Impact of technological advances on annual working time in Swiss farming.

C. Umstatter [1], R. Stark[1], D. Schmid[1], M. Schick[1]
[1] Agroscope ISS, Tänikon 1, CH-8356 Ettenhausen, Switzerland

e-mail of corresponding author: christina.umstaetter@agroscope.admin.ch

Summary
The study investigated the annual working time of Swiss farmers and its changes due to technological advances. First of all, a literature review was conducted. The second approach was a modelling exercise of labour requirements based on the accounting data of Swiss farms. This topic is of importance as the Swiss subsidy system is based on labour requirements on farms as entry level. In conclusion, the findings indicated that the technological advances are implemented on the farms but the labour savings are used to manage either more land or a higher number of livestock. In a nutshell, the labour savings are compensated through expansion and the amount of work per person and year tends to be roughly stable or even increase.

Key words: standard labour unit, working time, technological progress

Introduction

In 1999, Switzerland introduced the concept of the "standard labour unit" (SLU) in agricultural politics. This was used in the first instance to define the lower and the upper boundary for direct payments to farmers. Today, the system has evolved and is additionally used e.g. in the tax and rental regulations. A standard labour unit corresponds with an annual working time of 2800 MPh. For the operation branches, the number of SLUs are than calculated per ha or livestock unit. However, the question is, does a "standard" farmer work 2800 hrs per year and does the number of hours worked decrease over time due to e.g. advances in technology? It is currently planned by the Swiss administration to change the amount of MPh per SLU from 2800 to 2600 in January 2016 to incorporate the technical progress. We wanted to investigate the technical progress on farms further by doing a literature research and by modelling labour time requirements on Swiss farms.

Material and methods

First, we evaluated literature on working time regulations and labour studies in farming to find out the status quo. The literature research encompassed different countries.

The second part consisted of a modelling exercise. Agroscope compiles a report on agricultural data based on the Swiss Farm Accountancy Data Network every year (Hausheer Schnider, 2005; Hoop and Schmid, 2013). The data was used to calculate an average arable farm for 2003 and 2012 and an average dairy farm for the same years.

In Switzerland differences due to topographic characteristics can be expected between the lowland, the upland and the hill and mountain regions. Therefore, the two extremes, lowland and mountain area (from now on referred to as hill region), were chosen to model two dairy farm scenarios.

For crop production the data were based on 65 reference farms (24 for 2003 and 41 farms for 2012). For dairy farming in the lowlands 172 reference farms were included in the

calculation of the average farm (93 for 2003 and 79 reference farms for 2012). The dairy farms in the lowlands had tie stall or free stall barns. Therefore, we have based the modelling on both husbandry types as a mixed calculation based on the percentage of average animal numbers kept in either tie stall or free stall barns.

We also investigated if there were any differences in labour requirements between the lowland and hill regions for free stall barns in 2003 and 2012. In total, 129 reference farms with free stall barns were taken into account (22 for 2003 and 42 for 2012 in the hill region and 27 for 2003 and 38 for 2012 for the lowland region).

In general, only farms which were able to support themselves without extra income from an off-farm job were taken into account for the modelling exercise. The data made available by the Swiss Farm Accountancy Data Network provided us with the number of animals, the number of ha for pasture, the number of ha for forage production, the number of farm labour etc.

We also looked into the degree of mechanization in 2003 and 2012 in order to be able to model the technological progress (Schick, 2013). Table 1 displays the assumptions for the modelling in terms of mechanisation and production information on Swiss farms for the Years 2003 and 2012.

Table 1: Assumptions for Swiss model farms for 2003 and 2012.

General information		**2003**	**2012**
Altitude [m.a.s.l.]	Hill farm	1000	1000
	Lowland farm	500	500
Winter feeding [d]	Hill farm	189	189
	Lowland farm	154	154
Winter feeding period [wk]	Hill farm	44 - 18	44 - 18
	Lowland farm	46 - 15	46 - 15
Production information		**Mechanisation**	
		2003	**2012**
Tie stall barn	Stabling	Short standing	Short standing
	Milking system	Bucket milking	Pipeline milking
	No. milking units	2	3
	Equipment grass forage	Engine mower, loading wagon	Front mower, loading wagon
	Supply in barn		
	Pasture	119 grazing days	147 grazing days
	Feeding	Half-day supply feeding	Half-day supply feeding
	Feed removal	Manually	Grab crane system
	Feed supply	Manually	Manually
	Feed storage	Silage tower	Silage tower

Table 1 continued: Assumptions for Swiss model farms for 2003 and 2012.

Production information		Mechanisation	
		2003	2012
Free stall barn	Stabling	Free stall barn	Free stall barn
	Milking system	Tandem milking parlour	Auto tandem milking parlour
	No. milking units	1 x 3	2 x 2
	Equipment grass forage Supply in barn	Engine mower, loading wagon	Engine mower, loading wagon
	Pasture	119 grazing days	147 grazing days
	Feeding	Half-day supply feeding	Full-day supply feeding
	Feed removal	Grab crane system	Grab crane system
	Feed supply	Manually	Feed mixer
	Feed storage	Silage pit	Silage pit
Crop production	Primary tillage	3-furrow plough	3-furrow plough
	Seed bed preparation	3 m	3 m
	Sowing	3 m	3 m
	Planting potatoes	4-row semi-automatic	4-row fully automatic
	Cultivation (sugar beets)	Without thining	Planting to end spacing (contractor)
	Earthing up potatoes	4-row	4-row
	Crop protection	12 m	15 m (contractor)
	Potato haulm topper	3 m	3 m
	Crop harvesting	4.5 m	5 m (contractor)
	Harvesting straw	High pressure and round bales	High pressure and round bales
	Harvesting sugar beet	2-row	6-row self-propelled (contractor)
	harvesting potatoes	Single-row, drawn	Single-row, drawn
Forage production Lowlands	Mowing	Rotary mower, 2.4 m	Rotary mower, 3.5 m
	Processing unit	Rotary haymaker, 6.5 m	Rotary haymaker, 8.5 m
	Windrowing	Rotary windrower, 3.5 m	Rotary windrower, 7.5 m
	Harvest ventilation hay	Loading wagon 20 m3	Loading wagon 30 m3
	Harvest silage	Field shredder	Field shredder
	Store ventilated hay	Blower with telescope distributor	Grab crane system
	Store grass silage		
	- Tie stall barn	Silage tower	Silage tower
	- Free stall barn	Silage pit with concrete walls	Silage pit with concrete walls
Forage production Hill	Mowing	Two-axle mower, 2.5 m	Two-axle mower, 2.8 m
	Processing unit	Rotary haymaker, 5 m	Rotary haymaker, 5 m
	Windrowing	Belt rake, 3 m	Belt rake, 3 m
	Harvest ventilation hay	Transporter 15 m3	Transporter 18 m3
	Harvest silage	Transporter 15 m3	Transporter 18 m3
	Store ventilated hay	Blower with telescope distributor	Grab crane system
	Store grass silage		
	- Tie stall barn	Silage tower	Silage tower
	- Free stall barn	Silage pit	Silage pit

This information was then used in our self-developed software ("ART-Work-Budget", Agroscope, Ettenhausen, Switzerland) to calculate the working time requirements (Figure 1). The software is based on the working element method according to REFA (1978). As we did the modelling for two different years, we were able to visualize the change in labour requirements due to technological advances.

Figure 1: New version of the software „Work-Budget-Light" (Agroscope, Ettenhausen, Switzerland).

Results and Discussion

Literature review

Switzerland is split into 26 cantons. Each canton has a Standard Employment Contract for agriculture to avoid wage dumping. In some cantons there are different standardized employment contracts for livestock and for arable production. The majority of these contracts are based on 2640 working hours per year, with a range of 2160 to 3100 working hours per year for an employed farm labourer (Agrimpuls, 2013). Eight cantons have different working time requirements for farm labour working with livestock or without livestock, with 200 h less yearly working time for the latter.

To put regulated working time requirements for farm labour into an international perspective, we looked into the regulations for different countries (Table 2). The legal requirements for a farm labourer in Scotland describe a limit of 2216 working hours per year (Scottish Government, 2013). The employment contract for farm workers in South Africa state weekly working hours of 45 h which would add up to 2205 h (Molatseli, N.A.). Public holidays were not taken into account but annual leave of a minimum of three weeks. However, additional payment provided, a farm worker is allowed to work up to a maximum 60 h per week in South Africa, if necessary. It should also be noted that in South Africa there is an upper limit of daily working time of 9 h for a 5 day week and if the person needs to work more than 5 days a week, the maximum daily working hours can only reach 9 h. The collective agreement for agricultural labour in Germany amount to 1795 working hours per year according to the department of agriculture in North Rhine Westphalia (Brinker, N.A.). However, this figure does not rule out overtime and should be considered carefully.

Table 2: Examples of yearly working hours in different countries.

Country	Working hours per year	Type
Switzerland	Mode: 2640	Standardized employment contracts (Agrimpuls, 2013)
South Africa	2205 (public holidays need to be subtracted)	Employment contract (Molatseli, N.A.)
Germany	1795	Collective agreement (Brinker, N.A.)
Scotland	2216	Legal requirement (Scottish Government, 2013)

A study done by Rossier and Reissig (2014) investigated the time budgets on farms in Switzerland. The authors carried out a time budget study on 179 Swiss farms asking farmers wives to write down the amount of time spent on certain tasks. The study was carried out over a period of 12 months. The women documented how much time they spent on their tasks every 8 days and they also compiled the data for their husbands or partners. They found that on average the farmers worked 60.77 h per week, that included the actual farm work, the amount of time spent on off-farm work, time spent on tasks which are farm related but not actual farm work, e.g. running a farm shop, and time spent on administration. This is a total of 3160 working hours per year. On average the majority of time (81%) was spent on actual farm work, with an average of 13% spent on off-farm work. Rossier and Reissig (2014) stated that most of the farms had an additional income from a job outside agriculture. The Federal Office for Statistics also found a weekly working time of about 60 h for Swiss farmers, which is in line with our findings (Bundesamt für Landwirtschaft, 2013), see Figure 2.

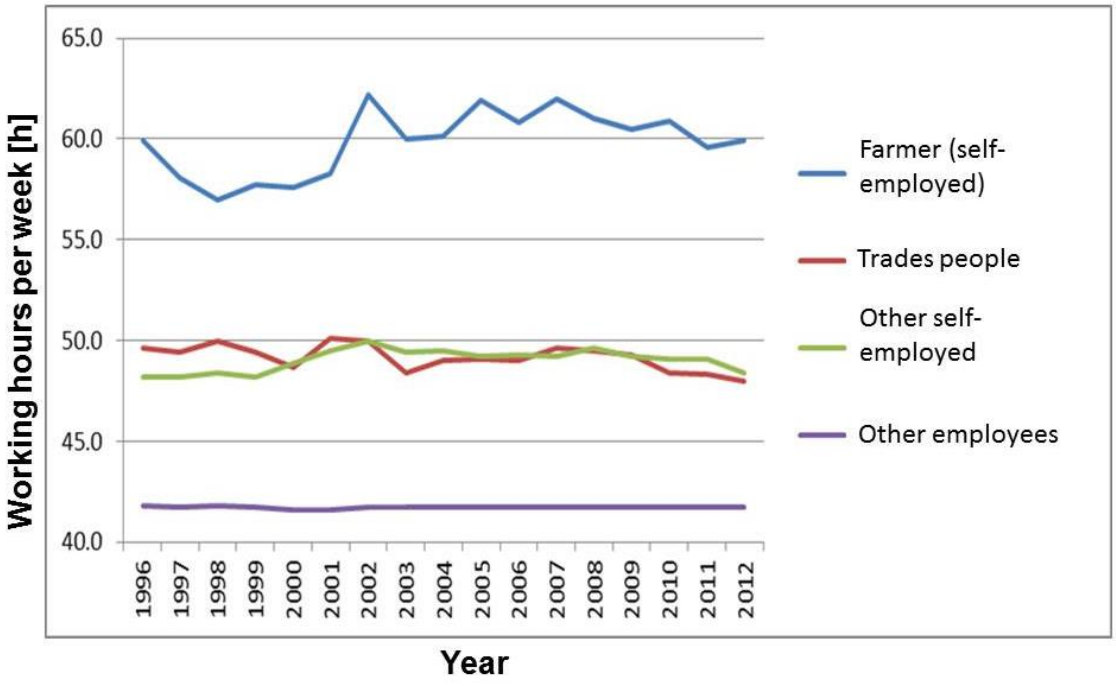

Figure 2: Development of the weekly working time of full employment (Bundesamt für Landwirtschaft, 2013).

Ryan (2013) described that Irish farmers worked 48 h per week on average but for dairying this increased to 55 h on average per week. However, in that questionnaire the weekly working hours referred to work on the farms whilst over 20% of farmers had additional off-farm jobs. Stadler et al. (2005) stated that Statistik Austria found an average yearly working time of 2160 MPh.

Other literature sources only state that farmers tend to work longer than 48 or 49 h as this is often the threshold which indicates that a person works long hours. In the guidelines of the European Union (2003) it is pointed out that the average working time per 7 days should not exceed 48 h including overtime. However, agricultural labour can be exempt by member states of the European Union. It is likely that the occurance of longer working hours for agricultural labour than 48 h per week is the case in most countries. For example, the Australian Bureau of Statistics found in 2011 (Australian Bureau of Statistics, 2012) that 50% of the farmers worked 49 hrs or more a week.

Modelling of working time requirements

Firstly, working time requirements were modelled for arable farms. From the reference farms of the Swiss Farm Accountancy Data Network, it was found that the average number of people working on the farm decreased slightly from 1.54 in 2003 to 1.37 in 2012 (Table 3). Yet, the number of ha increased from 21.3 to 30.1. The average estimated working time requirement based on the model went down in total from 2116 to 1941 h. Nevertheless taking the number of people working on the farm into account, the number of hours worked per person and year went up from 1374 to 1417 h in crop production in our case study.

If we exclusively consider the dairy farms in the lowlands, including both tie stall and free stall barns, we did not find any increase in working time requirements per labour person despite an increase in cattle numbers (Table 3). For dairy cows, there was an increase of 38% to 29.7 cows per farm and for breeding stock and steers an increase of 57% to 16.3 animals per farm. The analysis of animals kept in either a tie stall or a free stall barn revealed that in 2003, 33% of dairy cows were kept in free stall barns and 67% in tie stall barns. In 2012, the percentage of cows in free stall barns increased to 58% leaving 42% in tie stall barns. A similar trend, towards loose housing systems, was found for breeding stock and steers. In 2003, 60% of the animals were kept in loose housing systems with an increase by 10% until 2012.

Table 3: Calculated changes of key operating data between the Years 2003 and 2012 due to technical progress for dairy and arable farms situated in the lowlands.

	Key operating data	Unit	2003	2012	Percentage change
Arable Lowland	Labour persons (LP)	LP/farm	1.54	1.37	-11%
	Labour units (LU)	MPh/LP	1374	1417	3%
	Utilised agricultural area	ha/LP	13.8	22.0	59%
	Grass land	ha/LP	2.7	3.4	26%
	Arable land	ha/LP	11.1	18.2	64%
	Livestock	Livestock unit/LP	6.5	5.9	-9%
Dairy Lowland	Labour persons (LP)	LP/farm	1.78	1.89	6%
	Labour units (LU)	MPh/LP	2540	2545	0%
	Utilised agricultural area	ha/LP	11.1	12.7	15%
	Grass land	ha/LP	9.6	10.8	12%
	Arable land	ha/LP	1.3	1.8	38%
	Livestock	Livestock unit/LP	15.6	20.6	32%
	Dairy cows	No. of animals	21.5	29.7	38%
	Breeding stock	No. of animals	10.4	16.3	57%

On a dairy farm operating with a free stall barn in the lowland region, the number of cows increased by 42% (Table 4). However, the amount of calculated hours needed for these cows, including the amount of labour to manage pasture and forage production etc. has only risen by 15% from 4459 to 5131 hours per year. On the other hand, the number of people working on the farms has also risen from 1.78 to 2.02 persons. That means, that the amount of hours worked per year per person has hardly changed, with an increase from 2505 to 2540 h per year (+1.4%). In the hill region dairy farms, the number of cows has risen by 15% and as a result, the labour requirements have risen by 8% up to 5198 h per year. As the labour units also increased by 12%, a 4% reduction of working time per person was achieved.

Table 4: Calculated changes of key operating data between the Years 2003 and 2012 due to technical progress for dairy farms operating a free stall barn in the lowland and hill regions.

	Key operating data	Unit	2003	2012	Percentage change
Free stall barn Lowlands	Labour persons (LP)	LP/farm	1.78	2.02	13%
	Labour units (LU)	MPh/LP	2505	2540	1%
	Dairy cows	No. of animals	26	37	42%
	Calves	No. of places	9	12	33%
	Breeding stock	No. of animals	15	23	53%
	Grassland	ha	20.9	24.7	18%
Free stall barn Hill	Labour persons (LP)	LP/farm	1.71	1.91	12%
	Labour units	MPh/LP	2827.0	2721.6	-4%
	Dairy cows	No. of animals	20	23	15%
	Calves	No. of places	7	8	14%
	Breeding stock	No. of animals	20	22	10%
	Grassland	ha	30.1	34.1	13%

It should be pointed out that the labour requirements for the model farms were slightly underestimated, as these were average farms and not all farming operations were included. Farming operations with a very low quantity were not taken into account. In addition, when calculating the working time requirements with the software ART-Work-Budget, it can be assumed that another source of underestimation should be considered as there is a difference between the modelled requirements and the actual time worked.

In conclusion, although the number of hours calculated through modelling was lower than the current number of hours for an SLU (2800 hrs), it is more likely that the actual hours worked are closer to the one found in literature as in general the modelled working time requirements are lower than the actual hours worked. That means for a Swiss farmer a weekly working time of about 60 hrs (Rossier and Reissig, 2014) according to literature.

The modelling demonstrated the overall trend between the different production branches on the farm. In crop production the working time increased whereas in dairying the amount of work per person stayed almost the same. From that data, there was no indication that the technological advances actually led to a reduction of working time. Yet, it was shown that the technological advances were, indeed, implemented on farms but the labour savings were used to manage either more land or a higher number of livestock. In a nutshell, the labour savings were compensated through expansion and the amount of work per person and year tends to be roughly stable or has even increased.

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