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Analysis of a Planning Tool for the Calculation of Working Time Requirement in Agriculture

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Work economics calculation data form the basis for comprehensive work planning on the farm and for calculating labour costs and work productivity, as well as for estimating workload. A work budget (WB) is a planning tool for creating a time budget for the work to be done. The working-time requirement for labour and production processes is calculated with the help of the work budget. Work budgets need to be constantly refined and adapted to modern technologies.
The inclusion of dynamic models for work processes in the ART Work Budget (ART-WB) has created a comprehensive calculation tool that allows the working-time requirement of a farm to be modelled with great precision. However, usage of the tool has shown it to be too complex and user unfriendly for an advisory tool, and in particular for a planning tool for the farm manager.
Based on this experience, a new version – the Tänikon Work Budget (TWB) – was developed as an online tool (www.arbeitsvoranschlag.ch). The aim was to clearly improve the user friendliness, particularly the comprehensibility and the speed of the calculation process.
The present study focuses on the comparison of the new TWB with the ART-WB in terms of plausibility of results and user performance. In order to categorise the results of the TWB, the working-time requirement for selected work processes was calculated for a model farm with dairy farming in both ART-WB and TWB and the results compared with one another. In addition, the TWB was used to calculate the working-time requirement for three reference dairy farms. Finally, the farm manager gave an assessment of the results, and of the handling of the calculation tool.
The comparison of the working-time requirement for different work processes calculated with the ART-WB on the one hand and the TWB on the other hand showed that the deviation between the results varied considerably. Further optimisations should be carried out in order to improve the user-friendliness and the quality of the results of the TWB.

1. Introduction

Key work economics figures for work processes in agriculture are published in various media for practitioners, extension workers and educators. The working-time requirement values are usually available in the form of data tables in handbooks for several size categories of the main influencing variables (e.g. 10, 20, 30, 40, 60, 100 dairy cows). These data enable a detailed calculation of the working-time requirement at farm level, but the work processes themselves have to be put together manually. These data tables are often used in education and extension. However, depicting the entire farm with various branches of activity is complicated, and requires a great deal of time. By contrast, the analysis of individual work processes within a farm activity by means of key-figure tables allows us to gain a quick overview (Heitkämper, 2015).
The ART-WB is a software tool that contains both a dynamic modelling of work processes as well as the work budget as a calculation tool (Riegel, 2007). Through the dynamic modelling that underlies the ART-WB, influencing variables can be adapted to individual farms at the work-process level. This enables us to take very close account of farm circumstances. Moreover, by depicting the annual distribution of the working-time

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requirement – the so-called work graph – the ART-WB can also be used for planning staff resources (Heitkämper, 2010). The extensive configuration options require special knowledge of the application.
The TWB is completed as a tool and is available as a beta version (Heitkämper, 2015). The calculated work processes are available as a data table, and are compiled into predefined production processes. Data are continually supplemented and the models optimised. The TWB enables the user to calculate the working-time requirement for the individual farm with less data entries. The application is based on data tables at work-process level. Process variants that are common in practice are taken into account. The main influencing factor of a work and production process can be adapted for the individual farm.

2. Materials and Methods

2.1 Calculation of the Working-Time Requirement with ART-WB and TWB

For the evaluation accompanying the development process of the TWB, calculations were carried out with the ART Work Budget, version 2014, 1.4.2 and the Tänikon Work Budget, beta version, status as at 03/2016 published by Agroscope, Tänikon, 8357 Ettenhausen, Switzerland. Both tools were used to calculate the working-time requirement of the model farm.

2.2 Model Farm

For testing the usability of the TWB and compare it with the ART-WB a model farm was defined. The model farm represents an average dairy farm of the Swiss lowland region (Table 1).

Table 1: Description of the model farm

Production Process	Size	Description
Dairy cows	52 head	• Cubicle loose housing with outdoor exercise area, lime-straw mattresses, feed alley with slatted floor, solid-concrete corridors; • Manure scraper system • Tandem milking parlour, 7 milking places • Feed provision: Hay and chicory root with feed-mixer, concentrate by hand, also fresh grass and half-day grazing in summer
Calf rearing	10 places	• 5-place group igloos, residence period 4 months • Dung removal and strawing by hand • Bucket drinker; Feed provision: Hay and concentrate by hand
Cattle rearing	20 head	• Cubicle loose housing with outdoor exercise area as for cows, 3 age groups ((1): 4-8 mos.; (2): 9-15 mos.; (3): 16-24 mos.) • Dung removal with hand scraper • Feed provision: group 1 and 2: hay and concentrate by hand, group 3: ration as for dry cows • Half-day (group 2) or full-day (group 3) grazing.

2.3 Reference Farms

In order to validate the findings on working-time requirement calculated with the TWB software, a farm-specific calculation of the working-time requirement was carried out for three reference farms (Table 2). The reference farms have a similar operational structure as the model farm and were selected from Agroscope's pool of cooperating commercial farms.
A work budget was created together with the manager of the farm in question using the TWB. Afterwards the farm managers assessed the usability of the TWB. In guided interviews they were ask to give their opinion on

- Their personal rating of the organisation and planning of labour
- Their general impression of the TWB
- User-friendliness / comprehensibility
- Shortcomings in data entry (specialities of the farm)
- Time required for data entry
- Interpretation of the results
- Benefit for the farmer
- Suggestions for changes / improvements

Table 2: Description of the reference farms

	Farm 1	Farm 2	Farm 3
Age of farm manager	27 years	49 years	38 years
Utilized agricultural area	39 ha	28 ha	31 ha
No. of dairy cows	81	40	35
Farm activities	• Dairy cattle • Rearing of young cattle • Forage production • Field crops • Fruit production	• Dairy cattle • Rearing of young cattle • Forage production • Field crops • Poultry keeping • Fruit production	• Dairy cattle • Rearing of young cattle • Forage production
Rearing	On own farm	Contract rearing	Contract rearing

3. Results and discussion

3.1 Calculation of the working-time requirement for the model farm with ART-WB and TWB

The results of the calculation of the working time requirement for selected work processes with the TWB and ART-WB are presented in Table 3. Both work budgets attempted to depict farm circumstances as accurately as possible.

Table 3: Working time requirement for the model farm calculated with the ART-WB and the TWB

Work processes	ART-WB [MPh[1)]]	TWB [MPh]	Deviation of TWB from ART-WB [h]	Deviation of TWB from ART-WB [%]
Dairy Farming				
Milking	1055	1322	267	25
Feeding	636	679	43	7
Harvesting fresh grass	297	237	-60	-20
Grazing	139	179	40	29
Upkeep of cubicles / dung removal	401	218	-183	-46
Strawing cubicles	141	143	2	1
Cleaning exercise yard	110	14	-96	-87
Special jobs, dairy farming	210	361	151	72
Production management	630	601	-29	-5
Calf Rearing				
Milk feeding	398	596	198	50
Hay and concentrate feeding	10	18	8	80
Dung removal	8	7	-1	-13
Strawing group pens	105	97	-8	-8
Special jobs	24	24	0	0
Cattle Rearing				
Feeding	94	160	66	70
Strawing	27	43	16	59
Grazing	68	220	152	224
Special jobs	109	49	-60	-55
Production management	120	120	0	0

[1)] MPh = Manpower hours

It had to be considered, that the share of each work process in the production process varies considerably. For example, the share of the work process 'milking' was over 30% of the production process 'dairy farming' (ART-WB: 3619 MPh) and the share of the work process 'milk feeding' accounted even for 73% of the production process 'calf rearing' (ART-WB: 545 MPh). Therefore both the absolute deviation [MPh] and the relative deviation [%] of the results between TWB and ART-WB was compared. A result was declared as invalid when the absolute deviation was over 10% of the absolute deviation of the work process with the highest share of the production process and/or the relative deviation was over 50%.

Overall, the results deviate with an enormous spread in individual work processes. Some results of the TWB are higher, others are lower than the corresponding results of the ART-WB. The three production processes 'dairy farming', 'calf rearing' and 'cattle rearing' were analysed separately. In dairy farming the calculations for the work processes 'feeding', 'strawing cubicles' and 'production management' deviate less than 10% and not more than 43 hours. On the other hand, the work process 'special jobs, dairy farming' has to be considered as invalid, because the deviation is 72% and over 150 MPh. The work process 'upkeeping of cubicles/dung removal' is also declared as invalid, because the absolute deviation with 183 MPh is too high.

Two out of five work processes of 'calf rearing' deviate less than 10% and less than 10 hours, whereas 'milk feeding' is invalid with 198 MPh absolute deviation and 50% relative deviation.

The production process 'cattle rearing' (ART-WB: 418 MPh) has four invalid work processes out of five and has to be revised before further analysis can be carried out.

The reasons for these deviations can have various causes due to the functionalities of the two tools (Table 4).

3.2 Comparison of the functionalities of TWB and ART-WB

Four main functionalities were analysed for both planning tools and compared with each other (Table 4). These functionalities influence the results of the working-time requirement.

Table 4: Functionalities of TWB and ART-WB

Functionality	TWB	ART-WB
Influencing factors of work processes can be changed	• In order to simulate different circumstances on farms, a great many different work processes must be given as choices. • A number of special work processes cannot be depicted in the TWB, since the list of the processes would be very long and confusing.	• The different circumstances on farms, can be simulated by adapting the values of various influencing factors.
Dynamic modelling	• A corresponding work process to the work process applied on the farm may not be available in the data table, which means the process with the best similarity has to be chosen.	• The dynamic models included in the tool allow to select and calculate using the explicit value of the influencing factor.
Distribution of the working-time requirement over the course of the year	• There is no allocation of work processes to a completion period, therefore planning of the seasonal workforce is not possible.	• The working processes are allocated to a completion period which allows to calculate the seasonal workload. • The seasonal workload can be compared with the workforce available. • Workload peaks can be made visible.
Adding production processes	• Production processes not available in the tool cannot be added, and hence cannot be taken into account in the calculation.	• Production processes not available in the tool can be added in form of fix values.

3.3 Interviews of the farmers (TWB user feedback)

Farmers' assessment of organization / planning of work on their own farms
On all farms the workload is not viewed as excessive. On one farm, the work is regularly planned in advance; on one, it occurs spontaneously according to need, during a seasonally heavy workload; on the third farm, no planning occurs. The ART-WB was used once on one farm, in a training context, to calculate working-time requirement; the other farm managers are unfamiliar with this tool. On all farms, work planning is rated as sufficient.

General impression of the work budget
The overall impression is rated as positive. An adaptation of the layout and operation to existing, known tools would be helpful.

Ease of operation / comprehensibility
The structure is simple and comprehensible, even for users with limited computer knowledge. Selection of the processes is clearly structured. When entering data, the time requirement for the individual processes should be visible.

Shortcomings in data entry (farm's specialities)
Differentiated processes should be available. Long transport distances (field to farmyard) cannot be taken into account.

Time required for data entry
The three farmers required 25 to 35 minutes for data entry. The time requirement is seen as positive.

Interpretation of the results
At first blush, the results are rated as too high; on closer analysis, this is put into perspective. The farmers observed that their own working hours are often substantially underestimated. In the case of individual processes, however, a divergence from reality is observed on their own farms, especially in the keeping of calves.

Benefit for the farmer
According to the farmers opinion the TWB is deemed to be useful for the following issues:
- Training of farm managers and masters of the trade
- Planning of new farm activities
- Full-cost accounting
- Monitoring of one's own workload
- Farm conversions.

Suggestions for changes / improvements
- It should be possible to adjust the time requirement for each individual work process.
- Ideally would be an Excel tool that is combinable with other (existing) planning tools.
- More production processes should be available in order to simplify the choice of work processes.
- Getting started in the program should be simplified with a comprehensive overview.
- All three of the farm managers surveyed would only use the TWB if it were available free of charge.

The three farm managers assessed a very simple and straightforward operation of the TWB. With all the farms, it was possible to select work processes that for the most part were a good match for the circumstances of the farm. Despite this, the farmers would have liked to have more work processes to choose from in some areas, with the aim being to provide a clearer overview via new production processes. The structure of the TWB is clearly simplified vis-à-vis that of the ART-WB. The resultant advantages are greater ease of operation and a shorter acquisition time.

4. Conclusions

Both, the ART-WB and the TWB are models containing numerous provisions for the procedures and influencing factors. The dynamic models contained in the ART-WB and the possibility of many influencing factors being adapted allow for a substantially more accurate approximation to reality with this tool than with the static values in the TWB, which must satisfy average conditions.
In order to depict the farm circumstances as accurately as possible, different variants of a large number of work processes have to be made available. At the same time the user-friendliness as far as clearness is concerned should not lessen.

The large deviations between the results of the TWB and the ART-WB can be reduced with the diversification of work and production processes. However, a skilful combination of work and production processes is necessary to preserve the advantage of the TWB which is the short acquisition time in first place. This could meet the most important concerns of the users.

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