Assessment of two modern milk farms (low input versus high external input) in Switzerland focused on sustainability and resilience criteria

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Abstract: In many countries there is a trend in milk production to either maximize the milk yield with high inputs and modern milking technology or to choose a low external input strategy with emphasis on grazing. What about the sustainability and resilience of such types of farms? In this paper a comparison of two modern milk farms in the same region and village in Switzerland with similar climatic conditions and new free-range stables has been made. Both farms are run collectively. Farm A is a non-organic milk farm (integrated production) with milk robot machinery and high input of feed concentrates for milk production without using pasture but with a concrete outdoor run. Farm B is an organic milk farm with consequent low input milk production with full pasture access during the season, outdoor run in the winter as well as a non-use of cereal-based concentrates anymore due to consequent breeding efforts. Both farms have been assessed using the RISE 2.0 system developed by the School of Agricultural, Forest and Food Sciences (HAFL) in Zollikofen in collaboration with the Research Institute of Organic Agriculture (FiBL), Switzerland. This system uses 10 main sustainability criteria, categories and indicates through benchmarking the state of the farm in different areas (positive, to be verified, problematic).

The overall sustainability assessment showed that none of the two farms is in a problematic area. Both are economically successful. Both strategies, if well managed, can be profitable. The farms score socially well due to the collective management. Regarding environmental sustainability: soil usage and water management is positive; nutrient flow and ammoniac emissions could still be improved in both farms. Farm B uses 40 % less energy with 30 % lower milk production/animal/year and score better in biodiversity than farm A. Animal health and welfare of the two farms is difficult to judge with RISE 2.0 system, but it is interesting to look from a resilience perspective. Farm A has a technology-based system of analytical and electronic tools (health status permanently controlled and irregularities reported). Direct observations by the farmers in the stable seem less important, although also done. The strategy of Farm B is based on a much lower feeding and milk productivity level, which reduces the risk of several diseases. The farmers observe mainly their animals on pasture or in the outdoor run and milking station. However their consequent grazing system, with varying climatic impact on the fodder quality needs a very well planned pasture system. It is interesting that both farms have relatively low costs for veterinarians. Further reflections are needed in which way the sustainability and resilience of such type of milk farms can be better assessed and improved.

Keywords: milk farms, milk robots, sustainability assessment, resilience, low input, high input

Introduction

Development of different milk production strategies

In Switzerland like in other countries there is a trend in milk production to either maximise the milk yield with high inputs (in particular feed) and modern milking technology or to choose a low external input strategy with emphasis on grazing. It seems that the use of milk robots does accelerate this process towards high input based livestock systems, often with no grazing. The question comes up, if the farmer and their animals have to adapt to the modern technology or vice-versa. How much is there a dependency of the farmer from the technical and electronic supervision of the animals? Or is the modern ICT supported technology an important tool to better observe the health and behaviour status of the animals? What about farm resilience and overall sustainability in different milk farms?

Methodological approach on case study farms

The reflections in this paper are based on the comparison of the sustainability of two modern milk farms in the same region and village in Canton Lucerne (Switzerland) with similar climatic conditions. Both farms have built new free-range stables in the last 3-4 years and are run collectively.

Farm A: is an integrated milk farm run by 4 farmers, which built a new stable with milk robot machinery. The farm has 77 ha and 3.4 working units. Their strategy is high input milk production without pasture (although situated in the middle of a grassland area) and with optimised high use of concentrates. The milk production per cow on average is 8500 kg/lactation.

Farm B: is an organic milk farm with consequent low input milk production with full pasture access during the season and outdoor run in the winter. The farm has 42 ha and 3.5 working units (2 farm families). This farm does practically not use cereal-based concentrates anymore due to consequent breeding efforts. The milk production per cow on average is 5500 kg/lactation.

Both farms have been assessed using the RISE 2.0 assessment system developed by the School of Agricultural, Forest and Food Sciences (HAFL) in Zollikofen, which is part of Bern University of Applied Sciences in collaboration with the Research Institute of Organic Agriculture (FiBL), Switzerland.

The RISE 2.0 System (HAFL, 2014a) evaluates the sustainability of agricultural production through ten indicators, each calculated from four to seven parameters. The main criteria of indicator selection and development are: relevance for farm sustainability, methodological soundness, reproducibility, within the farmer's scope of action, transparent valuation functions, reasonable cost-benefit ratio. Data are transformed onto a scale from 0 to 100, through comparison between farm and reference data and by using valuation functions. The values of the resulting parameters range from an optimum (100 points, completely sustainable way of producing) to a completely intolerable (0 points) situation. Through benchmarking the state of the farm in three different areas is shown (positive 67-100, to be verified 44-66, problematic 0-33). The RISE feedback report consists of a farm profile, the farm sustainability polygon, a table with all parameter scores that is the basis for the detailed discussion, followed by further explanatory information on the indicators, their meanings and calculation. Based on the report, farm potentials and deficits are dis-cussed with the farm manager. Farmer and consultant clarify whether the RISE results are consistent with the farmer's view and which measures for improvement could be taken (HAFL, 2013b).

Assessment against sustainability and resilience criteria

Sustainability criteria

The overall sustainability assessment with RISE 2.0 showed that none of the two farms is in a problematic area (see Fig 1 and 2). Both are economically successful; interestingly in a comparable way. It means that both strategies, if well managed, can be profitable. The farms score both socially well regarding quality of life due to the fact, that the collective management allows also some free time and holidays. High input farm A could still improve regarding the working conditions of the farmers compared to Low input farm B, where seasonal calving and a more simplified work organization allows more "free time" particular in winter.

Fig. 1 Sustainability assessment of high input milk farm A

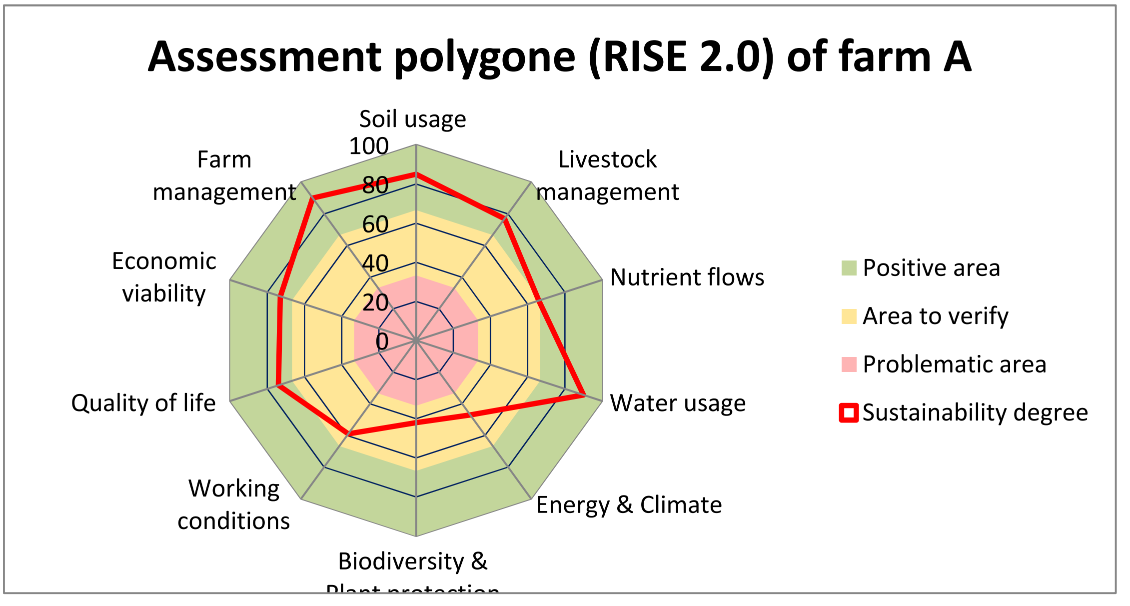
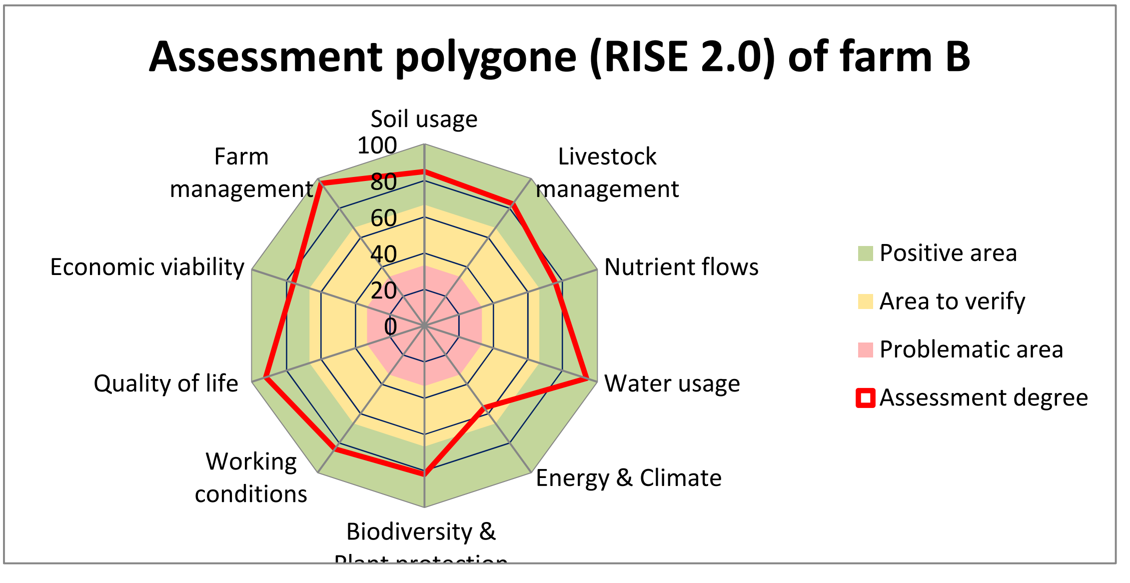


Fig. 2 Sustainability assessment of low (external) input milk farm B



Regarding environmental sustainability some differences are found:

- Both farms have a relative balanced rotation; therefore the soil usage indicator is comparable.
- Water management is in both farms quite optimized.
- Nutrient flow and ammoniac emissions could be still significantly improved in both systems (more in farm A).
- The energy input and the related climate impact of the stable systems could in both farms be better. However, farm B has a more optimized system (40 % less energy with 30 % lower milk production/animal/year).
- Biodiversity on the land is higher on the organic farm B due to a more extensive management of the meadows and a lower stocking density (and nutrient load).
- The use of pesticides (mainly herbicides) in farm A still could/should be reduced compared with farm B, where no pesticides are used.

The assessment of animal health and welfare of different farms is difficult to judge with the RISE 2.0 system (which takes a high milk yield as one of the positive health parameters), also due to the lack of suitable indicators. The use of more animal related indicators would be useful. The fact that farm B has during the full season permanent pasture can contribute to a better health and welfare of the animals. However Rise 2.0 does not foresee an objective animal welfare scoring.

In Tab. 1 an overview about the scores of the two farms with Rise 2.0 assessment related to different sustainability criteria is given.

Animal health and welfare in a resilience perspective

How can these two livestock systems be judged in a resilience perspective? Due to a lack of clear criteria for defining resilience, the following considerations and criteria might be taken into account, when discussion the resilience of milk production: a lower vulnerability to animal diseases due to a good and balanced health status of the whole herd and the individual animals. This might be influenced by the capacity of the livestock system to respond and to recover from changing climatic and management conditions. This might depend from a more balanced feeding system based on farm-own resources with more robust breeds. In this paper we will mainly discuss the animal health situation on the two farms in a resilience perspective.

Regarding animal health the farm A has a sophisticated system of analytical and electronic tools available, which during the whole time does report to the farmers, if any irregularities regarding somatic cells and other milk quality parameters are suddenly changing. The farmer in charge does immediately get a message on his mobile phone and has then to verify quickly the situation in the stable and consequently then to check the causes of these irregularities. The farmers in farm A think that the robot system even allows them to make better and more objective observations. They emphasize that the milk robot does not replace human observations during feeding and cleaning. To reduce the technical vulnerability farm A has two robots and also a fuel-based electricity security system. Furthermore a standard feeding is ensured with a full-ratio-feed mixing machine.

Tab. 1 Assessment scores of two milk farms with HAFL-RISE 2.0 (Näf, 2013)

Indicators	Sub-categories	High Input milk farm A total	detail	Low Input milk farm B total	detail
Soil use	• Soil management	**85**	84	**85**	84
	• Crop productivity		90		60
	• Soil organic matter supply		52		80
	• Soil reaction		89		78
	• Soil pollution		90		100
	• Soil erosion		100		100
	• Soil compaction		90		90
Animal husbandry	• Herd management	**77**	100	**83**	100
	• Livestock productivity		75		67
	• Species-appropriate behaviour		50		100
	• Quality of housing		100		100
	• Animal health		58		49
Nutrient flows	• Nitrogen balance	**66**	59	**76**	75
	• Phosphorus balance		70		76
	• N and P self-sufficiency		80		89
	• Ammonia emissions		33		43
	• Waste management		90		95
Water use	• Water management	**90**	100	**94**	100
	• Water supply		100		100
	• Water use intensity		59		75
	• Risks to water quality		100		100
Energy & Climate	• Energy management	**47**	100	**56**	95
	• Energy intensity agricultural production		47		76
	• Share of sustainable energy carriers		40		3
	• Greenhouse gas balance		0		50
Biodiversity & Plant production	• Plant protection management	**42**	84	**82**	100
	• Ecological priority areas		15		64
	• Intensity of agricultural production		31		74
	• Landscape quality		15		100
	• Diversity of agricultural production		65		73
Working conditions	• Personnel management	**59**	93	**84**	100
	• Working times		56		78
	• Safety at work		65		86
	• Salaries and income level		21		70
Quality of life	• Occupation + education	**74**	75	**92**	96
	• Financial situation		75		94
	• Social relations		88		100
	• Personal freedom + values		66		87
	• Health		64		83
Economic viability	• Liquidity reserve	**73**	26	**76**	19
	• Level of indebtedness		100		87
	• Economic vulnerability		70		79
	• Livelihood security		-		100
	• Cash flow - turnover ratio		94		97
	• Dept service coverage ratio		76		96
Farm management	• Farm strategy + planning	**90**	75	**97**	88
	• Supply and yield security		100		100
	• Planning instruments+ documentation		98		98
	• Quality management		77		99
	• Cooperation		100		100

Farm B has another strategy for animal health. With their low input livestock system with no concentrates, the two farmers of this farm want to reduce the vulnerability by having their feeding and management system on a much lower productivity level. It is more likely that several diseases are reduced, when having a lower milk production level of 5000-7000 kg milk/cow compared with farms over 9000-12000 kg milk per cow (mastitis, claw pain, genital catarrhs, ovarian cysts, post natal behaviour, milk fever) (Metzner, 1993). The main observations of the responsible farmers in farm B regarding irregularities are mainly done, when the cows go daily twice on the pasture land and in the milking station. However this grazing system, where the impact of weather conditions have a strong and changing impact on the fodder quality, needs a very well planned pasture system (with short rotation periods).

Conclusions

It is interesting that both farms have relatively low costs for the veterinarians, if we take this as concrete indicator for animal health Both milk production system try to reduce risks of irregularities in their owns way. The use of technology for supervision of the herd is much more important in the high input system. Good observations and a flexible grazing system with robust breeds on a lower production lead to less problems with animal diseases. Until now it was often stated, that it is not economically optimal to combine milk robots with extended pasture systems. However, it might be interesting to investigate and research the combination of the consequent pasture system with new mobile milk robots following the cows on the different pastures (as outlined in a project of Wageningen University by Spoelstra, 2002). Such systems would then contribute much more to animal welfare, allowing cows and young cattle to accomplish better their natural behaviour needs with grazing. In particular for organic farms, it would be very important, that such combined systems could be further developed.

Further reflections are needed in which way the sustainability and resilience of such type of milk farms can be better assessed and improved.

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