Crop production costs in Austria: Comparison of simulated results and farm observations

Produktionskosten ausgewählter Ackerbaukulturen: Vergleich von Simulationsergebnissen mit beobachteten Daten

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Summary

We compare simulated crop production costs with actual cost accounting data from farm records. The purpose is to validate INCAP ('Index-based Costs of Agricultural Production'), a detailed standard cost data set for Austria that differentiates by production characteristics, management variants and year. It was found that the level of some cost items was similar and that deviations which are substantial in some cases need further research. A further collaboration of farmers, advisors in farmers' working groups and researchers is necessary to improve the validity of cost data sets derived from technical data sets.
Keywords: crop production costs, validation, INCAP

Zusammenfassung

Die vorliegende Untersuchung vergleicht simulierte Produktionskosten im Pflanzenbau mit auf Betrieben gemachten Kostenrechnungsdaten. Dies dient der Validierung von INCAP ('Index-basierte Kosten der Agrarproduktion'), einem umfangreichen Datensatz, der verschiedene Produktionscharakteristika und Managementvarianten beinhaltet und mehrere Jahre umfasst. Der Vergleich zeigt, dass die simulierten und die beobachteten Kostenpositionen in vielen Fällen ähnliche Werte aufweisen. Größere Abweichungen müssen aber weiter ergründet werden. Eine Zusammenarbeit von LandwirtInnen, die ihre Kosten erfassen, mit der Forschung, die standardisierte Datensätze entwickelt, ist daher nötig, um zuverlässigere Ergebnisse zu ermöglichen.
Schlagworte: Produktionskosten, Ackerbau, Validierung, INCAP

1. Background

In agri-economic analyses, relevant developments or events are usually measured by means of changes in farm income. A newly-developed revenue and cost data set, the 'Index-based Costs of Agricultural Production' (INCAP) (HEINSCHINK et al., 2016a, 2016b, 2016c), is designed to make such analyses possible at the activity-, farm- or sector-specific level, factoring in spatial heterogeneity among Austrian regions. As an engineering data set, INCAP needs to undergo a thorough assessment in order to make judgments about its quality or validity. The objective of the validation exercise is to identify (a) whether the level of different cost items, yields and prices in INCAP is similar to observed cost data or systematically biased and (b), in case of bias, potential remedies to improve quality. We aim to document findings from one part of the validation focusing on selected conventional crop production activities. To this end, INCAP data are compared with statistics based on farm observations. In this paper, we briefly describe the data sets, the specific data as well as the approach chosen for validation. We then present our findings from the validation exercise and discuss how these can assist in improving the validity of INCAP.

2. Data sets and limitations

2.1 Index-based Costs of Agricultural Production (INCAP)

INCAP covers most plant and livestock production activities relevant in Austria's agricultural sector. The activities are differentiated by production conditions (e.g. climate type) and management variants (e.g. conventional or organic farming). Variable costs are provided as an annual time series, currently covering past periods (from 2000 to 2015), and with the possibility build in projections for future periods. INCAP is largely based on information from existing data repositories, primarily from the 'Internet gross margins and data' tool[1] (AWI, s.a.).

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[1] The AWI tool (AWI, s.a.) does not claim to be representative for Austria or its regions. Instead, it provides gross margin calculations populated with average default values. The users have the possibility to put their own parameters into the calculation (e.g. quantities, prices) depending on the purpose of the analysis.

These data are mostly derived from official information (e.g. yield and producer prices in conventional farming) and functional relations (e.g. nutrient uptake), but also from unpublished actual data (e.g. retail prices of inputs). Expert assumptions (e.g. type and quantity of inputs, machinery used and work steps, yield differentials between production systems) are used when sufficient observations are not available. The underlying sources, scope and structure of INCAP have been described before in more detail (see e.g. HEINSCHINK et al., 2016a, 2016c).

2.2 Working group (WG) data

In this paper, INCAP is compared with a sample of data taken from farmers' working groups (WG, in German: 'Arbeitskreise') (LFI-LKÖ, s.a.). WG operate throughout Austria and specialise in particular topics (e.g. crop production, piglet production, farm business management). A primary goal is to improve the economic performance of participating farms. Farmers collaborate by discussing problems, working on solutions and exchanging experience on production activities and economic outcomes. Experts from the local divisions of the Chamber of Agriculture handle the data (records of participating farms), coach the participants, support the discussion process and advise on problems at hand. WGs are supported by a publicly-funded extension programme (LFI[2]). An annual farm activity report ('Betriebszweigauswertung') indicates the average economic performance of the WG farms as well as the better- and lower-performing brackets. Such statistics give the individual farmer feedback on their position in the group of peers. A small sample of cost data from crop production WGs was made available for the INCAP validation exercise.

2.3 Limitations

It is worth noting the limited comparability of the two data sets. In particular, the WGs provide observed data recorded on existing farms, i.e. values that are based on actual production conditions, management choices, farming technology and work steps. These data are non-repre-

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[2] For more details, see: http://www.arbeitskreisberatung.at/?+Was+sind+Arbeits kreise+&id=2500%2C%2C1126007%2C (accessed 20.10.2016).

sentative since the participating farms are not chosen randomly among all farms in Austria. We assume that WG farmers have above average management skills and are more efficient. The WG data presented below are median values for each cost item (not the costs as reported by the farm with the median income). Conversely, INCAP provides average costs *(mean)* for many standardised activities: A range of production activities, production conditions, management variants, technologies and work cycles is pre-defined in INCAP and costs are determined for each activity using a mix of observed and planning data (functions, expert assumptions). Accordingly, engineering data do not capture all events that occur in practice (e.g. changes in management, due to weather events or new legislation). For instance, when the payments for abandoning fungicides were discontinued in the agro-environmental programme, farmers resumed the use of fungicides. Such management changes would be captured in WG data (i.e. higher plant protection costs), but might be disregarded in INCAP.

3. Specifications and validation approach

The *WG data* were recorded on farms situated in Lower Austria, a region in the East of Austria characterised by a dry climate. Data were available for 4 conventionally produced crops: rapeseed (WG-R), winter wheat (WG-Ww), corn maize (WG-Mc), maize silage (WG-Ms); and for 5 variable cost items: seeds, mineral fertiliser, plant protection, own machinery, hired machinery. One part of this data set indicated the costs for all of Lower Austria by cost item and year (2010 to 2015). The other part reported costs for 11 (out of 21) districts of Lower Austria by cost item for a 5y-average (2010 to 2014).

The *INCAP activities* which corresponded best to the characteristics of the WG data were: winter rapeseed (INCAP-Rw), hybrid rapeseed (INCAP-Rh), winter wheat (INCAP-Ww), corn maize (INCAP-Mc), maize silage (INCAP-Ms), produced conventionally on a 2 ha plot in a dry area, with standard tillage, applying a medium level of plant protection, using hired labour for certain work steps.

INCAP and WG data were compared and analysed from two angles. Firstly, how do the data sets for Lower Austria deviate by cost item and year? This was done to identify systematic bias due to the cost level in the reference period or due to the indices applied to generate

time series. Secondly, how do the data sets for a 5y-average deviate by cost item and district? This was done to assess the effect of spatial variation. The identified deviations were explored by experts involved in WGs and developers of INCAP. Such a collaboration not only gives a better fit of simulated and observed results, but also makes it possible to account for the heterogeneity of production on farms within INCAP.

4. Results

Figure 1 shows by how much INCAP deviated from WG data by year in the whole territory of Lower Austria (%). In WG-R, the proportion of farmers cultivating winter rapeseed or hybrid rapeseed is not known; hence both INCAP rapeseed activities were looked at. It was found that the *costs of seeds* were consistently lower for INCAP-Rw (–41%) than for WG-R, unlike the seed costs of INCAP-Rh (+5%) which were very similar to WG-R throughout the observed period. In a 5y-average, the seed costs of wheat were lower (INCAP-Ww: –20%), those of maize were higher (INCAP-Mc: +10%, INCAP-Ms: +25%) than the WG reference. However, the difference between INCAP and WG data varied substantially by year in the wheat and maize activities. An explanation is that farmers make deliberate choices on specific crop cultivars that are best suited for their conditions whereas INCAP' seed cost capture an Austrian average. Altogether, seeds costs in INCAP were in some cases higher and in other cases lower than in the WG reference activity.

As for the *fertiliser costs,* all INCAP activities reported notably higher costs than the WG reference (INCAP-Rw: +31%, INCAP-Rh: +39%, INCAP-Ww: +40%, INCAP-Mc: +120%, INCAP-Ms: +367%) for the 5y-average. These deviations are owed to the fact that the WG data reports only mineral fertiliser applied to the crop and disregards the nutrient value of farmyard manure and slurry. INCAP assigns a monetary value to the nutrients absorbed by the crop. The difference was particularly high in the case of INCAP-Ms which is plausible because such farms have large amounts of slurry or manure at their disposal.

Compared to the WG reference activities, the *costs of plant protection products* were, in the 5y-average, similar for rapeseed (INCAP-Rw: –7%, INCAP-Rh: –7%), they were substantially lower for winter wheat (INCAP-Ww: –64%) and markedly higher for the maize activities (INCAP-Mc: +19%, INCAP-Ms: +21%) in INCAP. Bearing in mind that
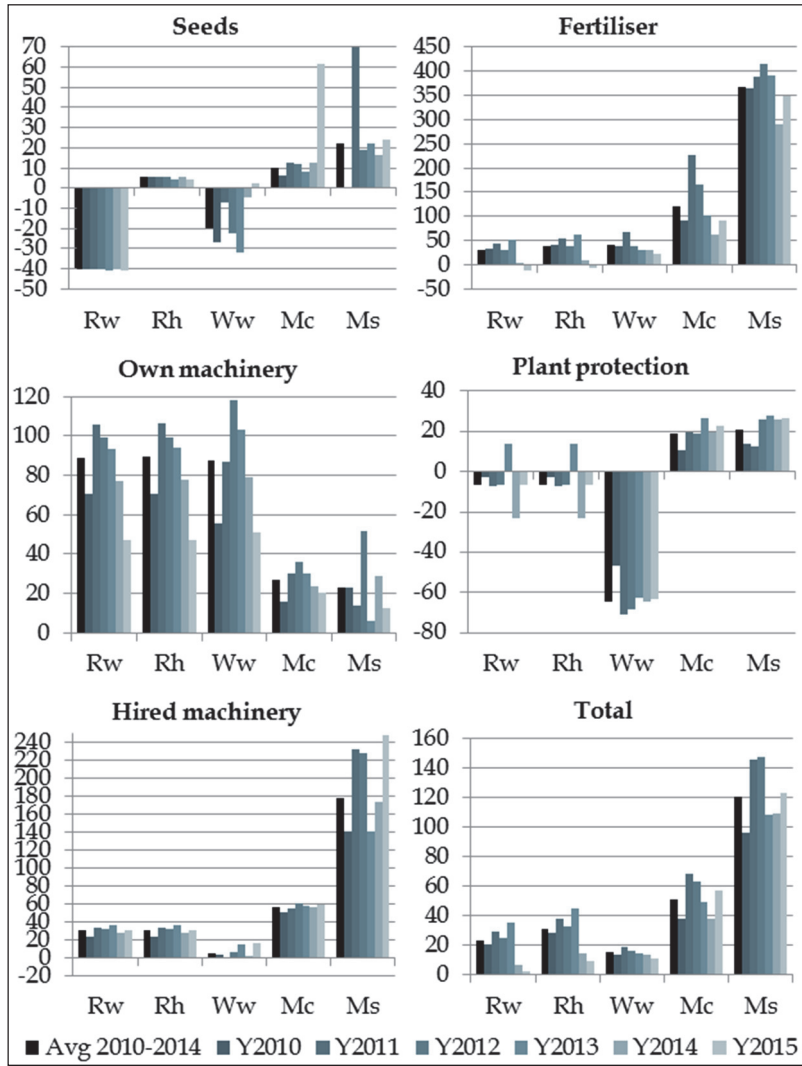
Figure 1. Deviation of INCAP data (means) from working group data for Lower Austria (medians) by year and for the 5y-average of 2010-2014 (%)
Crops: Rw = Rapeseed (winter), Rh = Rapeseed (hybrid), Ww = Wheat (winter), Mc = Maize (corn), Ms = Maize (silage).
Note: Scales differ markedly depending on the cost item.
Source: OWN FIGURE, 2016

the WG data reports on actual events, application rates (and thus costs) varied by year. In INCAP, plant protection measures are standardised for each activity, disregarding specific conditions of a given year.

Costs of own machinery included fuel, lubricants, maintenance and repairs in both INCAP and the WG data. Nevertheless INCAP costs were considerably higher for rapeseed (INCAP-Rw: +89%, INCAP-Rh: +89%) and wheat (INCAP-Ww: +87%) and somewhat higher for maize (INCAP-Mc: +27%, INCAP-Ms: +23%) compared to the 5y-averages of the WG reference activities. The assumptions on work cycles, specific types of machinery and depreciation in INCAP were *not* cross-checked with the WG data due to the diversity of farms in practice.
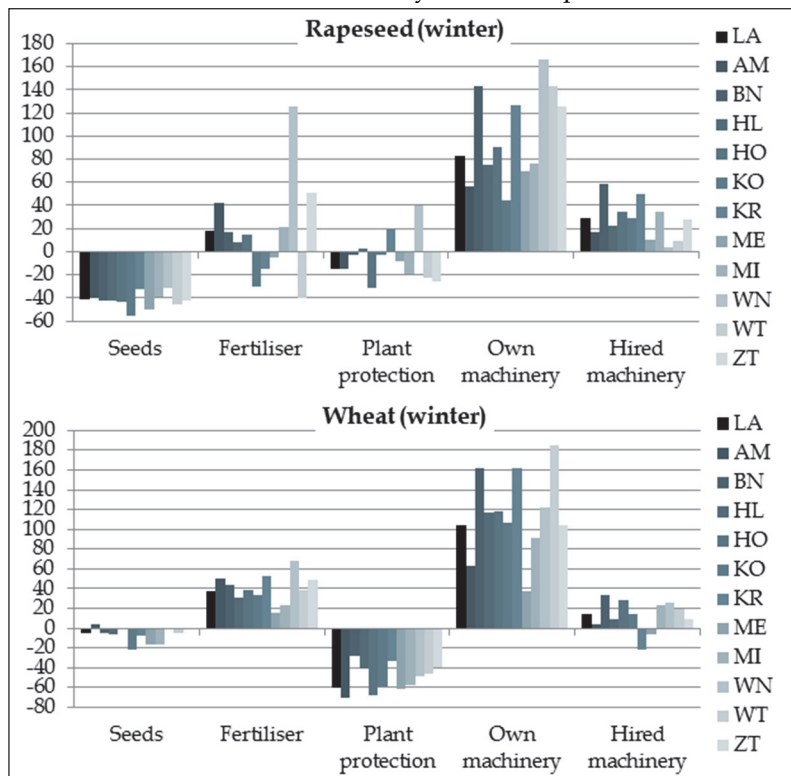

Figure 2. Deviation of INCAP data (means) from working group data for selected 11 districts in Lower Austria (medians), 5y-average 2010-2014 (%)
LA: all of Lower Austria; AM to ZT: selected 11 districts of Lower Austria
Source: Own figure, 2016

Costs of hired machinery included fuel, lubricants, repairs, maintenance as well as labour and a fixed-cost component (i.e. proportion of the purchasing costs of equipment) in both INCAP and the WG data. Both used cost data provided by machinery pools. In the 5y-average, there is a good fit for wheat (INCAP-Ws: +4%), an acceptable fit for rapeseed (INCAP-Rw: +31%, INCAP-Rh: +31%). The large deviation in maize (INCAP-Mc: +56%, INCAP-Ms: +178%) is mostly due to harvesting which is attributed to hired machinery in INCAP, but to own machinery in the WG data.

The aggregate of the cost items discussed above equals the deviation of *total variable costs* in INCAP compared to the WG data. In the 5y-average, wheat fitted the WG data better (INCAP-Ws: +15%) than rapeseed (INCAP-Rw: +23%, INCAP-Rh: +31%). A large deviation is apparent in maize (INCAP-Mc: +50%, INCAP-Ms: +120%). It is worth looking at the fit of the individual cost items rather than the total since the aggregate may balance out deviations of individual cost items, evoking the impression of a better fit than what actually is the case.

Figure 2 shows that the costs varied markedly by district. Costs of fertiliser and plant protection in the rapeseed activity, and thus the deviation from INCAP, were particularly heterogeneous. Lacking the information 10 districts, the results for the 11 selected districts might not accurately reflect the situation in all of Lower Austria.

5. Discussion and conclusions

5.1 Resume

INCAP is a comprehensive data set for agricultural production in Austria, providing cost data for most important plant and livestock production activities as a time series, differentiated by production characteristics and management variants. INCAP's primary purpose is its use in farm and sector models for Austria but it could also be used for many other tasks, such as activity-specific or farm-specific analyses. This is the first analysis comparing INCAP data with farm observations in an effort to validate the results. The analysis was facilitated by a collaboration of farmers, experts in extension services and researchers. Our findings show that the quality of data used in applied research can be significantly improved by combining the expertise of these groups.

5.2 Lessons learnt from the validation exercise

Only few data sets are currently available on activity-specific farm costing in Austria. Lacking enough farm observations, it is not possible to compare all facets of INCAP relating to the activities, production characteristics, management variants and their development over time. Also, other data sets may define activities, production characteristics, management variants or cost items differently than INCAP. In some cases, it will not be possible to correct for these and come up with values comparable with INCAP. For instance, work cycles and machinery used are heterogeneous in practice but INCAP applies standard work cycles carried out with standard machinery.

The results show a good fit with WG data with some cost items (e.g. INCAP-Rh: seeds, INCAP-Ww: hired machinery). The level of other cost items (e.g. INCAP-Rw: seeds, INCAP-Ww: plant protection) is systematically deviating at present. This is not surprising since INCAP and the WG data differ regarding underlying concepts (e.g. nutrient uptake vs. mineral fertiliser, work carried out by farmer or contractor). Adapting the concepts applied in INCAP to match the concepts as applied in the WG data should result in a better fit.

5.3 Next steps to improve INCAP

INCAP is subject to further development. INCAP will be revised continuously by updating the cost data to expand the time series, but also by adding further plant and livestock activities and possibly also production characteristics, management variants, cost items or, depending on the research question at hand, other areas of interest (e.g. kg of GHG emissions per unit produced). All of these advancements call for further validation and calibration.

At present, only data from one production region (Lower Austria) are used to validate INCAP data. Thus a necessary improvement is to collaborate with more WGs in order to extend the spatial scope and to cover additional activities. Once an acceptable correspondence between simulated and observed results is achieved, INCAP may be used for analysing a series of problem statements, including spatially explicit analyses (see HEINSCHINK et al., 2016a) or situations that are likely to occur as a consequence of climate change. In order to provide

tangible benefits, INCAP data will be published in an accessible format for farmers and experts in extension services for further use.

Acknowledgement

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