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A simple measure for workload as a social sustainability indicator for family farms

Christina Umstätter [a,c], Stefan Mann [a,*], Jessica Werner [b]

[a] Competitiveness and System Evaluation, Agroscope, Ettenhausen, Switzerland
[b] Animal Nutrition and Rangeland Management in the Tropics and Subtropics, University of Hohenheim, Stuttgart, Germany
[c] Johann Heinrich von Thünen-Institut, Bundesforschungsinstitut für Ländliche Räume, Wald und Fischerei, Switzerland

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ABSTRACT

Most criteria for social sustainability of farms rely on the presence of employed labour, so that the social sustainability of family farms is difficult to capture. We therefore propose to focus on workload as one aspect of social sustainability, with a particular angle on its manifestation in family farms. We compared existing labour resources to working time requirements according to the farm's portfolio. Different levels of detail in acquiring the necessary data are presented. Two case studies on samples of Swiss dairy farms indicate that around a third of all farms suffer from potentially being overworked whereas being underworked does not seem to be an issue. It has been indicated that the problem of overwork is more prevalent among lowland farms than in the mountains. The simple indicator proposed was found to be a potentially useful and easy-to-use tool. However, it became clear that added value could be found by including the degree of mechanisation on the farm and the degree of outsourcing of work processes to contractors in the calculation of the indicator. Further, an outlook is given on how to automate the indicator calculations to provide additional benefit.

1. Introduction

An analysis of existing tools for the evaluation and certification of social sustainability in agriculture (Janker and Mann, 2018) demonstrated that in the empirical assessment of the social sustainability of agricultural production, criteria are primarily applied that are relevant for employees of agricultural enterprises. The possibility of organising in trade unions is a typical example of this; a non-discriminatory wage system is another. On large commercial farms, such criteria are certainly a valuable point of reference for management. On family farms, especially those without employees, such indicators are of little use in making statements about company-specific social sustainability. In view of the fact that more than 90 percent of all farms are family farms (FAO, 2014), a gap can be observed between the current focus on social sustainability in agriculture and the reality of the dominant family farm. The present paper aims to close this gap with a simple, easy-to-use indicator to be able to assess a large number of family farms in terms of social sustainability. The indicator also holds the potential of automation, which would give its use more momentum. Thus, in the following sections, a sustainability indicator tailored to family farms is developed based on the labour resources versus the labour requirements, considering the farm portfolio, and subsequently tested on two different data sets featuring dairy farms as an example.

Conceptually, our contribution refers to rising voices claiming that the autonomy of the farmer is increasingly limited by external constraints (Bryant and Garnham, 2013; Forney and Häberli, 2017). These constraints, being partly of economic, partly of social nature, may lead to situations in which the social construct of "being a farmer" ceases to be viable and leads to difficulties that affect both physical and mental health.

2. Social sustainability on family farms

When conceptualising social sustainability on family farms, this contribution follows the arguments by Janker et al. (2019), claiming that it is fruitful to link Parson's (1991) system approach to Maslow's (1943) pyramid of needs. This approach puts the interdependencies between professional life and private life into the centre of the social dimension of a family farm, indicating that the quantity and quality of labour will have to play a central role for social sustainability, as also indicated by Dillon et al. (2016).

Switzerland is a good case study for such a claim, as almost 100 per

* Corresponding author.
E-mail addresses: christina.umstaetter@thuenen.de (C. Umstätter), stefan.mann@agroscope.admin.ch (S. Mann).

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cent of all farms are family farms with a relative low variance of size and a small average size of 20 ha. The high standard of regulations in the country, including safety measures, do not give as much reason for concerns about safety hazards and other obstacles to the quality of work as in poorer countries.

However, there are reasons to worry about the workload that the labour force on Swiss family farms is facing. The average of this workload has been quantified at around 60 (Federal Office for Agriculture FOAG, 2013, p. 66; Umstätter et al., 2015) or 66 h per week (Federal Statistical Office, 2016, 2017; Rossier and Reissig, 2014). This overload seems to be characteristic of the family farm as such than a Swiss peculiarity. In an Austrian study, only 20% of dairy farmers stated they would leave for at least one week of holiday in the last year (Wiesinger, 2005), and also a French study on family farms reports severe work overload (Navarrete et al., 2015), particularly for diversified farms. Dairy farms are a dominant farm type in Switzerland (Lips et al., 2013). They suffer particularly from high workloads (Reissig et al., 2016). This applies even more for the many farms in the country that link milk production with other production activities (Hochuli et al., 2021) or with off-farm occupations, even if part-time farming in Switzerland is somewhat less frequent than in neighbour countries (Latruffe and Mann, 2015). The labour overload can have significant health impacts for the ones affected. Both Wagner (2011) for Austria and Reissig et al. (2019) for Switzerland found, based on surveys, that farmers suffer much more often from burnout than other members of society. An overload of labour leads to bad decisions and health-related outages. It is therefore plausible to compare existing labour resources on the farm with required working times to make statements about the social sustainability of family farms.

3. Material and methods

To develop a simple and potentially automated sustainability indicator for workload (SIW) and to investigate its potential and usability, the study was conducted in two parts. First a pilot study was undertaken to find out if such an indicator can be obtained from easily accessible sources and if the results can be used to identify differences between groups. Further, a reference study was conducted to be able to put the simple indicator into a meaningful context. Therefore, a more detailed but laborious method was included in the suite of methods to check the concordance and therefore the usability of the indicator. In the following, first the indicator with its necessary methods is described, followed by the description of the pilot and the reference study. In the reference study the description of the additional methods is included. It is important to note that the two underlying methods are both based on the work element method according to the Association for Labour Studies and Company Organisation (Verband für Arbeitsstudien und Betriebsorganisation e.V. REFA, 1978). This method is explained in more detail in Chapter 3.1. Method 1, the Global Work Budget (GWB) is a software application to enable users in an easy manner to calculate labour time requirements for the whole farm. We also included a second method, the tool PROOF (Agroscope, Ettenhausen, Switzerland). It is also based on the work element method but is much more laborious to use. Therefore, it will only be used to model the labour requirement of a part of the farm to provide an insight into the usability of the proposed indicator in comparison of a more detailed level of labour requirements. The tool PROOF will be explained further in Chapter 3.5.

3.1. Composition of the sustainability indicator for workload

The SIW is calculated as a ratio between the required number of LUs (Labour Units) according to a modelling approach and the influencing factors such as farm size, also referred to as required workforce, and the available LUs on a farm, also referred to as the available workforce on the farm (1).

$$SustainabilityIndicator\ \ of\ \ WorkloadSIW = \frac{Requiredworkforce\ in\ LUs}{Workforceavailableonthefarm\ in\ LUs} \quad (1)$$

3.1.1. Numerator: Calculating the required workforce using the tool Global Work Budget

To create the SIW, the required workforce can be obtained by using the model calculation tool Global Work Budget (GWB). The GWB is used to calculate the number of required working hours per year in total. The required LUs on the farm can then be calculated by dividing the result of the GWB by 2600 h. In Switzerland a standard labour unit is currently set at 2600 h according to the Federal Office for Agriculture FOAG (2018b).

The GWB is an option within the ART-AV software Version 1.4.2 developed by Agroscope (Ettenhausen, Switzerland; Heitkämper et al., 2010) and was used for the calculations of the working time requirements of the farms in the pilot and reference study. The model calculation software is based on the work element method. For the work element method, work processes are divided into work elements with a defined beginning and end. As an example, work elements can be "meters walked without load", "grasping a stake" or "closing gate". The sequences of all work elements of a work process result in a workflow model (Table 1).

The work flow model is important for the time measurements as it gives an overview of all the elements which need to be considered for the modelling. Time measurements need to be conducted for the work elements. It is important to always combine time measurements with measurements of the influencing factors. For example, if the work element 'walking' or 'putting a stake in the soft ground' is measured, it is important to also measure the number of meters walked or the number of times the action was repeated to ensure comparability. Standard time

Table 1
Example of a workflow model for "moving fencing face in strip grazing".

Work Element	Dimension	cmin
Put on/take off wellington boots	action	50
Walk to field	m	1.7
Open/close gate (spring handle)	action	12
Walk to fencing face	m	1.7
Walk back to gate	M	1.7
Pick up reel/Hook up reel	action	0.17[a]
Unwinding tape/wire	M	1,7
Winding the tape/wire onto a reel by hand	M	3.3
Disconnect tape/wire from eyelet	action	3.8
Connect tape/wire (hang in eyelet on pole)	action	5.1
Walk to next stake	M	1.7
Pull out stake	action	2.8
Pull out stake and take them with you, including loosening the strands	action	5.7
Put plastic stake into soft ground	action	5.2
Put fibreglass stake into soft ground	action	10.6
Put fibreglass stake into soft ground	action	27.8

[a] This value is a place holder for demonstration purposes only. All other values are from the Agroscope work element database.

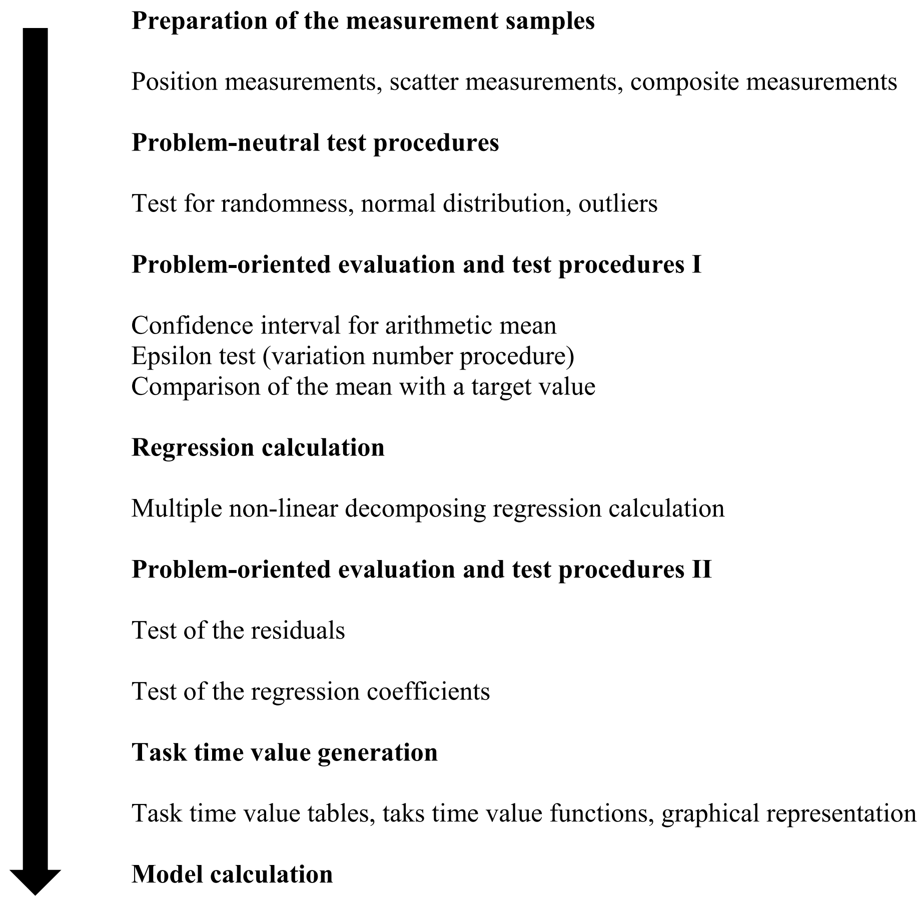


Fig. 1. Preparation and analysis of time recordings (translated from Schick, 2006, p. 30).

values can then be statistically derived from the time measurements (John, 1979, 1987; Schick, 2006). The analysis follows the order in Fig. 1.

In our study, we did not have to conduct time measurements, as for the individual work elements, standard time values have been generated at Agroscope for over 25 years, based on working time measurements. Over 3500 calculated standard time values have been collated and currently stored in a database at Agroscope. They form the basis for modelling working time requirements for the work processes. It should be noted that the calculated working time requirements only include the time needed for the actual tasks without any interruptions, breaks or learning processes.

When calculating the GWB, default settings are stored for three different levels of mechanisation (low, medium and high). Additionally, the option of using contractors can also be selected. In our study, we chose the high level of mechanisation. Due to the high diversity of Swiss farms, some of the work processes and enterprises were not included in the ART-AV software, such as maintenance of riparian shrubs, flower strips, hay meadows in the summering area with low-intensity meadow type, raspberry production and Christmas tree production. However, to provide a full picture of the working time requirements, the working time requirements for the missing enterprises were added from different print sources and other calculation tools (Agridea Lindau, 2014; Meier et al., 2012; Wirth et al., 2015, p. 239; more details in Roesch et al., 2015), so that the required working time per year was finalised the end of the calculations. Areas that were not part of the agricultural land, such as home gardens or designated construction land, as well as very small areas were not considered.

3.1.1.1. Denominator: workforce available on the farm. The data for the available workforce on the farm were derived from an annual work force survey for the agricultural policy information system (AGIS) in Switzerland, also known as the AGIS database. The AGIS database has been developed as a tool to control subsidies in Switzerland. AGIS is comparable to the European Farm Structure Survey (FSS) (Eurostat, 2019) but is based on an annual census. Administrative farm data of all agricultural holdings are compiled at federal level in the AGIS database (Federal Office for Agriculture FOAG, 2018a), which contains, among other things, a farm register, information on structural data, direct payment data and milk data. Farmers are required to autonomously record their farm data once a year. This also includes information on the number of workers (employees and family labour) on the farm, their workload and activity.

The AGIS definition for a 100% LU is given to farmers when they submit the information about their workforce and is described as 51 working hours per week which equates roughly to one standard labour unit in Switzerland. The survey identifies three different categories of part and fulltime workload (<50%, 50%–74%, >74%). The available work force was calculated using the mean value of the percentage range. Details are also described in Roesch et al. (2015).

3.2. Pilot study

For the pilot study, 60 farms were randomly drawn from the AGIS database from the 2013 survey year and anonymised. The inclusion criteria were ‘full time enterprise’, ‘dairy farm’, ‘management of the farms had to be carried out according to the guidelines of Swiss cross compliance conditions’, and ‘zonal distribution’ with a split of 50% for mountain and lowland region (Federal Office for Agriculture FOAG, 2017). The additional variables ‘animal categories and numbers’ and ‘land use and sizes of the land’ were also required. In addition, six mountain farms were managed according to strict organic farming guidelines (Bio Suisse, 2019).

The working time requirement for the farms was then calculated using the tool GWB. As the categories for livestock according to the AGIS database were not entirely congruent with the categories used in the tool, the data was adapted for both datasets. The data provided by the AGIS database was more detailed and was, thus, summed up in parts to be tailored to the simpler categories of the tool GWB. As an example, in the AGIS database there are two categories: number of 'bovine species and water buffalo, animals up to 120 days old, male' and 'bovine species and water buffalo, animals up to 120 days old, female'. These two categories were pulled together into the category number of calves. More details can be found in Roesch et al. (2015).

3.3. Reference study

As we focus in this paper on farms with a strong dairy emphasis as an example, the following methods used in the reference study are mainly applied to the dairy enterprise within the farms. Therefore, the labour time requirements for the dairy enterprise were calculated in more detail and put into context with the proposed SIW and parts of the indicator. Table 2 gives an overview over the different validation steps, visualised by Bland-Altman plots, and summarizes different levels of complexity in validating the indicator. In order to end up with a suitable methodology for the indicator, it will be crucial to scope out the potential and possible simplifications.

Two new approaches of obtaining the required LUs were introduced in the reference study (see also Table 1), the actual available LUs on the farm and the more detailed modelling approach with the tool PROOF. The approaches will be explained in the following section.

3.4. Actual recorded workforce on the farm

In order to map any irregularities that may exist between the information in the AGIS database and the labour force currently available on the farm, possibly due to time lags, personal interviews with the farm managers took place on the study farms of the reference study. Thus, the current number of workers on the farm was recorded.

3.5. Tool PROOF: calculating more detailed labour time requirements

PROOF (Agroscope, Ettenhausen, Switzerland) is a dynamically structured model calculation system based on the spreadsheet programme Excel (Microsoft, Redmond, USA, Fig. 2).

The model calculation system has a modular structure and is also based on the work element method using the standard time value database and the modules "list of influencing variables", "linear modelling" and "output area" (Schick et al., 2000; Riegel and Schick, 2005). The tool is designed to model working time requirements on the level of work processes. The basis are VBA macros in Excel using if then procedures linking the influencing factors with the work elements. It works similar to the GWB but is more flexible and can be adapted to specific farm characteristics (a detailed description in German can be found in Schick, 2006).

The tool PROOF was used to calculate the required working times for the work process for cows and calves based on more detailed data and influencing factors collected during farm visits, such as technology used, type of husbandry system, pasture management system, calf management. As the use of the tool is very laborious, we focused solely on the dairy enterprise and did not apply this method to the whole farm portfolio.

For a more detailed validation of the SIW, we focused on comparing the actual recorded LUs for the farm with the calculated working time requirements consisting of the working hours calculated by PROOF for the dairy enterprise, the working hours calculated by GWB for the other enterprises if possible and finally adding manually working hours for the enterprises which were not available in the tools (Table 2).

Finally, we also compared the LUs calculated by PROOF with the LUs calculated by GWB for the dairy enterprise only (Table 2).

Table 2
Calculated data sets for the Bland-Altman plots. In a Bland-Altman plot two methods are compared, referred to as Data sets 1 and 2. For the calculation of the differences to build the Bland-Altman Plot, Data set 2 was subtracted from Data set 1.

Study part	Bland-Altmann plot	Data set 1	Data set 2
Pilot	Fig. 4	Tool GWB + manually added required labour time for enterprises not included in the tool.	[a] LUs according to the AGIS database.
Reference	Fig. 5	Tool PROOF for the dairy enterprise + tool GWB for the other enterprises + manually added required labour time for enterprises not included in the tool GWB.	Actually recorded LUs on the farm in the time period of the data collection via personal interviews.
Reference	Fig. 6	LUs calculated using the tool GWB for the dairy enterprise only.	LUs calculated using the tool PROOF for the dairy enterprise only.

[a] LU = Labour Unit.

3.6. Farm sample

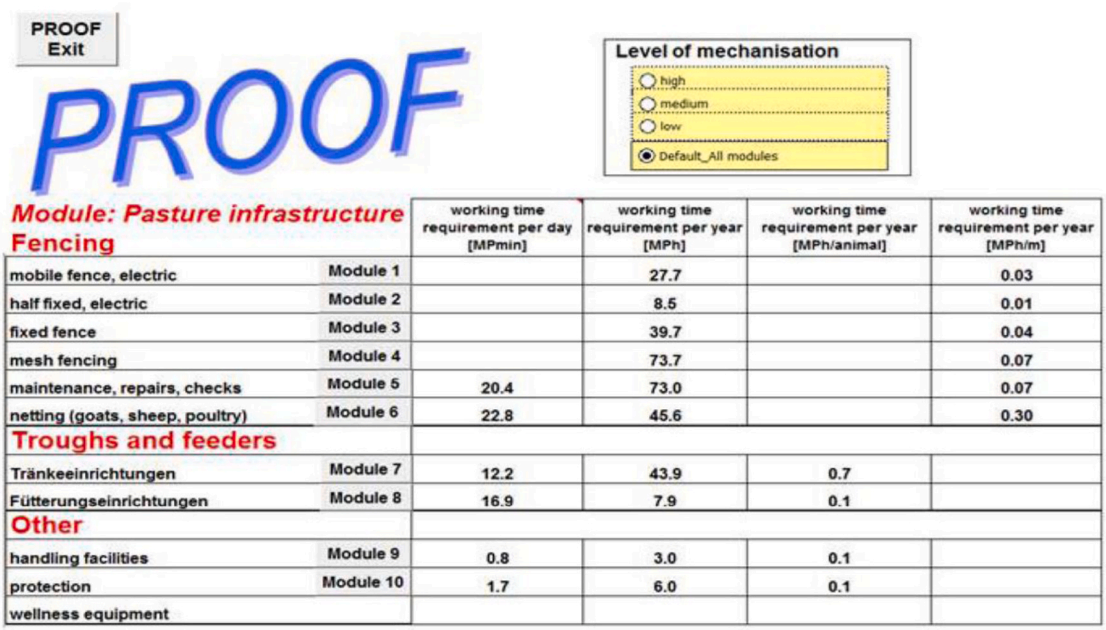
For the reference study, a data set from a systems comparison study (Gazzarin et al., 2018) analysing grass-based dairy systems has been utilized. Of the 36 described farms 34 farms were suitable and included in our study. For Fig. 6 only 32 of the farms could be included in the calculations. The farms were located in the Swiss midlands (Regions West, Central, East) and cow herds of different sizes were evenly represented.

3.7. A proposition: thresholds of the SIW

To put the SIW into context, boundaries of sustainable workload were defined and described in Table 3. The proposed thresholds were considered according to the principle of occupational science that a working person should not exhaust 100% of his or her working time capacity, but should allow time for example for breaks, sick leave, waiting, repairs (e.g. Märchy, 2001, p. 166). In addition, for entrepreneurial undertakings a farm manager should allow for an even higher time supplement to be able seek out new farming approaches. We would like to point out that this is just a hypothetical suggestion to put the SIW in context and may need further investigation.

3.8. Statistical methods

The data sets were assessed for normal distribution with a Kolmogorov-Smirnov test using the statistical package R Version 3.2.2. Paired data-sets with LUs obtained by different methods (AGIS, farm visit, GWB, PROOF) were analysed graphically by using Bland-Altman plots (Bland and Altman, 1986). The plots demonstrate the agreement between two different methods. For this the mean of the two methods is plotted against the difference between the methods. In our case, the difference was obtained by always subtracting Data set 2 from Data set 1 (Table 2). The dashed lines above and below were drawn at 1.96 standard deviations and are expected to enclose 95% of the observed differences between the methods. The solid line in the middle is representing the mean difference.



Module: Pasture infrastructure		working time requirement per day [MPmin]	working time requirement per year [MPh]	working time requirement per year [MPh/animal]	working time requirement per year [MPh/m]
Fencing					
mobile fence, electric	Module 1		27.7		0.03
half fixed, electric	Module 2		8.5		0.01
fixed fence	Module 3		39.7		0.04
mesh fencing	Module 4		73.7		0.07
maintenance, repairs, checks	Module 5	20.4	73.0		0.07
netting (goats, sheep, poultry)	Module 6	22.8	45.6		0.30
Troughs and feeders					
Tränkeeinrichtungen	Module 7	12.2	43.9	0.7	
Fütterungseinrichtungen	Module 8	16.9	7.9	0.1	
Other					
handling facilities	Module 9	0.8	3.0	0.1	
protection	Module 10	1.7	6.0	0.1	
wellness equipment					

Fig. 2. Proof model calculation system – module selection (Umstatter et al. 2015).

Table 3
Proposed categorisation of the Sustainability Indicator for Workload (SIW) with their respective thresholds.

Description	Thresholds for SIW
Underworked	<0.6
Sustainable	≥0.6 - < 0.9
Critical situation	≥0.9 - < 1.2
Overworked	≥1.2

Table 4
Distribution of the categories for the Sustainability Indicator for Workload (SIW) for two different farming regions.

Category	Lowland farms	Mountain farms
Underworked	2	1
Sustainable	7	17
Critical situation	9	7
Overworked	12	5

4. Results

4.1. Pilot study (60 farms)

Table 4 displays the distribution of farms in the different categories. The calculations of the working time requirement by means of the tool GWB range from 1.05 to 4.44 required LUs for the 30 farms in the lowlands. In the mountain region, the calculated working time requirements of the 30 farms ranged between 0.62 and 2.58 LUs. This means that larger farms regarding workforce can be found in the lowland region.

While calculating the SIW as a ratio of the data from the GWB calculations and the data from the AGIS database (Equation (1)), differences between the lowland and mountain farms became apparent (Fig. 3). The median of the mountain farms is 0.8 and therefore within the category of 'sustainable situation', whereas the median of the lowland farms is 1.0 and falls within the category of 'critical situation'.

Comparing the two data sets in a Bland-Altman plot (Fig. 4), it was demonstrated that the mean bias ± SD between the calculated LUs by the GWB and LUs obtained from the AGIS-database was 0.01 ± 0.726 LUs, and the limits of agreement were −1.409 and 1.436. The data was checked for normality distribution with the Kolmogorov-Smirnov test and the hypothesis was not rejected with $p = 0.246$.

The mountain farms show less variability with a range of LUs from 0.8 to 2.7 compared with the lowland farms with a range of 0.9–5.4 according to the AGIS database. Again, this is an indication for larger farm size in the lowland region. The lowland farms displayed 18 out of 30 farms with higher calculated labour requirements by the tool GWB compared with the number of LUs according to the AGIS database (Fig. 4), whereas the mountain farms showed the opposite trend with 20 out of 30 farms having a higher number of LUs according to the AGIS database compared with the calculated labour requirements, giving an indication that the workload per LU tends to be lower in the mountain region. However, it is noticeable that the mean value of the differences of all farms (Y-axis) is almost zero.

To put the SIW into context, a categorisation of the SIWs according to the description in Table 2 for the different farming regions was undertaken. It revealed that a high number of lowland farms could be in a critical situation or be even overworked (Table 3).

4.2. Reference study

In the reference study we focused on the comparison between the SIW calculated as described in Equation (1) and a more detailed modelling approach of the labour requirements of the farms put into relation to the actual number of LUs on the farm (Fig. 5).

The Bland-Altman plot (Fig. 5) shows the mean bias ± SD between the LUs calculated by the combination of the tool PROOF for the dairy enterprise and the tool GWB for the other enterprises on the farm and the actually recorded number of LUs on the farm at the time of the calculations as 0.17 ± 0.712 LUs. The limits of agreement were −1.225 and 1.568. The data was checked for normality distribution with the Kolmogorov-Smirnov test and the hypothesis was not rejected with $p = 0.658$. We found therefore, that the more detailed calculated LUs on the farms showed a slight bias towards a higher number of required LUs compared to the actual LUs recorded on the farm, meaning that there could be a tendency towards a critical situation due to a high workload.

The Bland-Altman plot (Fig. 6) showed the mean bias ± SD between the LUs calculated by the tool GWB and the more detailed calculations by the tool PROOF for the dairy enterprise as 0.11 ± 0.210 LUs, and the

Fig. 3. Box plot of Sustainability Indicator for Workload SIW for lowland and mountain farms. Data are presented as box plots indicating observed median, first and third quartiles and range of data. Points represent outliers defined as 1.5 times the interquartile distance (Roesch et al., 2016).

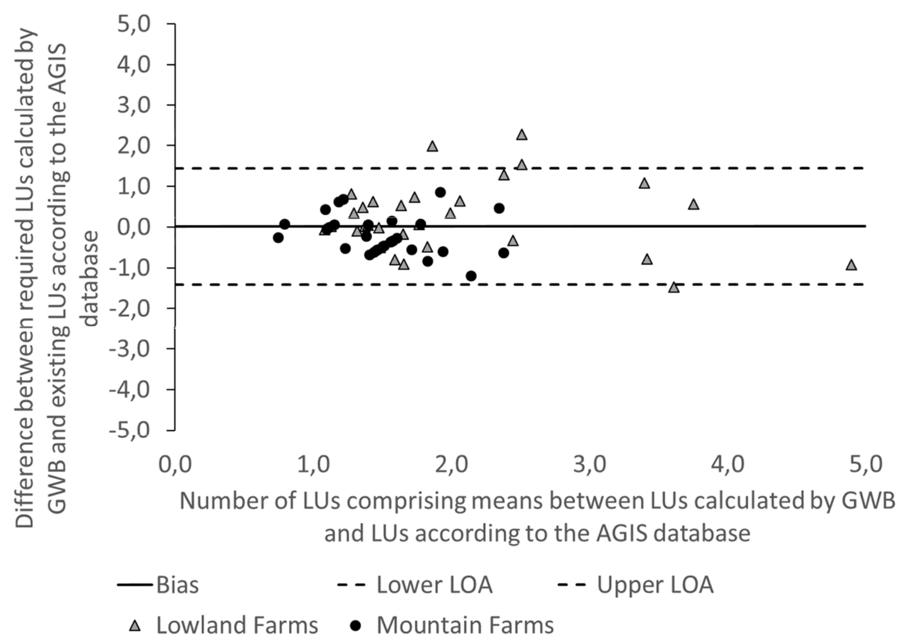


Fig. 4. Bland-Altman plot comparing LUs according to the AGIS database with LUs calculated by GWB for dairy farms in two different regions, mountain and lowland. The plot demonstrates the agreement between two methods. The dashed lines above and below indicate the upper and lower limit of agreement at 1.96 standard deviations. The solid line indicates the mean difference between the methods.

limits of agreement were −0.305 and 0.520. The positive bias demonstrates a slight overestimation of the LUs calculated by the tool GWB compared to the more detailed tool PROOF. This indicates that there is a tendency of overestimation using the tool GWB for our sample. Therefore, it might be useful in future to include more information in the labour time modelling for example based on the degree of mechanisation or the use of contractors. The data were tested against normal distribution and the hypothesis was rejected with $p = 0.746$ using a Kolmogorov-Smirnov test.

For being able to discuss the SIW the farms were categorized into four categories described in Table 3. According to this categorisation, 35% of the farms were identified as overworked, 32% as being in a critical situation and 29% having a sustainable workload (Fig. 7). One farm was categorized as underworked.

5. Discussion

The pilot study demonstrates that it is feasible to identify differences between e.g. two regions, lowlands and mountains, regarding the workload of farms by applying the simple SIW (Equation (1)). When comparing the two work forces (available and required), we found that lowland farms tend to have a lower workforce on the farm in contrast to the calculated working time requirements. This could be an indication that the degree of mechanisation is higher on lowland farms which could lead to this discrepancy. This hypothesis is supported by Groher et al. (2020) who found a higher degree of mechanisation and digitalisation on lowland farms compared to farms in mountain regions. Thus, it might be useful to be considered in future, possibly by recording key technologies as an indicator and integrate these into the calculations.

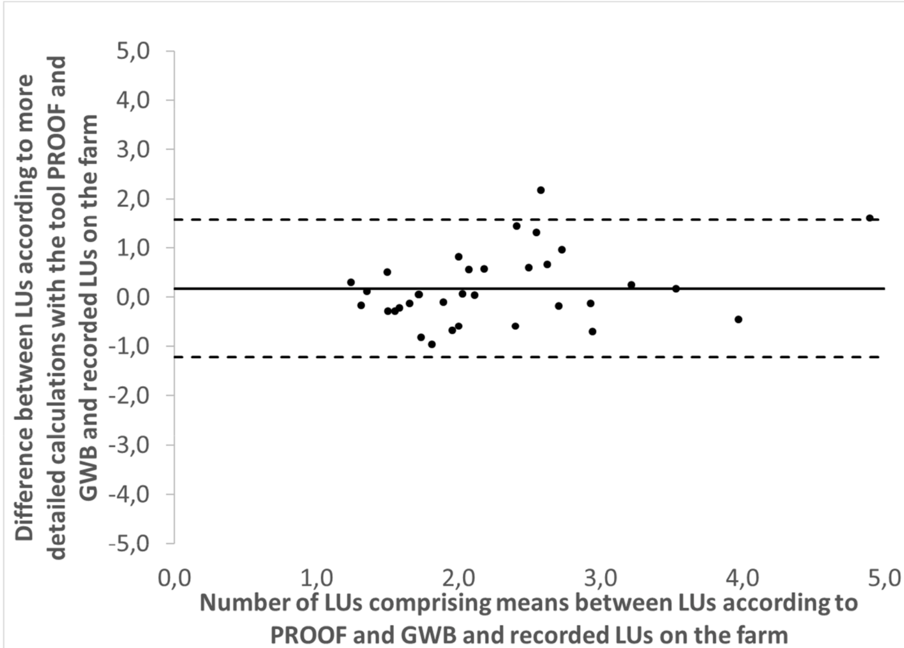


Fig. 5. Bland-Altman plot comparing actual recorded labour units (LUs) on the farm with required LUs according to more detailed calculations using the tool PROOF for the dairy enterprise and the GWB for the rest of the farm (n = 34). The plot demonstrates the agreement between two methods. The dashed lines above and below indicate the upper and lower limit of agreement at 1.96 standard deviations. The solid line indicates the mean difference between the methods.

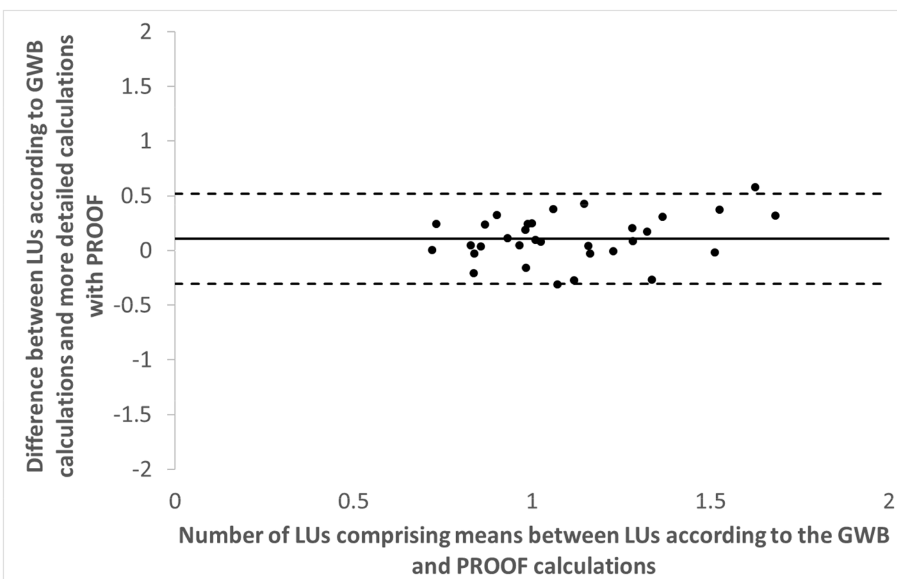


Fig. 6. Bland-Altman plot comparing labour units (LUs) according to the calculations using the tool GWB with more detailed calculations with the tool PROOF for the enterprise dairy (n = 32). The plot demonstrates the agreement between two methods. The dashed lines above and below indicate the upper and lower limit of agreement at 1.96 standard deviations. The solid line indicates the mean difference between the methods.

Further, it might be possible that within this farm sample, there were contractors used for parts of the work. Therefore, the second important addition to the SIW should be subtracting the contracting hours from the calculated required workforce.

The fact that the classification of a workload around 1.0 is deemed to be critical rather than sustainable has several aspects. First, the tool GWB as well as the tool PROOF calculate the working time requirement and not the working time input, whereas the number of LUs on a farm cover the working time input, which is usually higher than the labour time requirement allowing for additional time such as breaks, sick leave, waiting times, repairs. In addition, a degree of error occurs when looking at the available workforce. Therefore, the categories should be taken with a pinch of salt. First of all, we only received categorical data on part-time and fulltime workload with three categories (<50%, 50%–74%, >74%). Further, an LU is defined as a person, employed for a fulltime position, working 2600 h per year. As these are family farms in our data sets, there is a strong possibility that working persons underestimated their working times. This discussion point is supported by the fact that the Federal Statistical Office for Switzerland reported a weekly working time of about 60 h (Federal Office for Agriculture FOAG, 2013, p. 66) or higher hours (Federal Statistical Office, 2017) for Swiss farmers whereas the weekly working time of an LU equates to roughly 52 h per

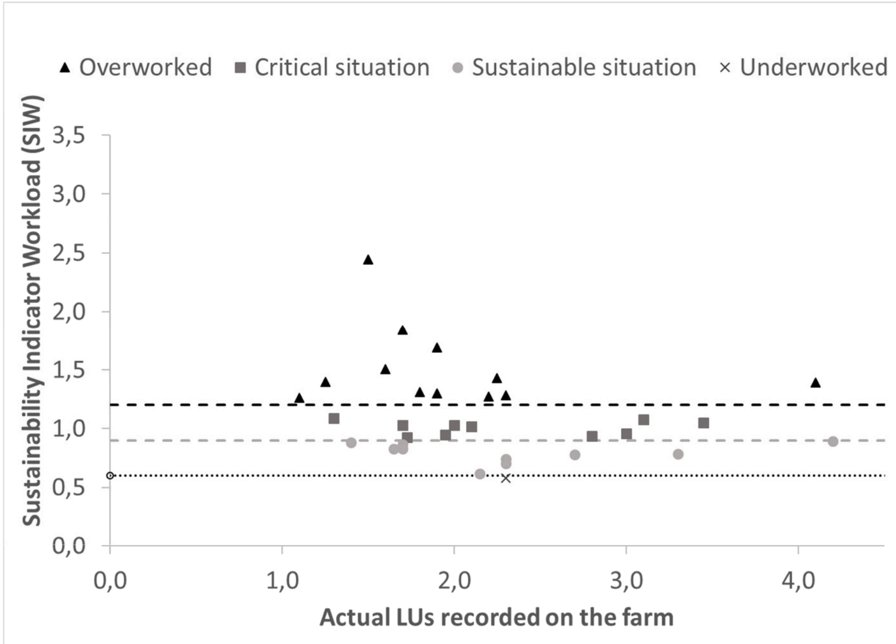


Fig. 7. Sustainability Indicator Workload calculated for the 34 farms of the reference study classified into four categories according to the workload situation and distributed according to the number of LUs (Labour Units) as a proxy for farm size. The dashed and dotted lines indicate the threshold to overworked (black, dashed), critical situation (grey, dashed) and sustainable situation (grey, dotted).

week when factoring in 1 week of holidays (Federal Office for Agriculture FOAG, 2013, p. 67).

The reference study supports the findings in the pilot study demonstrating a slight bias towards the more detailed calculated LUs compared to the actual recorded LUs on the farms. Thus, there is another indication that improving the indicator by the two measures, 'employed contracting hours' and 'key technologies' to describe the degree of mechanisation, which could add value to the indicator.

To be able to learn more about the potential discrepancies between the actual workload on farms and the simple calculation using the tool GWB, we looked at the mean bias and the limits of agreement because they provide an information about the utility of the simple method compared to the more detailed method. The positive bias demonstrated a slight overestimation of the LUs calculated by the tool GWB compared to the more detailed tool PROOF. This might indicate that a better knowledge of the deployed degree of mechanisation could help to reduce a potential overestimation of the required working hours per farm as the calculations with PROOF took more details of the mechanisation into account.

6. Conclusions

The pilot study demonstrates that with the simple indicator it is possible to identify differences regarding workload between certain groups, in this example between lowland and mountain farms. The data from the AGIS database is readily available and the calculations using the GWB can be carried out quickly and could potentially be automated.

The more detailed calculated LUs compared to the number of actual LUs on the farms showed a bias towards a higher number of required LUs compared to the actual LUs recorded on the farm. Therefore, there is an indication that the simple calculation of SIW could be improved by taking into account whether farms are using contractors and the degree of mechanisation on the farm. However, despite the crude modelling, the pilot study has shown that important trends could be identified with a simple sustainability indicator for workload.

7. Outlook

The ART-AV software has been recently superseded by the online tool LabourScope (www.labourscope.ch). LabourScope is an online version of the GWB. With the new application it is feasible to link it to farm management information platforms such as Barto (Barto AG, Ostermundingen, Switzerland), a Swiss platform based on 365FarmNet (365FarmNet, Berlin, Germany). If the application would be part of such a platform the relevant information could be easily accessed leading to a potentially automated indicator for workload. A further step could also be to provide a "benchmarking system" in which farmers can check directly how their farm compares to previous years or to other farms. Comparing the SIW of their own farm with other farms in the region or category could initiate improvement of labour organisation and workload reduction.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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