenhouse rent, cold storage/cooling, electricity costs and other infrastructure costs. For example, the production costs for oak leaf lettuce (76 cultivation days) are higher than for lamb's lettuce (27 cultivation days) due to the higher infrastructure and heating costs.

4.2.2 Differences between methods

Fertilisation

The fertilisation methods hardly made any difference to the yield in the different methods. In principle, the nutrient supply was therefore also sufficient with the alternative fertilisation methods ASC/transfer mulch and also with silage/transfer mulch.

Table 6 lists the costs of the different fertilisation methods in the trial for the tomato crop in summer 2020. There are clear cost differences between the methods, with a total of 5,600 CHF for the standard method with commercial fertiliser in BAU2, 18,500 CHF for the method using silage fertilisation and transfer mulch, and a much higher cost of 58,000-83,000 CHF for fertilisation with ASC and transfer mulch. With the latter method, the costs for the greenhouse infrastructure during the ASC cultivation period are particularly significant. For the mulch methods, the additional benefit of the mulch layer for weed suppression can also be taken into account (mulch film & laying approx. 2500 CHF/ha).

The total production costs of the tomato crops in 2020 for the mentioned methods were between 380'000-400'000 CHF (without including the ASC production costs). For the BAU2 and INN1 systems, fertiliser costs thus only account for about 1-5% of the total costs, whereas for INN2 they account for 13-17% of the costs. Fertilisation with ASC is therefore a very expensive option and must provide a clear additional benefit (e.g. soil or plant health) in order to pay off.

Table 4: Costs of different fertilisation methods in tomato cultivation in 2020.

Procedure	Fertilisation	Costs [CHF]
INN1	Silage material	1'500
	Spreading & incorporation of silage	7'300
	Mulch material	2'700
	Spreading Mulch	7'000
	Total costs	**18'500**

INN2	Cultivation costs ASC Incorporation of ASC Mulch material Spreading mulch **Total costs**	48’000-73’000 220 2‘700 7‘000 **58’000-83’000**
BAU2	Commercial fertiliser Spreading fertiliser **Total costs**	4’200 1’400 **5’600**

Weed management

In the trial, degradable mulch film was used in the standard methods (BAU1 and BAU2). In the INN1 and INN2 methods, transfer mulch was partially applied or the crops were hoed/weeded.

As shown in the cost calculations, the costs for the mulch film including laying (approx. 2,500 CHF/ha) correspond roughly to two rough weeding passes by hand (50h/ha/pass). For most crops, such as lettuce or kohlrabi, the weed control costs are thus about the same with or without mulch film. The costs of grass mulch correspond to about 10,000 CHF/ha, with additional fertiliser.

Overall, however, the weed control costs are not significant, as can be seen in Figure 1.

Plant protection

Overall, plant protection only plays a minor role in financial terms for all crops in the trial, with about 0-5% of production costs. The differences in the various plant protection regimes in the cultivation methods are therefore not financially relevant. The costs for beneficial insects in the summer crops are the most significant. The cost of cultivating the flower strips were not included in the cost calculation, but are unlikely to have a decisive influence on the production costs of the summer crops.

Heating

The different heating regimes in BAU1 (standard heating at 18°C from March) and the remaining 3 methods (frost-free 5°C all year round) lead to significant differences in terms of heating costs. For example, the heating costs in BAU1 amount to CHF 72000 and CHF 66000 per growing season (2019/2020), while the costs in BAU2 come to CHF 1700/2200. Overall, however, the heating costs in BAU1 can be compensated by shorter cultivation periods (e.g. oak leaf lettuce) or higher yields (e.g. tomatoes 2020). In this context, avoiding empty greenhouses as much as possible or that subsequent crops are planted quickly plays a significant role. In this way, the infrastructure

costs can be recouped more quickly. In the trial, this was only taken into account to a limited extent in the crop rotation design, which means that the balance of the BAU1 crop rotation tends to be too poor.

The frost-free methods could just as well have been planted in a polytunnel instead of a glass greenhouse. This would have reduced the infrastructure costs in BAU2 and INN1/2 somewhat. In Proficost, the costs in a glass greenhouse are estimated at 15,000 CHF/ha/month, in a polytunnel at approx. 10,000 CHF/ha/month. This would reduce the production costs for lamb's lettuce and tomatoes by about 5%, for Oak leaf by 10% and for ASC by 20%. The 10,000 CHF/ha/month for a polytunnel are calculated for solid swiss polytunnels which can withstand significant loads of snow. For other regions of Europe, costs for polytunnels might be significant lower.

Producer prices

In the case of yields, wholesale producer prices per calendar week for the last two years were taken from the Swiss Centre for Vegetable Growing (SZG). These can fluctuate greatly depending on the calendar week and year, as the example of lamb's lettuce in Fig. 2 shows. Cultivation can thus be more or less lucrative depending on the time of harvest.

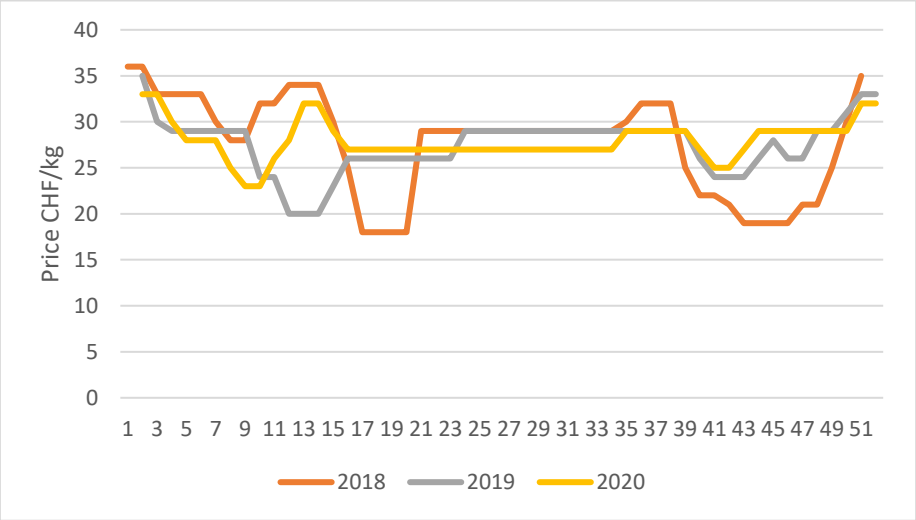


Figure 2: Price of lamb's lettuce, producer price wholesale by calendar week of 2018-2020. Source: Webreports SZG

It is important to mention that Swiss prices and cost were used for the cost calculations, which are higher than in many other countries. For instance, an hourly rate of CHF 27.10 was assumed for the workload, which corresponds to the weighted average wage of a Swiss farm (from harvest worker to executive salary). Import tariffs, which may or may not exist depending on the crop and season, also play a role in pricing in Switzerland. For example, import tariffs are levied on tomatoes from 1 June to 1 October. As soon as these are lifted in October, Swiss cultivation is effectively no longer worthwhile, which is why tomato crops in Swiss greenhouses are cleared in October and replaced by winter leafy crops (further, fruit quality decreases due to lack of sunlight).

4.3 Comparison of cultivation methods

BAU1

The entire crop rotation in the BAU1 system is the third most profitable of all systems in the trial. However, the system was at a slight disadvantage overall. For example, the lamb's lettuce was harvested about a week earlier than in BAU2, which meant that the plants were smaller at harvest time and the yield was lower. The tomatoes were also planted much too late, especially in the first year (1 April). In practice, organic tomatoes in Switzerland are planted in the first weeks of March if possible, as the greenhouses can be heated from 1 March. All in all, this means that the utilisation of the greenhouse space is too low and the costs incurred by the heating have to be compensated. However, the additional costs for the extra heating are also considerable.

BAU2

The BAU2 system performs better overall than BAU1, with an identical crop sequence. Despite greatly reduced heating, there was hardly any reduction in yield for most crops, although this was partly due to late planting and early harvesting with BAU1. Further, conditions for frost-free heating are ideal at the trial site in Valais (sunny, fog-free and mild climate) compared to other regions in Switzerland and Europe. All in all, the system showed hardly any disadvantages of the reduced heating strategy compared to the BAU1 system, both for winter crops such as lettuce and lamb's lettuce and for tomatoes.

INN1

The INN1 system is the most profitable per area in the trial. However, the crop rotation is difficult to compare with the rest of the trials, as it is very different. The only common crops, tomatoes and lamb's lettuce, perform very similarly to BAU2. Purslane appears to be a real goldmine, but sales of it are limited. Melons, on the other hand, seem to be very unprofitable in greenhouse cultivation. Overall, however, a very diverse crop rotation with as many different winter crops as possible could be economically interesting. Further, the use of transfer mulch has not had any negative impact on the economy and can therefore be a good option for the supply of nutrients, the closing of nutrient cycles and for the revitalization of the soil in greenhouses.

INN2

The INN2 system performed worst from an economic point of view. On the one hand, this is due to the yield losses caused by the cultivation of ASC. On the other hand, melons, kohlrabi and spinach also perform poorly financially. This unfortunate constellation somewhat masks the finding that the cultivation of tomatoes and lamb's lettuce at the end of the crop rotation perform similarly to the rest of the methods. The fertilisation strategy with ASC seems to work technically, but is very costly due to the long vacancy of the greenhouse. However, the cultivation of ASC ist more feasible in simple polytunnels. Further, if no cashcrop can be grown in the greenhouse over winter (e.g. for market reasons), ASC cultivation can also be an interesting option.

All in all, it can be said that the various approaches tested in the different crop rotations do have potential. Diversified crop rotations in greenhouses are economically interesting, provided that there is a market for the different crops. While there are many opportunities for diversification in the winter half of the year, it is difficult to find good alternative crops in the summer that can be grown economically and bring diversity into the crop rotation.

5. Literature

Schweizerische Zentralstelle für Gemüsebau und Spezialkulturen (SZG) (01. 01 2018). ProfiCost. Software. Verwendet am 31.05.21. Koppigen, Bern, Schweiz.

Schweizerische Zentralstelle für Gemüsebau und Spezialkulturen (SZG). Webreports, Markdaten Gemüse. Verwendet am 31.05.21. Koppigen, Bern, Schweiz.

6. Appendix

System Comparison [CHF]

Crop	2018	2018	2018	2018
Cultivation method	Organic	Organic	Organic	Organic
System	Lambs Lettuce BAU	Lambs Lettuce BAU	Purslane INN1	Kohlrabi INN2
Area	1 ha	1 ha	1 ha	1 ha
Cultivation site	Greenhouse	Greenhouse	Greenhouse	Greenhouse
Usage	Fresh market	Fresh market	Fresh market	Fresh market
Delimintation	Wholesale price	Wholesale price	Wholesale price	Wholesale price
Performance (Yield)				
Performance	176'162	237'757	856'623	145'500
Total	176'162	237'757	856'623	145'500
Direct costs				
Soil cultivation	2'068	2'068		
Seeding/ planting	25'452	25'452	25'452	11'969
Fertiliser				948
Plant protection	162	162	3'820	3'820
Irrigation	366	444	1'500	1'086
Containers	15'647	21'118	80'523	11'112
Infrastructure/Misc.	91	100	275	196
Third party work	1'133	1'253	3'435	2'445
Total	44'918	50'596	115'005	31'575
Structural costs				
Soil cultivation	2'363	2'363	1'843	1'843
Seeding/ planting	5'009	5'009	5'009	12'918
Fertilisation				2'528
Plant protection	2'193	2'193	3'655	3'655
Irrigation	217	217	678	434
Maintenance	68	81	537	3'494
Harvest	51'014	68'757	261'141	3'450
Preparation/Delivery	5'034	6'796	25'910	4'543
Infrastructure/Misc.	33'987	38'170	111'098	70'151
Transport/other time	3'305	4'281	14'949	1'541
Other structural costs	12'026	14'499	44'738	11'397
Total	115'217	142'367	469'556	115'951
Analysis				
Total Production costs/Area	**160'134**	**192'963**	**584'561**	**147'526**
Total Production costs/Unit	**11.20**	**10.00**	**7.94**	**1.48**
Comparable contribution margin	132'377	188'413	745'053	116'370
Profit/Loss	16'028	44'794	272'062	-2'026
=Profit/Loss per unit	1.12	2.32	3.70	-0.02
=Earnings per person hour	34.14	42.12	51.92	24.84

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System Comparison [CHF]

Crop	2019	2019	2019	2019
Cultivation method	Organic	Organic	Organic	Organic
System	Radish INN1	Lettuce BAU1	Lettuce BAU2	ASC INN2
Area	1 ha	1 ha	1 ha	1 ha
Cultivation site	Greenhouse	Greenhouse	Greenhouse	Greenhouse
Usage	Fresh market	Fresh market	Fresh market	Fresh market
Delimitation	Wholesale price	Wholesale price	Wholesale price	Wholesale price
Performance (Yield)				
Performance	102'303	180'525	164'157	0
Contributions	0			0
Total	102'303	180'525	164'157	0
Direct costs				
Soil cultivation		2'068	2'068	
Seeding/planting	7'826	11'969	11'969	1'136
Plant protection		517	900	
Irrigation	534	1'182	1'388	1'200
Maintenance	1'210			1'210
Containers	6'541	19'525	17'755	0
Infrastructure/Misc.	95	199	227	179
Third party work		2'490	2'835	
Total	16'207	37'950	37'141	3'725
Structural cost				
Soil cultivation	1'429	1'950	1'950	2'858
Seeding/planting	1'944	12'918	12'918	89
Plant protection		2'193	2'193	
Irrigation	271	650	813	542
Maintenance	907	474	501	569
Harvest	24'973	17'134	15'606	97
Preparation/Delivery	2'929	8'609	7'829	
Infrastructure/Misc	32'566	98'550	84'050	59'677
Transport/other time	1'633	2'207	2'101	208
Other Structural costs	6'745	15'290	13'894	5'705
Total	73'397	159'975	141'854	69'744
Analysis				
Total Production costs/Area	**89'603**	**197'925**	**178'995**	**73'470**
Total Production costs/Unit	**1.02**	**1.41**	**1.41**	**73'470.00**
Comparable contribution margin	86'096	145'065	129'851	-3'725
Profit/Loss	12'700	-17'400	-14'838	-73'470
=Profit/Loss per unit	0.14	-0.12	-0.12	-73'470.00
=Earnings per person hour	38.71	14.16	15.57	-818.89

System comparison [CHF]

Crop	2019	2019	2019	2019
Cultivation method	Organic	Organic	Organic	Organic
System	Melons INN1	Melons INN2	Tomatoes BAU1	Tomatoes BAU2
Area	1 ha	1 ha	1 ha	1 ha
Cultivation site	Greenhouse	Greenhouse	Greenhouse	Greenhouse
Usage	Fresh market	Fresh market	Fresh market	Fresh market
Delimination	Wholesale price	Wholesale price	Wholesale price	Wholesale price
Performance (Yield)				
Performance	84'763	92'014	428'897	374'678
Total	84'763	92'014	428'897	374'678
Direct costs				
Soil cultivation			2'068	2'068
Seeding/planting	30'000	30'000	71'400	71'400
Fertiliser	7'242	4'512	7'960	4'035
Plant protection	20'974	20'974	12'603	12'018
Irrigation	8'109	8'109	9'099	8'334
Maintenance	3'989	3'989	8'752	8'454
Containers	6'503	7'059	23'534	20'559
Yield	4'250	4'250	4'250	4'250
Infrastructure/Misc.	276	276	313	284
Third party work	3'450	3'450	3'908	3'555
Total	84'793	82'619	143'886	134'957
Structural costs				
Soil cultivation	2'114	2'114	5'514	2'114
Seeding/planting	4'743	4'743	6'450	6'450
Fertilisation	15'661	7'361	1'409	1'409
Plant protection	4'623	4'623	6'995	8'278
Irrigation	1'537	1'537	1'679	1'604
Maintenance	31'263	31'263	50'344	46'368
Yield	12'956	13'759	34'479	28'529
Preparation/Delivery	3'819	4'146	11'498	10'044
Infrastructure/Misc.	97'174	97'330	155'022	103'122
Transport/other costs	3'847	3'488	5'916	5'251
Other Structural costs	22'256	21'478	36'192	29'541
Total	199'992	191'842	315'497	242'710
Analysis				
Total Production costs/Area	**284'785**	**274'461**	**459'384**	**377'668**
Total Production costs/Unit	**8.15**	**7.23**	**2.91**	**2.74**
Comparable contribution margin	3'420	12'845	288'918	243'276
Profit/Loss	-200'022	-182'447	-30'487	-2'990
=Profit/Loss per unit	-5.72	-4.81	-0.19	-0.02
=Earnings per person hour	-46.83	-45.49	19.53	26.22

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System Comparison [CHF]

Crop	2019	2019	2019	2019
Cultivation method	Organic	Organic	SGA	Organic
System	Lambs Lettuce BAU	Lambs Lettuce BAU	Spinach INN2 2x	Plantago INN1
Area	1 ha	1 ha	1 ha	1 ha
Cultivation site	Greenhouse	Greenhouse	Greenhouse	Greenhouse
Usage	Fresh market	Fresh market	Fresh market	Fresh market
Delimitation	Wholesale price	Wholesale price	Wholesale price	Wholesale price
Performance (Yield)				
Performance	189'019	209'506	264'725	214'886
Contributions			0	
Total	189'019	209'506	264'725	214'886
Direct costs				
Soil cultivation	2'068	2'068		
Seeding/ planting	25'452	25'452	35'706	7'466
Plant protection	162	162	2'292	2'292
Irrigation	366	444	1'800	1'500
Containers	16'828	18'652	25'119	40'399
Infrastructure/Misc.	89	100	242	205
Third party work	1'110	1'253	3'023	2'565
Total	46'075	48'131	68'182	54'427
Structural costs				
Soil cultivation	2'363	2'363	3'272	1'843
Seeding/ planting	5'009	5'009	38'536	1'915
Plant protection	2'193	2'193	118	2'193
Irrigation	217	217	1'394	678
Maintenance	68	81	6'258	3'081
Harvest	54'846	60'762	11'070	34'531
Pre paration/Delivery	5'415	6'003	6'069	12'999
Infrastructure/Misc	39'122	37'711	86'924	79'886
Trans port/other costs	3'516	3'842	3'346	2'872
Other Structural costs	12'895	13'520	18'949	16'242
Total	125'644	131'701	175'936	156'240
Analysis				
Total Production costs/Area	**171'719**	**179'832**	**244'118**	**210'666**
Total Production costs/Unit	**11.17**	**10.55**	**9.35**	**11.41**
Com parable contribution margin	144'054	162'627	199'566	163'025
Profit/Loss	17'300	29'674	20'607	4'220
=Profit/Loss per unit	1.12	1.74	0.79	0.23
=Earnings per person hour	34.22	38.23	36.40	29.57

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System Comparison [CHF]

Crop	2020	2020	2020	2020
Cultivation method	Organic	Organic	SGA	Organic
System	Oak Leaf Salad BAU	Oak Leaf Salad BAU	Spinach INN1	ASC INN2
Area	1 ha	1 ha	1 ha	1 ha
Cultivation site	Greenhouse	Greenhouse	Greenhouse	Greenhouse
Usage	Fresh market	Fresh market	Fresh market	Fresh market
Delimitation	Wholesale price	Wholesale price	Wholesale price	Wholesale price
Performance (Yield)				
Performance	134'543	127'497	207'617	0
Contributions			0	0
Total	134'543	127'497	207'617	0
Direct costs				
Soil cultivation	2'068	2'068		
Seeding/planting	11'969	11'969	17'853	1'136
Fertiliser	560	552		
Plant protection	2'505	2'505		
Irrigation	1'146	900	600	900
Maintenance				1'210
Containers	14'552	13'790	8'758	0
Infrastructure/Misc.	194	160	125	115
Third party work	2'423	1'995	1'560	
Total	35'415	33'938	28'896	3'361
Structural costs				
Soil cultivation	1'950	1'950	1'429	2'858
Seeding/planting	12'918	12'918	19'268	89
Fertilisation	509	509		
Plant protection	2'924	2'924		
Irrigation	650	488	465	407
Maintenance	461	420	3'102	569
Harvest	12'839	12'181	4'815	97
Preparation/Delivery	6'417	6'081	2'116	
Infrastructure/Misc.	72'315	90'987	44'260	37'557
Transport/other costs	1'944	1'884	1'570	201
Other structural costs	12'388	13'640	8'702	3'729
Total	125'314	143'981	85'726	45'506
Analysis				
Total Production costs/Area	**160'729**	**177'919**	**114'623**	**48'868**
Total Production costs/Unit	**1.54**	**1.80**	**6.29**	**48'868.00**
Comparable contriubtion margin	101'550	95'554	180'281	-3'361
Profit/Loss	-26'186	-50'422	92'994	-48'868
=Profit/Loss per unit	-0.25	-0.51	5.11	-48'868.00
=Earnings per person hour	4.91	-16.96	116.36	-571.80

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System Comparison [CHF]

Crop	2020	2020	2020	2020
Cultivation method	Organic	Organic	Organic	Organic
System	Tomato BAU2	Tomato IN N1	Tomato BAU1	Tomato IN N2
Area	1 ha	1 ha	1 ha	1 ha
Cultivation site	Greenhouse	Greenhouse	Greenhouse	Greenhouse
Usage	Fresh market	Fresh market	Fresh market	Fresh market
Delimitation	Wholesale price	Wholesale price	Wholesale price	Wholesale price
Performance (Yield)				
Performance	452'583	470'643	630'881	456'382
Total	452'583	470'643	630'881	456'382
Direct costs				
Soil cultivation	2'068		2'068	
Seeding/planting	84'000	84'000	84'000	84'000
Fertiliser	4'252	4'219	5'841	2'685
Plant protection	10'998	10'998	13'994	10'998
Irrigation	8'019	8'019	9'054	8'019
Maintenance	8'330	8'330	8'752	8'330
Gebinde	21'264	22'113	29'641	21'443
Containers	4'250	4'250	4'250	4'250
Infrastructure/Misc.	273	273	332	273
Third party work	3'413	3'413	4'148	3'413
Total	146'867	145'614	162'080	143'410
Structural costs				
Soil cultivation	2'114	2'114	2'114	2'114
Seeding/planting	7'588	7'588	7'588	7'588
Fertiliser	1'409	14'446	1'409	7'148
Plant protection	3'340	3'340	6'801	3'340
Irrigation	1'574	1'574	1'674	1'574
Maintenance	43'113	49'699	50'330	49'699
Harvest	29'298	30'222	38'422	29'712
Preparation/Delivery	10'390	10'806	14'483	10'479
Infrastructure/Misc	99'241	99'439	154'919	99'283
Time away/breaks	4'952	6'000	6'152	5'594
Other Structural costs	29'669	31'338	38'306	30'450
Total	232'688	256'565	322'199	246'979
Analysis				
Total Production costs/Area	**379'555**	**402'179**	**484'278**	**390'389**
Total Production costs/Unit	**2.66**	**2.71**	**2.43**	**2.71**
Comparable DB (VDB)	309'129	328'442	472'949	316'385
Profit/Loss	73'028	68'464	146'603	65'993
=Profit/Loss per unit	0.51	0.46	0.74	0.46
=Earnings per person hour per ha	48.38	43.94	62.14	44.18

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System Comparison [CHF]

Crop	2020	2020	2020	2020
Cultivation method	Organic	Organic	Organic	Organic
System	Lambs Lettuce BAU	Lambs Lettuce BAU	Lambs Lettuce INN1	Lambs Lettuce INN2
Area	1 ha	1 ha	1 ha	1 ha
Cultivation site	Greenhouse	Greenhouse	Greenhouse	Greenhouse
Usage	Fresh market	Fresh market	Fresh market	Fresh market
Delimitation	Wholesale price	Wholesale price	Wholesale price	Wholesale price
Performance (Yield)				
Performance	209'544	254'943	273'832	248'353
Total	209'544	254'943	273'832	248'353
Direct costs				
Soil cultivation	2'068	2'068		
Seeding/planting	25'452	25'452	25'452	25'452
Irrigation	300	354	354	354
Containers	12'247	14'900	16'005	14'515
Infrastructure/Misc.	79	87	87	87
Third party work	990	1'088	1'088	1'088
Total	41'136	43'949	42'985	41'496
Structual costs				
Soil cultivation	2'363	2'363	1'843	1'843
Seeding/planting	5'009	5'009	5'009	5'009
Irrigation	163	217	217	217
Maintenance	54	68	2'262	2'262
Harvest	39'989	48'593	52'175	47'344
Preparation/Delivery	3'942	4'794	5'151	4'669
Infrastructure/Misc	29'588	32'621	32'833	32'548
Transport/other costs	2'586	3'063	3'343	3'077
Other Structural costs	10'127	11'420	11'830	11'238
Total	93'822	108'148	114'662	108'207
Analysis				
Total Production costs/Area	**134'958**	**152'097**	**157'647**	**149'703**
Total Production costs/Unit	**12.06**	**11.17**	**10.78**	**11.28**
Comparable contrubution margin	169'398	212'082	231'934	207'945
Profit/Loss	74'586	102'846	116'185	98'650
=Profit/Loss per unit	6.66	7.55	7.94	7.44
=Earnings per person hour	68.38	74.92	76.31	72.57

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