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Do commonly used workload indicators capture the social sustainability of farm workload? Evidence from Switzerland

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A B S T R A C T

Farm workload is typically measured using quantitative indicators that may overlook how farmers actually experience their work. This study empirically examines how three commonly used workload indicators, namely self-reported working hours, available workforce, and modeled working hours, relate to farmers' perceived workload burden as a proxy for the social sustainability of farm labor. The data comprise information on 571 Swiss farms, with farm characteristics merged from three datasets: the Swiss agricultural census (AGIS), the LabourScope labor-requirement model, and an online survey on farm work conducted in 2025. Reliability analysis reveals poor internal consistency among the three workload indicators, indicating they cannot be used interchangeably. Across several regression specifications, self-reported working hours emerge as the strongest and most robust predictor of perceived burden across farm types and levels of on-farm diversification. Modeled working hours show little to no association with perceived burden, while available workforce exhibits mixed and weaker relationships. Farm-type-specific analyses reveal substantial heterogeneity. In dairy systems, none of the workload indicators explain perceived burden despite the highest reported working hours, whereas in arable and suckler cow farms, perceived burden is linked to self-reported working hours. These findings suggest that time-based, structural, and model-based workload measures capture distinct dimensions of farm work and do not necessarily reflect farmers' perceived workload burden fully. To strengthen sustainability assessments, we recommend incorporating perception-based indicators, such as perceived workload burden, alongside conventional structural measures in national monitoring systems and farm advisory programs.

1. Introduction

Social sustainability has been gaining attention over the past decade and is now recognized as an important pillar of sustainable development, even in agriculture (Boström, 2012; Janker et al., 2020). The increased relevance of social sustainability indicators can be linked to the implementation of the United Nations' sustainable development goals, which made social dimensions such as well-being, equity, decent work, inclusion, and reduced inequalities more explicit within global sustainability agendas. Consequently, the need for robust and standardized social sustainability indicators that can be applied systematically to inform policy and research has increased (Desiderio et al., 2022; Orou Sannou et al., 2023; European Union Commission, 2024).

For instance, at the European level, several social aspects, including labor conditions, generational renewal, and gender balance, are integrated into the Farm Sustainability Data Network (FSDN) for monitoring purposes in 2025, although other social aspects related to workload are yet to be incorporated, such as work organization and time off (European Union Commission, 2024). This development reflects broader efforts within the Common Agricultural Policy (CAP) to incorporate social-level data into holistic sustainability evaluations.

Workload is among the most frequently used indicators in the agri-food and farm sustainability literature (Orou Sannou et al., 2023; Segerkvist et al., 2020), highlighting its central role in assessing farm-level social sustainability. It is most commonly operationalized using objective quantifiable metrics, such as time-based measures (e.g., total working hours, labor intensity measured as hours per hectare, or livestock unit) and structural and organizational characteristics (e.g., workforce composition, task allocation, and work organization). These approaches account for differences in labor availability, mechanization,

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and organizational structure, as well as for variations in workload and labor needs across farm types (Desiderio et al., 2022; Roesch et al., 2013; FAO, 2013; Grenz et al., 2012; Umstätter et al., 2022; Kallioniemi et al., 2022). Model-based workload indicators (Grenz et al., 2012; Kallioniemi et al., 2022; Wilhelmsson et al., 2021), which combine technical coefficients with farm structure data to estimate required labor input under standard production conditions, are seldom used in social sustainability assessments.

Several established sustainability frameworks illustrate this diversity of approaches. The Swiss Agricultural Life Cycle Assessment (SALCA) framework considers workload as labor input and measures it objectively through time per production unit (Roesch et al., 2013). The Sustainability Assessment of Food and Agriculture systems (SAFA) relies on farmer-reported working hours and compares them with international benchmark work values to check compliance with decent employment (FAO, 2013). However, it is important to note that farmer-reported working hours typically reflect what farmers recall and report, rather than how they perceive or experience their workload. Similarly, the Farm Sustainability Indicators (IDEA, Durabilité des Exploitations Agricoles) focus on decent working conditions and measure workload with farmer-reported working hours, available workforce, and time for holidays (Grenz et al., 2012). The Response-Inducing Sustainability Evaluation (RISE) goes further by including both quantitative and qualitative measures focused on working hours and work satisfaction. The Sustainability Indicator of Workload (SIW) developed by Umstätter et al. (2022) offers a benchmark screening of labor balance and shows how farmers can be overworked, under worked, or balanced. Overall, the existing frameworks have examined workload in one or two of its dimensions, with a clear preference for quantitative measures and for a range of purposes, including social sustainability assessment, monitoring, benchmarking, and farm advisory purposes. This diversity matters because indicators developed for one purpose are not necessarily suitable for another. In particular, an indicator useful for benchmarking labor balance may not adequately reflect how the workload is experienced by farmers in practice. Although workload and labor demands have been shown to be associated with stress, emotional strain, and reduced well-being among farmers (Kallioniemi et al., 2022; Wilhelmsson et al., 2021; Brennan et al., 2021; Logstein, 2016; Truchot et al., 2018), subjective measures such as perceived burden, satisfaction, or well-being remain less systematically integrated into farm-level sustainability assessments. Notably, none of these frameworks explicitly assess how farmers perceive or experience their workload burden.

Accounting for farmers' subjective perceptions of their workload is nevertheless relevant for policymakers, as these perceptions shape how agricultural policies are experienced and whether interventions aimed at reducing workload, including administrative workload, are perceived as necessary by farmers (Herrera Sabillón et al., 2022; Läpple et al., 2025; Eidgenössischer, 2021; El Benni et al., 2021). Despite this relevance, existing farm-level sustainability assessment tools predominantly rely on objective workload indicators and rarely establish an explicit link to farmers' perceived workload burden (FAO, 2013; Grenz et al., 2012; Zahm et al., 2008). Without assessing whether commonly used workload indicators explain variations in perceived burden, the social sustainability of farm workload cannot be properly evaluated. Thus, policies may fail to develop targeted interventions on specific workload issues and could affect farms' resilience and the long-term attractiveness of farming as a profession (El Bilali et al., 2021; Panelli et al., 2016). It is therefore unclear whether commonly used objective workload indicators meaningfully reflect farmers' lived experiences of workload and can therefore serve as robust indicators of social sustainability. This paper addresses this gap by using data from Switzerland, which contain three workload indicators that capture distinct dimensions of farm work and that can be systematically compared: a time-based measure based on self-reported working hours from survey data, a structural measure capturing available workforce retrieved from the agricultural census (AGIS), and a model-based measure of required working hours estimated using a labor requirement tool developed for Swiss farms known as LabourScope. This paper examines how these indicators relate to one another and, crucially, the extent to which they correlate with perceived workload burden. By linking objective workload metrics with farmers' subjective appraisals of their work situations, the study contributes to the literature in three ways. First, it clarifies the conceptual complementarity and limitations of different workload indicators. Second, it provides empirical evidence on whether standard objective indicators are suitable proxies for farmers' experienced burden. Third, it identifies implications for the selection and interpretation of workload indicators in farm-level sustainability assessments and for the design of better-targeted agricultural policies and advisory approaches.

2. Conceptual framework

Workload is broadly defined as the amount of effort expected of a person and is measured to avoid overload or, in some instances, underload (Jacobs et al., 2013). It is multidimensional and consists of both objective labor demands (e.g., physical and cognitive effort) and subjective experiences (e.g., perceived burden and distress). Building on this definition, in the context of farming, where workload is not clearly defined, farm workload can be understood as being shaped by the physical and cognitive demands of farming, which is characterized by its constant evolution (e.g., changes in mechanization levels, administrative and regulatory duties, and financial pressure), unpredictability (e.g., machine breakdowns, animal health incidents, and extreme weather events), and time pressure (e.g., seasonality, temperature fluctuations) (OECD, 2018). Farm workload, therefore, encompasses multiple domains that together form the total workload required to operate the farm. Being structured differently across production systems and farm types (e.g., seasonal peaks in arable farming and day-to-day demands in dairy farming), workload is therefore shaped not only by the number of working hours but also by how work is organized, the predictability of the work calendar, and whether tasks can be postponed, delegated, or shared across workers (Dedieu et al., 2019; Elliott et al., 2022; Hogan et al., 2024). These forms of work organization lead to varying workloads and experiences of farming. Thus, farm workload can be viewed in terms of whether farming offers fair and livable working conditions considering workload demands and levels and whether farmers have sufficient autonomy, recovery time, and the ability to sustain health and family life. In this sense, socially sustainable farm work is work that remains manageable over time without chronic strain and burden, supporting well-being and long-term farming viability. Farm work demands must be balanced by making resources available (e.g., staffing, equipment) to avoid burnout and sustain well-being (Demerouti et al., 2001) and ensuring that needed working hours and burden perceptions are equally relevant for workload assessment.

Workload and its implications can vary substantially across farm types. For example, many arable farms are characterized by short but intense labor peak periods, such as during harvesting, which are associated with long working hours that can increase fatigue and perceived burden through heightened time pressure and limited opportunities for recovery (Elliott et al., 2022). By contrast, dairy farmers typically report high weekly working hours and limited time off throughout the year (Hogan et al., 2024). Although the nature and temporal distribution of work differ across farm types, both systems may generate heightened feelings of responsibility and strain. These patterns highlight two closely related points. First, the documented link between workload and perceived burden highlights a key social aspect that should be captured in sustainability assessment. Second, they underscore the importance of perceived burden as a measure that reflects farmers' lived realities on the farm beyond what objective indicators alone may convey.

In fact, indicator theory, which provides guidance for designing and evaluating indicators for complex constructs, emphasizes the importance of combining quantitative and qualitative information in complex sustainability assessments (Gallopin et al., 1997; Wu et al., 2012; Innes, 1989). These perspectives highlight that robust indicators must reflect not only observable states, such as working hours and labor demand, but also individual lived experiences of stress and perceived burden. Burden reflects how workload is appraised and experienced in practice, including feelings of responsibility, time pressure, mental strain, and reduced capacity to recover, which may arise even when working hours appear comparable across farms (Wilhelmsson et al., 2021; Gopher et al., 1986; Schanz et al., 2023). It therefore reflects both physical and mental load and provides essential contextual meaning to objective workload estimates by revealing whether the work is experienced as manageable or overwhelming and by capturing the psychosocial dimensions through which workload translates into well-being outcomes. Furthermore, a valid argument is that a high workload does not necessarily entail a negative social sustainability experience at farms. For instance, organic farmers indicate high satisfaction and well-being despite their high workload (Schanz et al., 2023; Reissig et al., 2016). This finding shows that subjective evaluations of farmers' perceptions are indispensable for capturing a fuller picture of farmers' experiences of social sustainability within different farming contexts. Herrera Sabillón, Gerster–Bentaya (Herrera Sabillón et al., 2022) found that satisfaction with work reflects broader life quality but cannot be inferred from farm-level monitoring data alone, highlighting the need for direct perception-based measures.

Therefore, within the domain of workload-related social sustainability, which is the specific dimension most commonly assessed at the farm level, perceived burden might be a better measure than relying solely on the objective indicators currently in use. Instead, it is necessary to integrate both objective (e.g., working hours) and subjective dimensions, that is, personal perceptions of burden. It is important to note that separately, these two workload dimensions have limitations (e.g., generic assumptions and lack of clear interpretability potential) and provide only a partial understanding of workload as a social sustainability issue. However, considered simultaneously, they can arguably offer a more comprehensive view of workload, as the perceived burden helps interpret and understand the farmers' experiences with their working hours. Their link allows for a better understanding of workload that aligns with integrating objective and subjective metrics into sustainability monitoring, which has not yet been applied together in existing frameworks. Therefore, this paper assesses farm workload in a multidimensional way by examining the relationship between workload and perceived burden as an indicator of farm social sustainability. More specifically, we focus on farm-level working hours as operationalized in social sustainability research. Working hours are often assessed using three different indicators: (1) model-derived working hours, (2) self-assessed labor capacity available in secondary data sources, and (3) self-reported working hours collected via farmer surveys. We additionally assess perceived burden directly through farmer self-reports.

3. Data and methods

In this paper, we combine three different data sources to measure farmers' perceived workload burden and three workload proxies: self-reported workload, modeled workload, and available workforce. We briefly introduce the datasets and key variables in the next subsection, before presenting the methods in Section 3.2.

3.1. Data

3.1.1. Online survey

The first data source is an online survey conducted among farm managers from the French- and German-speaking parts of Switzerland between February and April 2025 to measure perceived burden and self-reported workload. Originally, a random sample of 2998 farms receiving direct payments was invited to participate in the survey. Farmer contact information was provided by the Swiss Federal Office for Agriculture (FOAG). The survey received ethical approval from the Agroscope Ethics Committee (approval number EK-2025-AGS-009-B). In total, 885 farmers accepted the consent form and completed the entire questionnaire, which corresponds to a response rate of 29.5%. This is slightly lower than the response rate of 40% in an earlier study on the administrative burden in Swiss agriculture (Mack et al., 2024), but it is within the range of typical response rates for farm surveys in Switzerland (Reissig et al., 2025; Kaiser et al., 2025). To ensure good data quality, several plausibility checks were performed, which further reduced the sample to 832 farmers, corresponding to 28% of those initially invited.[1]

Furthermore, missing information on key variables and limitations imposed by the construction of the modeled workload measure reduced the sample by 260 observations. The final analytical sample used in this paper therefore comprises 571 farmers. The survey included detailed questions on administrative work, total work hours, and perceived workload burden. For the purposes of this study, we focus on two key measures obtained from the survey: perceived burden and self-reported workload.

Perceived burden captures the subjective assessment of workload-related strain. In the survey, farmers were asked, "How burdensome would you rate your current workload?" Burden was assessed for four workload categories, including total farm work,[2] using a seven-point Likert scale ranging from 1 ("not burdensome at all") to 7 ("extremely burdensome"). The measure was based on a previous study on farmer workload in Switzerland (Mack et al., 2024). In the present study, we use the burden measure of the overall farm work, as it is intended to capture overall perceptions of workload burden in a simple and efficient manner. As a single-item measure, it does not allow for the assessment of internal consistency or dimensionality. Therefore, the item is interpreted as a global indicator of perceived workload burden rather than as a psychometric scale. Self-reported workload was measured as total working hours on the farm, expressed in hours per week, and averaged over the year. Both measures refer to work at the whole-farm level, including all farm-related activities and all available workforce.[3] This scope was explained to respondents at the beginning of the survey using a visual illustration and was accessible throughout the questionnaire via an information icon. In addition, the survey contained respondents' sociodemographic information, such as age, gender, and education.

3.1.2. Census data

The second data source used to obtain measures of available workforce and other farm-level information is Swiss agricultural census data (AGIS) from 2024, which we merged with the online survey using a unique farm identification number. AGIS contains detailed information

[1] Observations containing clearly implausible information (e.g., reported age values far outside a realistic range) were removed. In addition, observations were dropped when reported total work hours were smaller than the sum of sub-categories such as administrative work hours for state requirements and administrative work for label requirements. The minimum value for total farm work was set to 10 h per week, which corresponds to the theoretical minimum average workload required to be eligible for direct payments (FOAG, 2025). The maximum work hours were capped at 24 h per day and worker. Furthermore, survey duration was used as an additional quality criterion. Questionnaires completed in less than half of the median survey duration (11 min) were excluded. Note that this threshold was applied only to questionnaires completed in a single session, as duration data are not available for surveys that were paused and resumed later.

[2] The other categories were farm management tasks, administrative work associated with state requirements and administrative work associated with label requirements.

[3] More specifically, total farm work was defined in the questionnaire as follows: "The total farm work on your agricultural holding includes both work directly concerned with production (milking, fertilizer spreading, etc.) and office work. Here, we mean the workload for the entire farm, including all on-farm staff. The total farm work does not include supplementary off-farm work and domestic chores.

regarding the available workforce, as it records all individuals (aged >15 years) who worked on the farm during the week preceding the reference date. More specifically, the data distinguish between farm managers, family labor, and non-family labor (with the latter being either Swiss or foreign workers) and their respective genders. For each person, the data show their workload based on the percentage worked (full-time or part-time). Full-time work is considered equivalent to working more than 38 h per week with a workload proportion of more than 74%, while part-time work is considered either 50–74% or less than 50% working proportion. These working proportions are explained in the farm declaration form that farmers complete annually. We then simplified these percentages into labor units (LU) following Roesch et al. (2017). Their conversion is based on the Ordinance of Agricultural Terminology, which defines one labor unit as equivalent to 2600 h per year (Roesch et al., 2017). As shown in Table A1 in the Appendix, individuals working more than 74% of full-time are assigned 0.75–1 LUs, with an average value of 0.87 LUs (equivalent to 43.5 h per week). Similarly, those in the 50–74% category are assigned0.50–0.74 LUs, with an average value of 0.62 LUs (equivalent to 31 h per week), and those working less than 50% assigned <0.50 LUs, with an average value of 0.25 LUs (equivalent to 12.5 h per week). This conversion allows the heterogeneous farm workforce structure (i.e., family members, non-family workers, Swiss and foreign laborers, and apprentices) to be aggregated into a standardized measure of available labor capacity across farms.

AGIS data also contain structural data, such as farm type, which is determined by the dominant production activities, as well as detailed information on crop and livestock production (Hoop et al., 2020), which allows us to investigate heterogeneity in terms of farm types and the degree of farm-level diversification.

3.1.3. LabourScope

Finally, we used LabourScope, Agroscope's standardized labor-requirement modeling system (Heitkämper et al., 2020), to obtain the modeled workload indicator. LabourScope estimates the annual workload based on activity-specific labor coefficients calibrated for Swiss production systems. The model uses a bottom-up calculation structure in which it identifies all relevant production activities for each farm (e.g., livestock, crops, and on-farm processing) and applies task-level labor coefficients expressed in minutes or hours per physical unit (e.g., milking per livestock unit, hoeing per hectare). The model integrates multiple structural and management parameters, including livestock (number of livestock units by category, such as dairy cows, suckler cows, heifers, pigs, poultry), housing system (stable layout), farm equipment (milking technology, feeding system, calving/production cycles and machinery complement), crop production (crop area by type, cultivation intensity, irrigation, harvesting system), and degree of automation, as well as management intensity (frequency of operations, herd management routines, specialized activities). For each activity, LabourScope aggregates all elementary tasks (e.g., feeding, bedding, manure handling, milking, cleaning, field preparation, planting, crop protection, and harvesting) and multiplies them by their corresponding labor coefficients. The total modeled labor requirement was then obtained by summing the task-level requirements across all production branches of the farm. The results are expressed in annual working hours, providing a standardized estimate of the theoretical workload required to operate the farm under average Swiss production and labor-efficiency conditions.

3.2. Methods

To investigate how the three workload measures—self-reported workload, modeled workload, and available workforce—relate to each other and to perceived burden, we initially estimated the degree of agreement among the three workload measures. We then examined the correlation between perceived burden and the three workload measures using Pearson's correlation coefficients, before applying ordinary least squares regression analysis. We describe each method below.

Absolute agreement between the three workload measures was evaluated using the intraclass correlation coefficient (ICC) (Kottner et al., 2011). The ICC was estimated using the two-way mixed model (ICC 3,1), which assesses whether farms with high values on one workload indicator also have high values on the other. ICC values below 0.50 indicate poor agreement, values between 0.50 and 0.75 indicate moderate agreement, values between 0.75 and 0.90 indicate good agreement, and values above 0.90 indicate excellent agreement. Additionally, Cronbach's alpha was calculated across the three workload indicators to evaluate their internal consistency when treated as a single scale, with values of $\alpha \geq 0.70$ considered acceptable.

Next, we investigated the relationship between perceived burden and the three workload proxies. Pearson's correlation coefficients were calculated separately by farm type. Estimating correlations by farm type allowed us to account for heterogeneity in production systems and organizational structures.

We then estimated a set of linear regression models to examine how perceived burden relates to alternative workload proxies. In these models, perceived burden serves as the dependent variable and was regressed separately on each workload measure. This bivariate setup avoids multicollinearity and allows for direct comparison of the explanatory power of each workload proxy. In the main specification, all regressions were estimated separately by farm type to account for structural heterogeneity in production systems and labor organization. As a robustness check, we estimated pooled regression models that included interactions between each workload proxy and farm-type indicators, allowing the relationship between perceived burden and the workload proxy to vary across farm types within a unified framework. In addition, we investigated heterogeneity by the degree of farm-level diversification. To do so, farms were grouped into quintiles based on the average diversification index that combines diversification in crop and livestock production, and regressions were estimated separately for each diversification quintile. We complemented this approach with pooled regression models interacting workload proxies with diversification quintile indicators. It should be noted that all pooled regressions included control variables such as farmer age, gender, education, agricultural training, number of workers, and off-farm employment but not in the main farm-type-specific specifications. This allows the preservation of the degrees of freedom in smaller subgroups and maintains clarity in the comparison of workload proxies across farm types. Together, these robustness checks assess whether the main results are sensitive to alternative modeling strategies and sources of heterogeneity.

4. Results

4.1. Descriptive statistics

Table 1 reports the summary statistics of our analytical sample.[4] The average respondent was 46.5 years old, with ages ranging from 21 to 65 and women accounting for approximately 11% of the sample. Educational attainment was predominantly vocational. More specifically, 61%

[4] A comparison of key values to the whole farm population in Switzerland is available in Appendix Table A8 and shows that the analytical sample is broadly representative, as key values such as age, farm types, and number of workers are comparable. Yet, the share of women in the analytical sample (11%) was somewhat higher than in the census (8%) 42. Federal Office for Statistics (FOS). *Agrarbericht 2025 – Betriebe*. 2025; Available from: https://agrarbericht.ch/de/betrieb/strukturen/betriebe. While we cannot fully rule out that some male farm managers asked a woman to fill out the survey, the age reported in the survey matched the AGIS age of the farm manager in 95% of cases, suggesting that respondents were predominantly farm managers themselves.

Table 1
Summary statistics of the analytical sample (N = 571).

Statistic	Mean	St. Dev.	Min	Max
Age (years)	46.48	10.60	21	65
Woman (1 = yes)	0.11	0.31	0	1
No vocational qualification (1 = yes)	0.03	0.17	0	1
Basic vocational education (1 = yes)	0.61	0.49	0	1
Advanced vocational education (1 = yes)	0.30	0.46	0	1
Tertiary education (1 = yes)	0.06	0.24	0	1
Agricultural training (1 = yes)	0.89	0.31	0	1
Number of workers	2.85	1.40	1	13
Arable farm (1 = yes)	0.08	0.28	0	1
Combined farm (1 = yes)	0.30	0.46	0	1
Dairy farm (1 = yes)	0.31	0.46	0	1
Suckler cow farm (1 = yes)	0.15	0.36	0	1
Mixed cattle farm (1 = yes)	0.15	0.36	0	1
Shannon crop diversity index	0.45	0.47	0.00	1.69
Shannon livestock diversity index	0.18	0.24	0.00	1.31
Average relative diversification across crop and livestock activities	0.17	0.15	0.00	0.68
Perceived burden (Likert)	4.20	1.46	1	7
Self-reported workload (hrs)	73.34	36.12	25.00	166.10
Modeled workload (hrs)	82.01	44.70	22.76	182.18
Available workforce (hrs)	80.62	28.21	43.50	139.10

Source: Authors' own calculations

of respondents completed basic vocational education and 30% completed advanced vocational education, while only 6% reported tertiary education, and 3% had no vocational qualification. Nearly 90% of respondents reported having had agricultural training.

With respect to farm types, following the official S3 farm typology in Switzerland (Hoop et al., 2020), dairy farms constituted the largest group (31%), followed by combined farms (30%). Suckler cow farms and mixed cattle farms each accounted for roughly 15% of the sample, whereas arable farms represented a smaller share (8%). On-farm diversification was moderate on average.[5] The mean Shannon crop diversity index was 0.45 (ranging from 0 to 1.69), while the livestock diversity index was lower at 0.18 (ranging from 0 to 1.31). In terms of effective numbers, these values correspond to approximately 1.6 crop groups and 1.2 livestock groups per farm, indicating that most farms were characterized by a dominant production activity with, at most, one minor additional activity. The average relative diversification measure combining crop and livestock activities was 0.17, indicating substantial heterogeneity in diversification patterns across farms, with a small subset of farms exhibiting markedly higher levels of diversification.

Regarding perceptions and workload, respondents reported a relatively high perceived burden, with a mean of 4.2 on a seven-point Likert scale (ranging from 1 = not burdensome at all to 7 = extremely burdensome). Self-reported weekly workload averaged 73.3 h, whereas modeled workload was higher, at approximately 82 h per week. Available workforce averaged 80.6 h, suggesting that, at the farm level, labor demand and availability are closely aligned, albeit with substantial heterogeneity across farms.[6] However, when we accounted for the overall number of workers on the farm (including the farm manager, family workers, and non-family farm workers), workload levels appeared more moderate. Dividing total workload by the average number of workers (2.85 per farm) yielded average weekly workloads of approximately 30 h per worker for self-reported workload, 36 h for modeled workload, and 31 h for available workforce.

Furthermore, Fig. 1 shows the density plots of the three workload measures by farm type. For self-reported workload, the density plots show clear differences by farm type, with dairy and combined farms tending to report higher weekly workloads than arable farms. The distributions are right-skewed, indicating a non-negligible share of farms with very high self-reported working hours.

By contrast, modeled workload exhibits much less variation across farm types as the density plots largely overlap. Moreover, the pattern partly contrasts with that observed for self-reported workload, particularly for dairy farms, which show high self-reported workloads despite comparatively similar or even lower modeled workload levels. This suggests that modeled workload captures standardized labor requirements based on technical coefficients, which differ conceptually from self-reported workload and do not fully reflect organizational, managerial, or perceived workload differences across farm types. The distribution of available workforce resembles the distribution of self-reported workload, with arable farms showing lower available labor hours on average, while livestock-oriented farms, particularly dairy and mixed cattle farms, display higher and more dispersed levels of available workforce. Overall, the figure highlights that self-reported workload and available workforce vary more strongly by farm type than modeled workload, pointing to important differences between subjective assessments, reported labor input, and technically derived labor requirements.

4.2. Intraclass correlation coefficients (ICC) and internal consistency

Overall, the ICC results in Table 2 indicate low to very low reliability among the three workload measures, with substantial differences across farm types. For arable farms, reliability between the workload indicators was poor (ICC = −0.02, 95% CI [−0.15, 0.16]), accompanied by a negative Cronbach's α of −0.05, suggesting no internal consistency among the measures. For combined farms, reliability remains low but statistically significant (ICC = 0.14, 95% CI [0.05, 0.24], $p < 0.001$), with a Cronbach's α of 0.33, indicating modest internal consistency. A similar pattern was observed in dairy farms, where the three workload measures showed significant but low reliability (ICC = 0.14, 95% CI [0.05, 0.23], $p < 0.01$), exhibiting a Cronbach's α of 0.32. In suckler cow farms, reliability was very low and nonsignificant (ICC = 0.04, 95% CI [−0.05, 0.15]), showing a Cronbach's α of 0.13. Among all farm types, reliability was highest in mixed cattle farms, although it remained weak (ICC = 0.14, 95% CI [0.01, 0.28], $p < 0.05$), exhibiting a Cronbach's α of 0.33.

4.3. Pearson's correlations of the three workload variables and perceived burden per farm type

Fig. 2 presents Pearson's correlation coefficients between perceived burden and the three workload proxies, separately by farm type. Across all farms, perceived burden was most strongly and consistently correlated with self-reported workload. This relation was particularly pronounced for suckler cows ($r = 0.47$) and arable farms ($r = 0.36$), and remained positive, albeit weaker, for combined, dairy, and mixed cattle

[5] Crop and livestock diversification are measured using Shannon diversity indices based on AGIS data from 2024. The crop diversification index is calculated based on the distribution of cultivated area across aggregated crop groups, using area shares within each farm. The livestock diversification index is constructed using livestock units (LSU), with animal numbers converted into LSU using official coefficients and aggregated into broad livestock groups. Diversification is then measured using the distribution of LSU shares across these groups. In both cases, the Shannon index is defined as $H = -\sum_i p_i \log(p_i)$, where p_i denotes the within-farm share of crop area or livestock units in category i. To obtain an overall on-farm diversification measure, the crop and livestock Shannon indices are normalised by their respective maximum entropy (i.e., six crop groups and eight livestock groups) and averaged, yielding a combined diversification index that captures diversification across both plant and animal production activities.

[6] Note that these variables have been winsorized at the 5th and 95th percentiles to limit the influence of extreme values. Table A2 in the Appendix reports the distribution of the corresponding unwinsorized variables.

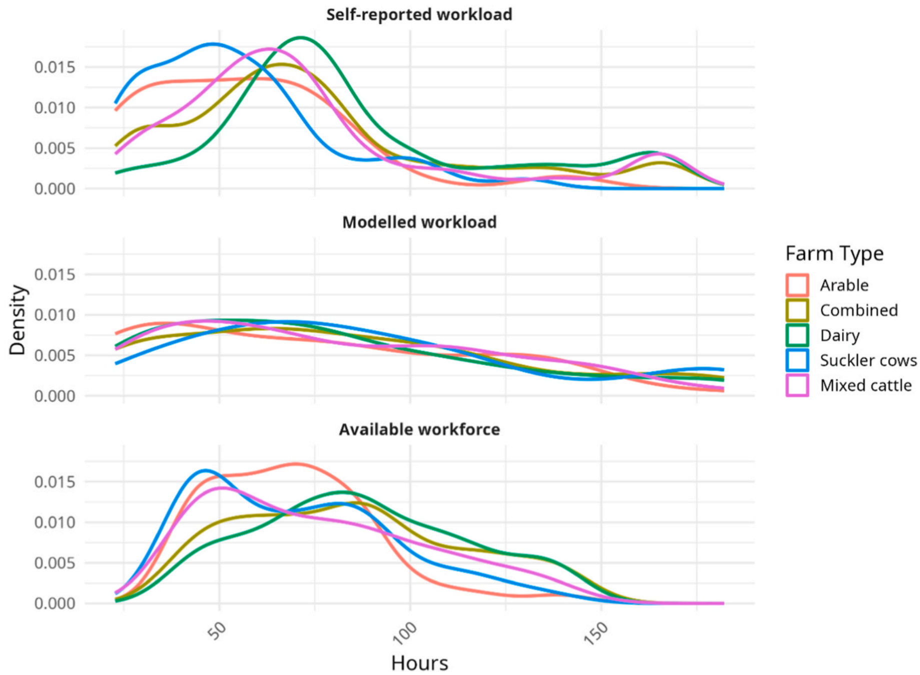

Fig. 1. Density plots of three workload proxies by farm type.
Source: Authors'own calculations

Table 2
Intraclass coefficients and Cronbach's alpha for the three workload indicators per farm type.

Farm type	ICC (3,1)	95% CI	Cronbach's α
Arable (n = 48)	−0.02	[-0.15, 0.16]	−0.05
Combined (n = 170)	0.14***	[0.05, 0.24]	0.33
Dairy (n = 179)	0.14**	[0.05, 0.23]	0.32
Suckler cows (n = 87)	0.04	[-0.05, 0.15]	0.13
Mixed cattle (n = 88)	0.14*	[0.01, 0.28]	0.33

Source: Authors' own calculations

farms ($r \approx 0.18$).

By contrast, correlations between perceived burden and modeled workload were generally weak and close to zero across all farm types, indicating little systematic association between subjective workload perceptions and technically derived labor requirements. For mixed cattle, the correlation was even negative ($r = -0.36$), suggesting a clear divergence between perceived burden and modeled workload in this production system.

Available workforce showed a modest positive correlation with perceived burden across most farm types, although the magnitude was substantially smaller than for self-reported workload ($r \approx 0.06$–0.16). Moreover, available workforce was strongly positively correlated with self-reported workload for all farm types ($r \approx 0.35$–0.51), reflecting that farms with higher reported working hours also tend to have a larger available labor supply.

Overall, the correlation pattern highlights marked heterogeneity across farm types and suggests that self-reported workload is most closely aligned with perceived burden, whereas modeled workload captures a distinct dimension of labor input that is only weakly related to subjective workload strain.

4.4. Regression analyses

Before considering the results of the regression analyses, it should be noted that some farm-type subsamples were relatively small, most notably arable farms (N = 48), and that farm types were unevenly distributed across diversification quintiles (see Table 3). Consequently, some estimates showed wide confidence intervals and should be interpreted with appropriate caution.

Fig. 3 presents the estimated coefficients from separate linear regressions of perceived burden on each workload proxy, estimated separately by farm type.[7] Across all farm types, self-reported workload was positively associated with perceived burden, with coefficients that were statistically significant for most farm types, except for dairy and mixed cattle, and largest in magnitude for suckler cows and arable farms. This indicates that higher reported working hours are consistently linked to higher perceived workload strain, although the strength of this relationship varies across farm types.

By contrast, modeled workload showed no systematic positive association with perceived burden. Estimated coefficients were close to zero for arable, combined, dairy, and suckler cow farms, and even negative for mixed cattle farms, where higher modeled workload was associated with lower perceived burden. In most cases, confidence intervals included zero, reinforcing the conclusion that technically derived labor requirements are weak predictors of perceived workload strain across farm types. Available workforce exhibited a positive association with perceived burden for combined, dairy, suckler cow, and mixed cattle farms, although the estimates were generally smaller in magnitude than those for self-reported workload and were not statistically different from zero.

Overall, the regression results mirror the Pearson's correlation patterns and underscore substantial heterogeneity across farm types. Self-

[7] The interested reader can find the full regression results in tabular form in Appendix Table A3.

Fig. 2. Pearson correlations between perceived burden and the three workload indicators per farm type.
Source: Authors'own calculations

Table 3
Number and percentage of farm types within quintiles.

Quintile	Range	Combined	Dairy	Suckler cows	Mixed cattle	Arable
Q1	0–0.03	2 (1.7%)	45 (39.1%)	29 (25.2%)	39 (33.9%)	NA
Q2	0.03–0.09	2 (1.8%)	59 (51.8%)	21 (18.4%)	31 (27.2%)	1 (0.9%)
Q3	0.09–0.18	17 (14.9%)	52 (45.6%)	31 (27.2%)	14 (12.3%)	NA
Q4	0.18–0.32	75 (65.8%)	21 (18.4%)	6 (5.3%)	4 (3.5%)	8 (7%)
Q5	0.32–0.68	74 (64.9%)	1 (0.9%)	NA	NA	39 (34.2%)

Source: Authors' own calculation

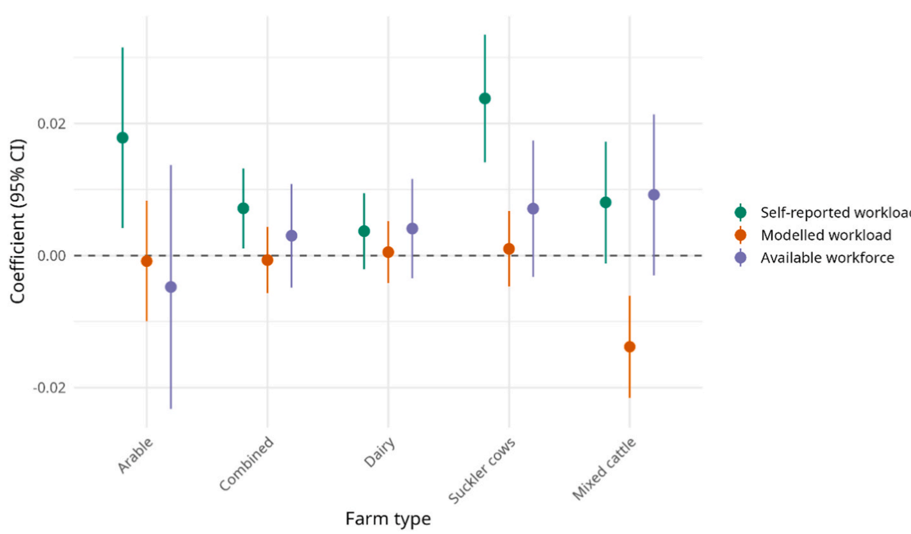

Fig. 3. Correlation between perceived burden and workload proxies, by farm type.
Note: The figure shows whisker plots of coefficient estimates and 95% confidence intervals from linear regressions of perceived workload burden on alternative workload proxies. Regressions are estimated separately for each farm type and without additional control variables.
Source: Authors'own calculations

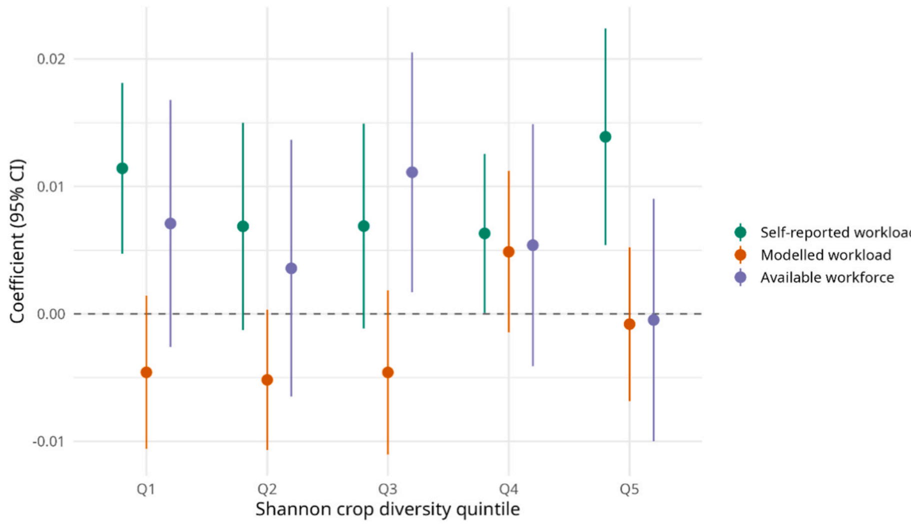

Fig. 4. Correlation between perceived burden and workload proxies, by diversity quintile.
Note: The figure shows whisker plots of coefficient estimates and 95% confidence intervals from linear regressions of perceived workload burden on alternative workload proxies. Regressions are estimated separately for each diversity quintile and without additional control variables. Table A4 in the Appendix shows the full regression results in tabular format.
Source: Authors' own calculations

reported workload emerged as the most consistent predictor of perceived burden, whereas modeled workload performed poorly in explaining perceived burden across production systems. These findings reinforce the conceptual distinction between subjective workload perceptions, reported labor input, and technically modeled labor requirements.

Given that we used winsorized workload proxies to limit the influence of extreme values, we re-estimated these models using raw, unwinsorized workload values. Table A4 in the Appendix shows that the results are qualitatively identical to those obtained with the winsorized variables, with coefficients of similar magnitude and the same pattern of statistical significance across farm types. This suggests that the main findings are not sensitive to the winsorization of extreme values.

To test whether the farm-type-specific patterns observed in Fig. 3 hold in a pooled framework, we estimated pooled linear regression models in which perceived burden was regressed on each workload proxy interacted with farm type indicators, while controlling for sociodemographic characteristics (see Table A6 in the Appendix). Farm-type-specific marginal effects were obtained by taking the linear combination of the coefficient on the workload proxy and the corresponding interaction term. The resulting marginal effects closely mirror the estimates from the separate regressions by farm type shown in Fig. 3, indicating that the main findings are robust to alternative model specifications.

As an additional robustness check, we investigated whether the relationship between workload and perceived burden was consistent across subgroups, defined by the degree of on-farm diversification. To this end, we regressed perceived burden separately on each workload proxy by diversification quintile. Before presenting the results from these separate regression models, Table 3 summarizes the distribution of farm types across quintiles of the combined diversification index. The table shows a strong association between farm type and diversification level. Farms in the lowest diversification quintiles were predominantly specialized livestock operations, whereas higher quintiles were increasingly dominated by combined and arable farms. This uneven distribution indicates that differences across quintiles likely reflect farm-type heterogeneity as much as diversification per se, and the analysis should therefore be understood primarily as a check on whether the main findings hold across structurally heterogeneous subgroups rather than as a direct test of diversification effects.

Fig. 4 shows that across all diversification levels, self-reported workload was positively associated with perceived burden, with effect sizes that were relatively stable across quintiles and largest for farms in the highest diversification quintile (Q5). This suggests that higher reported working hours are consistently associated with a higher perceived burden, regardless of the degree of diversification, although the relationship appears somewhat stronger among more diversified farms.

By contrast, modeled workload exhibited no systematic positive association with perceived burden across diversification quintiles. Estimated coefficients were negative for farms in the lower and middle quintiles (Q1–Q3), turned slightly positive in Q4, and were close to zero in Q5, with confidence intervals overlapping zero. This pattern reinforces the limited relevance of technically derived workload measures for explaining perceived burden, particularly among less diversified farms. The association between available workforce and perceived burden varied across diversification levels. Although positive coefficients were observed for the lower (Q1) and middle quintiles (Q3), the estimates became smaller and statistically insignificant in the highest diversification quintiles (Q4 and Q5).

Overall, bearing in mind the structural heterogeneity across quintiles, the results consistently identify self-reported workload as the most robust predictor of perceived workload strain across all diversification levels, reinforcing the main findings from the farm-type analyses. These findings are robust to alternative model specifications, as shown in Table A7 in the Appendix.

5. Discussion

In this paper, we examined which workload indicators commonly used in the literature—that is, self-reported working hours collected via farmer surveys, self-assessed labor capacity available in secondary data sources, and model-derived indicators—best relate to farmers' lived experience of workload burden and, thus, an important social sustainability dimension in the farming context. We used correlation and regression analyses to examine the relationship between farmers' perceived burden and the three workload indicators across different farm types and different levels of on-farm diversification.

Our results clearly show that these three workload indicators cannot be used interchangeably. None of them fully captures the others, and each captures a distinct dimension of farm work. Consequently, relying on a single workload measure risks providing a narrow or incomplete picture of farmers' overall working conditions and hence obscures whether workload-related social sustainability is improving or deteriorating (Duval et al., 2021). These findings suggest that current workload indicators may be deficient when used separately to examine the social sustainability of farm labor. However, it is important to note that since these indicators measure distinct elements of workload, they can still be used if the purpose is to examine these elements or other specific purposes (e.g., advisory services for planning farm work). The choice of indicator depends on the question being asked, and selection should be made accordingly.

Looking at the three workload indicators separately and investigating their explanatory power for perceived burden yields a consistent pattern: farmers' self-reported workload is strongly and robustly associated with perceived burden, both across farm types and degrees of on-farm diversification. In addition, this relationship holds in separate and pooled models with interaction terms, which underscores the stability of the results across alternative model specifications. By contrast, modeled workload shows little to no association with perceived burden. Although the LabourScope tool indicates modeled workload as useful for planning and benchmarking farm work, the indicator does not capture how burdensome farmers perceive their workload. Finally, available workforce exhibits a mixed pattern. On the one hand, it is positively correlated with self-reported workload, and in some farm types (specifically livestock) and diversification quintiles (in the medium quintile), it is also positively associated with perceived burden. The positive correlation between available workforce and self-reported workload may reflect the higher overall demands by larger operations and how supervising employees or training apprentices adds coordination and administrative tasks for the farm manager. On the other hand, the explanatory power of available workforce is consistently weaker than that of self-reported workload. Overall, this suggests that structural labor capacity alone does not determine how burdensome farmers experience their work (Kallioniemi et al., 2022; Purc-Stephenson et al., 2024; Jansen, 2000; Orsini et al., 2018) and cannot substitute for experiential measures when the objective is to assess the perceived workload burden of farm labor conditions.

Farm-type-specific results reveal marked heterogeneity in how the three workload indicators relate to perceived burden. Notably, none of the workload indicators was significantly associated with perceived burden in dairy production, despite dairy farmers reporting the highest working hours in the sample. Perceived burden in dairy farming is similar to that observed in arable and mixed cattle farms, which have substantially lower reported workloads. This decoupling of workload volume and perceived burden in dairy farming warrants careful interpretation, and several non-mutually exclusive mechanisms may be at play.

For example, dairy farmers may have adapted to their working hours over time in a way that decouples the sheer volume of work from how burdensome it feels. The rigid and predictable structure of dairy farming, driven by fixed milking schedules, may foster routinization (Hogan et al., 2024), reducing the experienced burden of long hours relative to systems with more variable and unpredictable workload patterns.

Second, survivor bias may contribute to this finding. Farmers who found dairy farming too burdensome may have already exited the sector or switched to less labor-intensive systems, such as suckler cow farming (Zorn et al., 2022), leaving a sample that was selected for greater tolerance of demanding work conditions. This would mean that the absence of a workload–burden relationship in dairy reflects a compositional feature of the remaining dairy farming population rather than an inherent characteristic of the system itself.

Third, perceived burden in dairy farming may be driven by factors that the present study did not measure. Financial stress, social isolation, the difficulty of taking time off because of the daily milking obligation, or concerns about the long-term viability of dairy farming in Switzerland may all contribute to burden perception independently of working hours (Kallioniemi et al., 2022; Hogan et al., 2024). If burden in dairy is primarily shaped by these structural and psychosocial factors rather than by workload volume per se, this would explain why none of the three workload indicators captures meaningful variation in perceived burden within this group.

From a policy perspective, these results imply that interventions aimed at improving social sustainability in dairy farming should look beyond reducing working hours alone and instead address qualitative aspects of work organization, flexibility, financial security, and social connectedness. Future research should further investigate the factors shaping perceived burden among dairy farmers and assess which types of interventions could effectively reduce workload-related strain in this sector.

By contrast, for arable and suckler cow farms, self-reported workload is strongly and significantly correlated with perceived burden. Although these farm types are commonly assumed to have comparatively low workloads, the results suggest that in these systems, perceived burden is primarily driven by the number of working hours. In such contexts, farmer-reported workload appears to be a particularly informative proxy for burden. Integrating short, validated scales measuring perceived workload burden into national surveys (e.g., AGIS) could therefore enable systematic monitoring of farmers' experiential well-being over time and improve the assessment of labor-related social sustainability across farm types.

5.1. Limitations and future research

There are several important methodological limitations in the present study. First, self-reported working hours are subject to recall bias from farmers. In addition, perceived burden is solely measured from the farm managers' perspectives and does not encompass the experiences of other farm workers, such as family members or hired labor. Future studies should explicitly differentiate workload experiences across different groups of farm workers, including women, family members, and hired laborers, and explore how these perspectives can be incorporated into assessments of farm workload and social sustainability.

Second, the cross-sectional nature of the data used here does not account for changes in workload and burden perception over time. This is particularly relevant in the context of farm diversification, which is a dynamic process that may unfold over several years and is likely to affect both objective workload and subjective burden perception at different stages. For example, the initial phase of introducing a new enterprise may temporarily increase the workload and burden, while the long-term effects may differ substantially once the new activity is established. Longitudinal data would allow future studies to examine how workload and burden evolve in response to farm transformation, diversification decisions, and policy changes, and could help disentangle short-term adjustment costs from longer-term structural effects.

Third, the modeled working hours calculation relied on assumptions about mechanization levels based on farm characterization, such as farm size, because no information on their actual mechanization levels was available. It is also unclear whether animals, such as horses, are kept for hobby purposes or as part of farming activities, which may contribute to an overestimation of modeled workload in these cases.

Fourth, the available workforce calculations provided by AGIS do not account for seasonal workers and may therefore not reflect actual labor capacity. Incorporating this information into the census data would substantially improve the assessment of farm workload conditions.

Fifth, some subgroup analyses are based on relatively small samples, most notably arable farms (N = 48), which limits statistical power and results in wide confidence intervals. The findings for these subgroups should therefore be interpreted with caution. In addition, farm types are unevenly distributed across diversification quintiles, meaning that the quintile-based regression results may partly reflect farm-type differences rather than effects specifically attributable to the degree of diversification. Replication studies with larger and more balanced samples would allow for a cleaner identification of diversification effects net of farm-type heterogeneity.

6. Conclusion

Workload is one of the most important factors in social sustainability assessments in the agricultural context, and it is measured using various indicators in literature. This study is the first to compare three commonly used workload indicators and evaluate their ability to explain farmers' perceived workload, thereby capturing workload-related social sustainability from the farmers' perspective. Our study provides valuable insights into meaningful social sustainability indicators at the farm level and thus contributes to the development of robust indicators for comprehensive sustainability assessments, such as those currently discussed in the development of the Farm Sustainability Data Network in Europe. We show that self-reported workload most accurately reflects perceived workload burden. We therefore recommend developing a scale and collecting this type of data across several countries. This would enable comparisons to be made across space and time, improving our understanding of social sustainability in agriculture and allowing us to develop targeted support measures for farmers.

CRediT authorship contribution statement

Rita Saleh: Conceptualization, Data curation, Formal analysis, Methodology, Project administration, Writing – original draft. **Katja Heitkämper:** Data curation, Methodology, Writing – review & editing. **Sarina Altermatt:** Data curation, Methodology, Writing – review & editing. **Nadja El Benni:** Conceptualization, Methodology, Writing – review & editing. **Sabine Liebenehm:** Formal analysis, Visualization, Writing – original draft.

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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Appendix

Table A1
Conversion of available workload proportions reported in AGIS into labor units (LU) and weekly working hours

Available workforce proportion	LU range	Average LU used	Weekly hours equivalent*
>74%	0.75–1.00	0.87	43.5 h/week
50–74%	0.50–0.74	0.62	31 h/week
<50%	<0.50	0.25	12.5 h/week

Note: The conversion is based on the Swiss Ordinance of Agricultural Terminology, where 1 LU = 2600 h/year, converted to weekly hours using: Weekly hours $= \text{LU} \times \frac{2600}{52}$

Source: Hoop, D., and Schmid, D. (2020). *Typologie des exploitations DC2015 du Dépouillement Centralisé des donnéescomptables*. https://www.agroscope.admin.ch/agroscope/de/home/themen/wirtschaft-technik/betriebswirtschaft/zabh/methode/_jcr_content/par/columncontrols/items/0/column/externalcontent_450185637.bitexternalcontent.exturl.html/aHR0cHM6Ly9pcmEuYWdyb3Njb3BlLmNoL2RlLUNIL0FqYXgvUH/VibGlrYXRpb24_ZWluemVscHVibGlrYXRpb25JZD00MzgwMyZw/YXJlbnRVcmw9JTJGZGUtQ0glMkZQdWJsaWthdGlvbnNsaXN0ZS/UyRkVpbnplbG4lM0Zwb3NpdGlvbiUzRG1pZGRsZSUyNnB1Ymxp/a2F0aW9uSWQlM0Q0MTg2Mg==.html

Table A2
Summary statistics of non-winsorized variables

Variable	Mean	St. Dev.	Min	Max
Self-reported workload (hrs)	75.418	45.072	10.000	399.000
Modeled workload (hrs)	84.359	53.035	14.951	425.556
Available workforce (hrs)	81.764	34.538	12.500	273.500

Source: Authors' own calculations

Table A3
Correlation between perceived burden and workload proxies by farm type (separate regressions by farm type and no additional control variables)

Main RHS variable	Dependent variable: Perceived burden														
	Arable			Combined			Dairy			Suckler cows			Mixed cattle		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Self-reported workload	0.018**			0.007**			0.004			0.024***			0.008*		
	(0.007)			(0.003)			(0.003)			(0.005)			(0.005)		
Modeled workload		−0.001			−0.001			0.001			0.001			−0.014***	
		(0.005)			(0.003)			(0.002)			(0.003)			(0.004)	
Available workforce			−0.005			0.003			0.004			0.007			0.009
			(0.009)			(0.004)			(0.004)			(0.005)			(0.006)
Observations	48	48	48	170	170	170	178	178	178	87	87	87	88	88	88
R^2	0.130	0.001	0.006	0.031	0.0004	0.003	0.009	0.0003	0.006	0.219	0.001	0.021	0.034	0.128	0.025
Adjusted R^2	0.111	−0.021	−0.016	0.026	−0.006	−0.003	0.003	−0.005	0.001	0.210	−0.010	0.010	0.023	0.117	0.014

Note: *p < 0.1; **p < 0.05; ***p < 0.01.
Source: Authors' own calculations

Table A4
Correlation between perceived burden and raw, unwinsorized workload proxies by farm type (separate regressions by farm type and no additional control variables)

Main RHS variable	Dependent variable: Perceived burden														
	Arable			Combined			Dairy			Suckler cows			Mixed cattle		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Self-reported workload	0.018**			0.005**			0.002			0.024***			0.005		
	(0.007)			(0.002)			(0.002)			(0.005)			(0.003)		
Modeled workload		−0.001			0.001			−0.0001			0.001			−0.013***	
		(0.004)			(0.002)			(0.002)			(0.002)			(0.004)	
Available workforce			−0.004			0.0004			0.003			0.009*			0.010*
			(0.009)			(0.003)			(0.003)			(0.005)			(0.006)
Observations	48	48	48	170	170	170	178	178	178	87	87	87	88	88	88
R^2	0.142	0.001	0.004	0.025	0.0005	0.0001	0.004	0.00002	0.005	0.237	0.001	0.038	0.025	0.122	0.036
Adjusted R^2	0.123	−0.022	−0.017	0.019	−0.005	−0.006	−0.002	−0.006	−0.0004	0.228	−0.010	0.026	0.013	0.112	0.025

Note: *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.
Source: Authors' own calculations

Table A5
Correlation between perceived burden and workload proxies based on diversity quintile (separate regressions by quintile and no additional control variables)

Main RHS variable	Dependent variable: Perceived burden														
	Q1			Q2			Q3			Q4			Q5		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Self-reported workload	0.010***			0.007*			0.007*			0.006**			0.014***		
	(0.003)			(0.004)			(0.004)			(0.003)			(0.004)		
Modeled workload		−0.005			−0.005*			−0.005			0.005			−0.001	
		(0.003)			(0.003)			(0.003)			(0.003)			(0.003)	
Available workforce			0.007			0.004			0.011**			0.005			−0.0005
			(0.005)			(0.005)			(0.005)			(0.005)			(0.005)
Observations	115	115	115	114	114	114	114	114	114	114	114	114	114	114	114
R^2	0.092	0.020	0.018	0.024	0.030	0.004	0.025	0.017	0.047	0.035	0.020	0.011	0.086	0.001	0.0001
Adjusted R^2	0.084	0.011	0.010	0.016	0.021	−0.004	0.016	0.009	0.038	0.026	0.012	0.002	0.078	−0.008	−0.009

Note: *$p < 0.1$; **$p < 0.05$; ***$p < 0.0$.
Source: Authors' own calculations

Table A6
Correlation between perceived burden and workload proxies based on farm type (Pooled sample by farm type interaction and control variables)

Dependent variable: Perceived burden			
	Self-reported workload	Modeled workload	Available workforce
	(1)	(2)	(3)
Self-reported workload	0.020**		
	(0.008)		
Modeled workload		−0.0005	
		(0.005)	
Available workforce			−0.002
			(0.010)
Farm types (Ref is Ararble):			
Combined	0.464	−0.036	−0.771
	(0.540)	(0.477)	(0.784)
Dairy	1.430***	0.549	−0.075
	(0.556)	(0.473)	(0.798)
Suckler cows	−0.226	−0.120	−0.911
	(0.609)	(0.539)	(0.843)
Mixed cattle	0.937	1.524***	−0.634
	(0.592)	(0.536)	(0.836)
Age	0.015**	0.010*	0.012*
	(0.006)	(0.006)	(0.006)
Woman	0.127	0.141	0.110
	(0.194)	(0.196)	(0.197)
Education (Ref is No vocational edu)			
Basic vocational	0.053	−0.015	−0.037
	(0.394)	(0.393)	(0.395)
Advanced vocational	0.273	0.222	0.203
	(0.406)	(0.408)	(0.410)
Tertiary education	0.315	0.282	0.335
	(0.460)	(0.463)	(0.468)
Agricultural training	0.232	0.399*	0.414*
	(0.219)	(0.219)	(0.220)
Number of workers	−0.067	−0.011	−0.107*
	(0.046)	(0.045)	(0.061)
Off-farm employment	−0.076	−0.267**	−0.223*
	(0.131)	(0.128)	(0.130)
Interaction terms			
Self-reported: Combined	−0.011		
	(0.008)		
Self-reported: Dairy	−0.016*		
	(0.008)		
Self-reported: Suckler cows	0.004		
	(0.010)		
Self-reported: Mixed cattle	−0.012		
	(0.009)		
Modeled: Combined		−0.001	
		(0.005)	
Modeled: Dairy		0.0002	
		(0.005)	
Modeled: Suckler cows		0.001	
		(0.006)	
Modeled: Mixed cattle		−0.014**	
		(0.006)	
Available: Combined			0.009
			(0.011)
Available: Dairy			0.008
			(0.011)
Available: Suckler cows			0.013
			(0.012)
Available: Mixed cattle			0.014
			(0.011)
Constant	2.057***	3.301***	3.600***
	(0.728)	(0.676)	(0.912)
Observations	571	571	571
R^2	0.106	0.086	0.073
Adjusted R^2	0.079	0.058	0.045
Residual Std. Error (df = 555)	1.402	1.418	1.427
F Statistic (df = 16; 555)	3.858***	3.047***	2.580***

Note: *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.
Source: Authors' own calculations

Table A7
Correlation between perceived burden and workload proxies based on diversity quintile (Pooled sample with interaction terms between diversity quintiles and workload proxies plus control variables)

Dependent variable: Perceived burden			
	Self-reported workload	Modeled workload	Available workforce
	(1)	(2)	(3)
Self-reported workload	0.011***		
	(0.004)		
Modeled workload		−0.005	
		(0.003)	
Available workforce			0.009*
			(0.005)
Diversity quintiles (Ref Q1)			
Q2	0.554	0.254	0.305
	(0.431)	(0.401)	(0.589)
Q3	0.408	0.269	−0.200
	(0.420)	(0.403)	(0.558)
Q4	0.105	−0.922**	−0.206
	(0.410)	(0.406)	(0.600)
Q5	−0.540	−0.644	0.111
	(0.431)	(0.398)	(0.572)
Age	0.014**	0.011*	0.012**
	(0.006)	(0.006)	(0.006)
Woman	0.124	0.118	0.069
	(0.197)	(0.199)	(0.199)
Education (Ref is No vocational edu)			
Basic vocational	0.066	−0.109	−0.103
	(0.395)	(0.399)	(0.399)
Advanced vocational	0.321	0.163	0.133
	(0.411)	(0.415)	(0.415)
Tertiary education	0.304	0.215	0.202
	(0.465)	(0.471)	(0.473)
Agricultural training	0.216	0.366	0.339
	(0.223)	(0.223)	(0.225)
Number of workers	−0.064	0.020	−0.097
	(0.047)	(0.045)	(0.062)
Off-farm employment	−0.113	−0.293**	−0.252*
	(0.132)	(0.129)	(0.129)
Interaction terms:			
Self-reported: Q2	−0.006		
	(0.005)		
Self-reported: Q3	−0.003		
	(0.005)		
Self-reported: Q4	−0.004		
	(0.005)		
Self-reported: Q5	0.005		
	(0.006)		
Modeled: Q2		−0.001	
		(0.004)	
Modeled: Q3		−0.001	
		(0.004)	
Modeled: Q4		0.009*	
		(0.005)	
Modeled: Q5		0.004	
		(0.004)	
Available: Q2			−0.002
			(0.007)
Available: Q3			0.005
			(0.007)
Available: Q4			−0.0002

(*continued on next page*)

Table A7 (*continued*)

Dependent variable: Perceived burden			
	Self-reported workload	Modeled workload	Available workforce
	(1)	(2)	(3)
			(0.007)
Available: Q5			−0.005
			(0.007)
Constant	2.640***	3.910***	3.077***
	(0.582)	(0.569)	(0.643)
Observations	571	571	571
R2	0.085	0.059	0.057
Adjusted R2	0.057	0.030	0.028
Residual Std. Error (df = 555)	1.419	1.438	1.440
F Statistic (df = 16; 555)	3.012***	2.035***	1.958**

Note: *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.
Source: Authors' own calculations

Table A8
Mean comparison of the analytical sample (N = 571) and the AGIS farm population (N = 40,244)

Statistic	Mean analytical sample	Mean AGIS
Age (years)	46.48	48.77
Woman (1 = yes)	0.11	0.08
Number of workers	2.85	3.34
Arable farm (1 = yes)	0.08	0.07
Combined farm (1 = yes)	0.30	0.38
Dairy farm (1 = yes)	0.31	0.31
Suckler cow farm (1 = yes)	0.15	0.13
Mixed cattle farm (1 = yes)	0.15	0.12

Note: Combined farm types ("combined dairy/arable," "combined suckler cows," "combined fattening," and "combined other") were aggregated into the category "combined farm". AGIS farm type shares were re-calculated to sum to 100% after excluding the farm types "horses, sheep goats," "special cultures," and "fattening," which were also excluded from the analytical sample. Consequently, the reported AGIS farm-type shares are based on a reference population of 32,791 farms.
Source: Authors' own calculations, (Federal Office for Statistics (FOS), 2025)

Data availability

The data will be anonymized and made available on Zenodo, and the code will be available on GitLab

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