LANDTECHNIK 73(1), 2018, 10–19

DOI:10.15150/lt.2018.3177

LANDTECHNIK
AGRICULTURAL ENGINEERING

The role of e-commerce in the purchase of agricultural input materials

Simon Ackermann, Isabel Adams, Nicola Gindele, Reiner Doluschitz

In recent years classical trading outlets are being increasingly displaced by online-based distribution channels. This development is especially interesting in marketing of agricultural input materials because here, price rises and the EU-wide increasing proportion of required preliminary investment (~60% of final production value) stimulate the search for optimising measures along the entire value-added chain. Via a standardised online survey, quantitative answers from 303 farmers were collected. Subsequent statistical analyses of the responses produced the following results: Online purchasing of input materials is widespread across Germany. User structure proved to be independent of age, farm size and location and also of farm enterprise type. Determined as main motivation for purchase of input material via e-commerce channels are the savings in time offered, and not the cost savings given in the literature. Where there is a good supply of well-distributed agricultural trading outlets on the land, this represents an effective obstacle to e-commerce growth. These could provide a connecting point for online trading too, or allow the attachment of further marketing tools to be integrated with farm management systems.

Keywords
E-commerce, agriculture, agribusiness, input materials

Electronic commerce (e-commerce) includes “every type of business transaction [...], whereby those involved initiate and develop business, or conduct electronic trading, with goods and services using electronic channels” (Doluschitz 2002). Especially investigated in this presentation is the purchase of input materials because, in Germany, the proportion of preliminary investment in input materials within the agricultural sector lies at approx. 60% (2014) of final production value (Riester and Huber 2015), thus underlining the economic importance of such costs. Additionally, in recent years purchase prices of agricultural input materials have increased by around 50% (Riester and Huber 2015). For most farm businesses, fertiliser and feed represent the biggest costs in this respect. The prices for these inputs are especially interesting because they have risen markedly over the last years. Nowadays, almost 90% of farmers use the Internet regularly, not least because a large proportion of management tasks can be accomplished thereby (Kleffmann 2016). Because e-commerce offers a number of advantages in the purchasing of farm inputs from a business management aspect, trading of inputs via Internet is attractive, considering the background of higher purchase prices. Certainly, a substantial increase could be observed in this form of trading in recent years (Riester and Huber 2015).

The classical physical transaction location, i.e. market place, is increasingly displaced by online-based distribution channels. The first agricultural input materials were already offered online in the early 2000s (Doluschitz and Pape 2002). This paper aims to give a balance of market penetration so far, and to determine the demographic, structural and spatial expansion of e-commerce structures.

received 21 August 2017 | accepted 22 January 2018| published 28 February 2018

Also determined in this presentation are the preferred materials purchased online and the attributable reasons. This information helps identify market potential for electronic business development, especially with agricultural dealerships in mind.

Based on these aims, the investigation orients itself on the following research questions (FF):

- FF 1: How widespread is use of online trading platforms for the purchase of input materials amongst German farmers?
- FF 2: What is the user structure of persons exploiting e-commerce services for purchasing input materials?
- FF 3: Which main motivation is decisive for using e-commerce for purchasing materials and what is the main limitation?
- FF 4 Which products, or product groups, are increasingly in demand on online trading platforms? Which items experience a decrease in demand?

Method

A written quantitative online survey was conducted. This form of survey is practical for clarification of the presented aims, the Internet being methodological tool and communication channel as well as research object (Scholl 2015). However, one must remain aware of the limited representative nature of the responder group with regard to the statistical population in that non-users of Internet were not included from the start (Kuss 2012). A subsequent removal of those not using Internet was therefore not considered necessary. Thus, associated scientifically-based statements cannot be made. However, in that nowadays almost 90% of farmers use Internet (Kleffmann 2016), with complete coverage in this respect soon be assumed, the results of this research project can be regarded as an overview of the future conditions and the proportion of the statistical population not considered in the survey can be ignored.

In June 2016, 4,500 agricultural managers of educational farms and agricultural cooperatives in Germany were written to. Included in the evaluation are 303 completely answered question forms (response rate 6.7%). The response rate is relatively low in comparison with other surveys. However, the result is acceptable for an online survey, lying within the 6–73% range given in the literature (Tuten et al. 2002). In general, the response rate for online based surveys is lower than that for postal surveys (Batanic 2003). Mainly, the hesitant response to the survey presented here can be explained through its timing (June), it being sent out during agricultural peak labour periods. The participant sample was selected randomly; the farm e-mail addresses being collected from freely accessible online portals (educational farms and agricultural cooperatives in the cooperative register). Around 4,500 addresses were collected, to which were e-mailed the survey link. The collected data were statistically evaluated and aggregated.

Characteristics of the random sample

Table 1 offers a short overview of the random sample description.

Table 1: Random sample overview

Characteristic	Specification
Target groups, respondents	Farms, farmers, n = 303
Survey period, location, type	June 2016, Germany, online survey
Type of farming	85% conventional, 15% organic
Distribution Germany-wide	23.4% Bavaria 16.2% Baden-Württemberg 14.5% Hesse 11.9% North Rhine-Westphalia 34% further German federal states
Average age	47 years
Farm enterprises	49.2% livestock production 32% arable farming 6.9% specialty crops 6.3% biogas 5.6% other enterprises
Education level	2.3% farming course 37.3% master craftsman training 13.7% technical training 42.7% university study 4.0% others

Through the random sample selection (from online portals, cooperative register) the participants in the sample reflected mainly large size farms that lay over the federal average in area (2015: 59.6 ha farmland) (Deutscher Bauernverband 2016). 294 farmers gave their farmed area, the average figure being 606 ha. It may be assumed that lists of educational farms and agricultural cooperatives represent only to a limited extent the characteristics of the general farm structure. However, this was taken into account in the methodology. Perhaps for this reason, the division of full-time and part-time farms provided a majority of full-time units, which does not reflect the actual situation. Regarding the question of farm enterprises or the focal points of businesses, all 303 respondents answered. As main farm enterprise, 49.2% gave livestock production, 32% arable cropping, 6.9% specialty crops, particularly horticulture or permanent cropping, and 6.3% production of biogas. Around 6% of respondents reported, in a free answer field, that they managed a mixed farm system (crop and livestock production). The proportion of livestock production in the surveyed farms differs only minimally from the general German structure (50.2%) (Statistisches Bundesamt 2014), as does the proportion of farms focusing on arable production (28.3%) and on growing specialty crops (9.9%). Biogas producing farms are not considered separately in the statistics. The distribution of farm enterprises represents a good similarity to the German farm enterprise structure. The farming systems followed show a clear tendency towards conventionally farmed businesses with 85.0% (n = 256). In the random sample in this presentation 15% (n = 45) report that they farm organically, compared to the German average of 9% (Deutscher Bauernverband 2016) representing an above-average proportion. With 71 respondents (23.4%) from Bavaria, this is the most represented federal state, followed by Baden-Württemberg with 49 respondents (16.2%) and Hesse with 44 respondents (14.5%). Thus, distribution within the random sample in this respect indicates a similar tendency to the general situation. For instance, the high-

est number of farms (32.8%) is in Bavaria, followed by Baden-Württemberg with 14.8% of all farms (Deutscher Bauernverband 2016).

Respondents average 47 years of age with a span from 20 to 88 years old. Regarding age structure within the random sample, the following can be said: in the age category up to 30 years are 24 respondents (7.9%), from 31 to 40 years, 55 respondents (18.2%) and from 41 to 50 years, 94 respondents (31.1%), from 51 to 60 years, 113 respondents (37.4%) and in the group over 60 years of age are 16 respondents (5.3%). 2.3% of the responding farmers declare a training course in farming as the highest agricultural education received and 37.3% report absolving a master craftsman training. 13.7% report receiving training as technician and 42.7% completed a university course. 4.0% selected the term "other" as answer in this respect. From a demographical aspect, it can be said that the participants in this survey indicate an above-average level of education.

Results

Distribution of e-commerce

FF 1: How widespread is the use of online trading platforms amongst German farmers for purchasing input materials?

It appears that already 99% of the respondents (n = 300) use the Internet several times per week for business purposes. 76.6% use an Internet-capable mobile apparatus in this respect. The Internet is most used for accessing information and for communication. This agrees with findings in previous investigations (Doluschitz and Pape 2000a, Doluschitz and Pape 2000b, Stricker et al. 2001, Vennemann and Theuvsen 2004). The data show that frequent interaction with Internet can be assumed and, with that, the basic conditions for use of online trading platforms are given.

Through application of a six-level Likert scale (1 = never; 2 = seldom; 3 = now and again; 4 = often; 5 = very often; 6 = always), mean values were calculated for different sources of supply (Figure 1). The greater the mean value, the more often the appropriate source is used. Main source for input materials remained agricultural cooperatives (mean value = 3.17) and the classical private dealerships (mean value = 2.97). Following these outlets, the Internet now represents the second most important supply source of input materials (mean value = 2.15) and is presented in Figure 1 as intermediary source form. The purchase of input materials via catalogue and post (mean value 1.82) or via travelling sales representative (mean value = 1.8) tended to occur to a lesser extent. Altogether, 87.1% (n = 264) of respondents indicated knowledge over online trading, almost three-quarters of all responding farmers already having purchased input materials online (72.9%, n = 221). From this can be concluded that the expansion of e-commerce for purchase of input materials is certainly widespread.

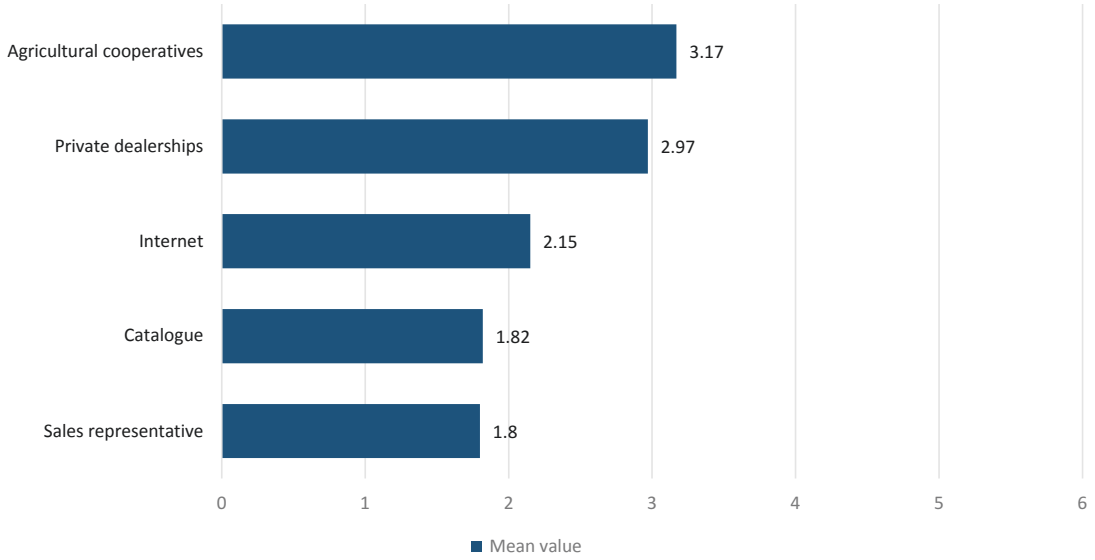

Figure 1: Average frequency of use of various supply sources (n = Ø 281)

Demographic and structural differences

FF 2: What is the user structure of persons exploiting e-commerce services for purchasing input materials?

No significant correlation can be determined between age of respondent and frequency of online purchase of input materials. Accordingly, the use of e-commerce is homogeneously distributed through all age classes. It is notable that general age distribution within the random sample tends towards older respondents over 40 years of age, thus emphatically demonstrating online trading platforms are also accessible to the farmers of the "digital immigrant" generation.

Applying the Kruskal Wallis Test confirms limited differences regarding frequency of use between the education levels. There exists a weak correlation (correlation coefficient r = 0.3) between level of education and use of e-commerce. Post hoc, the Bonferroni Test indicates that, with higher educational status, there occurs more e-commerce activity. The situation determined over the total population (Statista 2016) can therefore be applied to the farmers within the random sample.

Regarding farm size, there lies no significant correlation between the size classes established. With regard to the different sizes of farms within Germany, it may be assumed that there is no difference in this respect between farms in the former East Germany and those in former West Germany. This is confirmed by the results of an appropriate investigation between the individual federal states. According to Doluschitz and Pape (2000a, 2000b) there was still a difference at the beginning of the millennium concerning Internet use in the former East Germany. This was more widespread at that time. If this situation is applied to the use of e-commerce, then the inner German relationships in this respect over the last years have aligned. On large farms, the use of e-commerce structures is just as widespread as on smaller ones. Based on the random sample, the user structure regarding online based purchasing of farm input materials is therefore shown as non-dependent on age, farm size or farm locality.

Table 2: Correlation of characteristics in online purchase of input materials

Characteristic	Correlation coefficient (Kendall τ_b)	
Education	0.2	→ the higher the education level, the more often input materials are sourced online
Age	0.081	→ Online sourcing is not age related
Farm size	0.022	→ Online sourcing is not related to farm size
Location	0.06	→ Online sourcing is not related to location

Main motivation and limitation

FF 3: Which main motivation is decisive for using e-commerce for purchasing materials and what is the main limitation?

The survey results indicate that the inherent time-saving advantage in purchasing input materials via e-commerce is main motivation. This contradicts the results of other research whereby the main advantage is given as cost savings (Clasen 2005). Decisive acceptance barrier to use of e-commerce structures is existence of a good regional supply system through local rural dealerships. This allows the conclusion that physical markets can definitely compete with e-commerce. Clasen (2005) arrives at similar conclusions. The survey helped establish that the responding farmers certainly judge the time factor as most important in input material purchase, the cost factor as less important. Statistically it could be shown: the more important the time factor is in purchase of input materials for a respondent, the more often e-commerce structures are used. The farmers for whom the time advantage is most important buy more online compared with those for whom the cost advantage is of greater importance.

Demand according to products

FF 4: Which products, or product groups, are increasingly in demand on online trading platforms? Which items experience a decrease in demand?

Online demand is heterogenic for different input materials (Figure 2). Above all, spare parts, closely followed by lubricants and workshop requirements as well as livestock barn requirements, are most often sourced online. Fuel and lubricants, as well as spare parts, are already in great demand, according to other authors (Clasen 2005, Stricker et al. 2001). Fertilisers, plant protection materials, feed, seed, heating oil and fuel are, on the other hand, considerably less in demand (Figure 2).

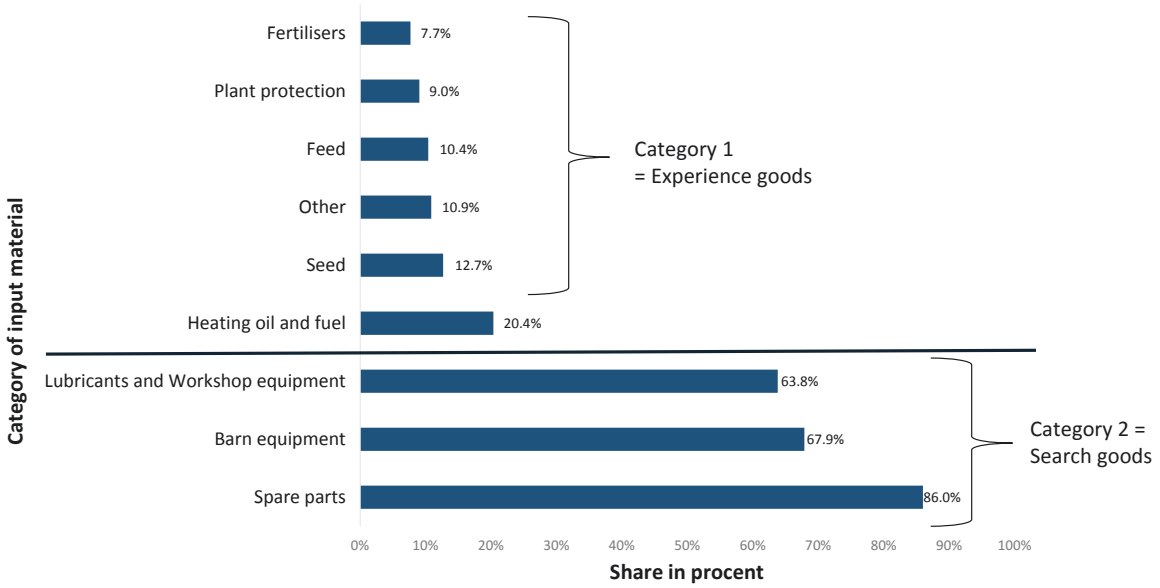

Figure 2: Percentage distribution of online purchased farm input material categories, separation into experience or trust-bought goods and search goods; multiple answers possible (n = Ø 221)

In the process of further evaluation, two categories of input materials are considered. The first category involves goods such as feed, plant protection materials, seed and fertiliser. In some respects, this group of goods is characteristic of typical experience goods. Experience goods are those with characteristics that are more often first known following their use. By these, not only the price is decisive, but also factors such as quality characteristics, certificates of quality, guarantees and trust in the supplier (Koester 2010). Moreover, these are, for instance, verifiable through brand attributes. Further reasons why such groups of goods are less often purchased online might, on the one hand, be that they occupy a higher, although plannable, cost position by which personal advice and trust are especially important for the farmers involved, and because of which they purchase through local (and known) agricultural dealerships. On the other hand, such positions have a repeating character through the years with, for instance, purchase plannable via delivery contracts. Additionally, the goods of the first category are sent less often via parcel service compared with the second category goods because of their higher volume, but instead tend to be delivered by freight contractor. To save transport costs, farmers can sometimes collect fertiliser, plant protection material, feed and seed personally from the local agricultural dealership, a measure which strengthens the dealership position and increases direct contact to farmer.

In the second category are goods such as spare parts, lubricants and requirements for workshop or livestock barn. In their characteristics, such goods represent typical search goods (Koester 2010). By search goods are meant goods for which information over quality can be collected via an information search before purchase. The digitization suitability of the first category is substantially more complex than that of the second category through the limited verifiability of the former.

The degree of brand recognition differs for online sourcing of both the categories of input materials. Farmers mainly use online purchase for input material of the second category (search goods). The higher demand for plant protection material in e-commerce might well come through the suitability for online trading in this case in that product characteristics are completely transferrable and brand characteristics play a role here. Almost half the respondents (46.2%) that stated they had, up until

then, no experience with e-commerce, indicated a desire to involve themselves with the theme in the future.

Discussion

From the methodology aspect, the procedure for data collection can be evaluated as expedient and target-oriented in that only relevant farmers are involved, namely those that already do business online. While the extent of Internet use by farmers has substantially increased in recent years, what has not increased is the basic direction of Internet use which mainly lies with information collection and communication. However, the results show that some farm business processes are already digitized and stored in the Internet. Compared with the usage detailed in the literature, e-commerce activities appear to have possibly tripled (Stricker et al. 2001), which can be traced back to a generally higher Internet use and increased use of mobile terminal devices.

Above all in the planning and introductory phases of e-commerce within a business, there arise high costs and a large personnel input which is probably why it is some time before there is a resultant positive cashflow, or before returns actually cover costs. Over longer periods, there exists the danger that new trends and technologies are introduced and overtake existing forms of e-commerce. This aspect, as well as the limited e-commerce experience of agricultural dealerships, continues to inhibit the entry of many companies into Internet trading. According to Voss and Spiller (2008), the importance for agricultural dealerships will increase through the ongoing change in customer structures. After all, the structural alterations within German agriculture result in fewer, although therefore larger, farm businesses, the input purchase volumes of which, however, remain about the same in total. This situation creates key account structures, with respective management requirements. Alongside this, however, the "economically uninteresting segment (part-time farmers or smaller structured farms)" have to be served as well (Voss and Spiller 2008). Here, the strengths of e-commerce can pay off: strengths such as low transaction costs and scale effects for the supplier. Möller (2016) also established that online trading is now gaining in importance, this being demonstrated by, among other things, the expansion of online shops by two large German agricultural dealership companies. Joining-in here are also a number of start-ups, appearing recently in the area of agricultural e-commerce.

Conclusions

Within the framework of advancing digitization in agriculture, e-commerce could also be involved in a network of digitized and automated farming processes. Modern information and communication technologies offer comprehensive solutions for complete data management upon which can be built efficiency increases. Hereby, networking can take place horizontally (on a value-added level, various competitors), and vertically (over and above different value-added stages). Such an approach can be used to guarantee complete traceability of agricultural products, plus all information over possible transactions stored via digital data transfer.

E-commerce may also be able to close the gap, through information technology, between upstream service industries, or the agricultural dealership and farmers. Data on completed purchases can be directly processed electronically and transmitted into the system. Additionally, the development, as in industry, proceeds in a way that allows a comprehensive farm management system to record input materials or their on-farm application. Based on the collected data, a further step might be to incorporate an automatic re-ordering procedure as soon as stored goods fall below a predetermined level.

This procedure is, in fact, already being applied by some suppliers. For the farmer, this could offer time savings, suppliers and producers could calculate so that logistic development could be further optimised.

A certain potential exists for products that momentarily still experience only limited online demand. For instance, transport costs for large online orders of fertiliser must not cancel out e-commerce cost advantages. In general, there are high demands on logistic systems which nowadays are difficult to meet. Additionally, there are also the legal requirements to comply with, such as the required proof of technical knowledge about plant protection and application of the respective substances for which clear regulations are involved as part of the supply of plant protection materials. That the legal requirements are followed must also be assured electronically just as it is, for example, in the purchase of rifle ammunition by hunters.

With search goods, online purchase is already more widely used than with experience goods. Thus, we can conclude that for fully exploiting the potential of e-commerce the product group of experience goods should be further integrated with addition of online sales channels. In order to create targeted e-commerce structures in the category of experience goods, online advisory service could be established as well as further marketing tools, for instance in integration with farm management systems. The changes in agricultural structures could be catered for with the help of e-commerce, whereby key customers could tend to be serviced via the physically-present businesses, and less profitable trading such as with part-time farms and smallholdings, via resource efficient online business (Voss and Spiller 2008). On top of this, it is important to deal with the logistical challenges in order to allow the customers the advantages of the time saving aspect of online purchase.

Biggest limitation to e-commerce development can be seen as competition from the physical trading outlets already established on the land. Main advantage of these is the trust aspect. Building on this foundation, established agriculture dealerships could react with a multi-channel strategy. This could give a choice of different marketing channels, e.g. online and physical. In this way, risk-averse farmers might be encouraged towards e-commerce (Doluschitz et al. 2004).

References

Batinic, B. (2003): Internetbasierte Befragungsverfahren. Österreichische Zeitschrift für Soziologie, 28(4), S. 6-18

Clasen, M. (2005): Erfolgsfaktoren digitaler Marktplätze in der Agrar- und Ernährungsindustrie. Dissertation, Universität Kiel, S. 42ff

Deutscher Bauernverband (2016): Situationsbericht 2016/17. Trends und Fakten zur Landwirtschaft. Berlin

Doluschitz, R. (2002): Electronic Business in der Agrar- und Ernährungswirtschaft - Ernüchterung und Konsolidierung lösen die anfängliche Euphorie ab. Agrarwirtschaft 51(2), S. 97–98

Doluschitz, R.; Emmel, M .; Kaiser, F.; Pape, J.; Roth, M. (2004): E-Business in der Agrar- und Ernährungswirtschaft. Bergen/Dumme, Agrimedia, S. 23

Doluschitz, R.; Pape, J. (2000a): E-Business in der Agrarwirtschaft zwischen Euphorie und Resignation. Teil 1: Thematische Einführung und Befragung von Landwirten aus Baden-Württemberg. Stuttgart, Universität Hohenheim, S. 20ff

Doluschitz, R.; Pape, J. (2000b): Erfolgspotentiale für e-Commerce im Agrargewerbe. Befragung von Landwirten in Mecklenburg-Vorpommern und Sachsen. Stuttgart, Universität Hohenheim, S. 8ff

Doluschitz, R.; Pape, J. (2002): E-Business in der Agrarwirtschaft zwischen Euphorie und Resignation. Zeitschrift für Agrarinformatik 10(1), S. 1–8

Kleffmann (2016): New Media Tracker 2016. https://www.kleffmann.com/de/kleffmann-group/news–presse/pressemitteilungen/03012017_new_media_tracker, accessed on 14 Aug 2017

Koester (2010): Grundzüge der landwirtschaftlichen Marktlehre. München, Verlag Franz Vahlen, S. 19

Kuß, A. (2012): Marktforschung. Grundlagen der Datenerhebung und Datenanalyse. Wiesbaden, Springer Gabler, S. 128

Möller, R. (2016): Winken „online“ neue Chancen? DLG Mitteilungen (9), S. 28–30

Statista (2016): Internetnutzer - Anteil nach Bildungshintergrund in Deutschland 2016 | Statistik. https://de.statista.com/statistik/daten/studie/3622/umfrage/internetnutzung-nach-bildungshintergrund/, accessed on 22 Nov 2016

Riester, R.; Huber, J. (2015): Betriebsmittel. Agrarmärkte Jahresheft 2015 11, S. 307–318

Scholl, A. (2015): Die Befragung. Konstanz, UVK-Verl.-Ges., S. 53

Statistisches Bundesamt (2014): Land- und Forstwirtschaft, Fischerei. Betriebswirtschaftliche Ausrichtung und Standardoutput-Agrarstrukturerhebung-Fachserie 3, 3.1.4-2013. Wiesbaden, S. 38

Stricker, S.; Sundermeier, H.-H.; Müller, R. A. E. (2001): Landwirte im Internet: Stand der Nutzung und Verwendungsabsichten. In: Hans Kögl (Hg.): Referate der 22. GIL-Jahrestagung in Rostock 2001. Bonn, S. 138–142

Tuten, T. L.; Urban, D. J.; Bosnjak, M. (2002): Internet surveys and data quality: A review. Online social sciences 1, pp. 7-26

Vennemann, H.; Theuvsen, L. (2004): Landwirte im Internet: Erwartungen und Nutzungsverhalten. In: Gerhard Schiefer, Peter Wagner, Marlies Morgenstern und Ursula Rickert (Hg.): Integration und Datensicherheit - Anforderungen, Konflikte und Perspektiven. Referate der 25. GIL Jahrestagung, 8.–10. September 2004, Bonn, Ges. für Informatik (GI-Edition Proceedings, 49), S. 241–244

Voss, J.; Spiller, A. (2008): Die Wahl des richtigen Vertriebswegs in den Vorleistungsindustrien der Landwirtschaft: konzeptionelle Überlegungen und empirische Ergebnisse. Diskussionspapiere//Department für Agrarökonomie und Rurale Entwicklung (0804), S. 20

Authors

M. Sc. Simon Ackermann is graduate of the University of Hohenheim, **M. Sc. Isabel Adams** and **Dr. Nicola Gindele** are members of the scientific staff, **Prof. Dr sc. agr. Reiner Doluschitz** is managing director of the Institute of Farm Management, manager of the Department for Computer Applications and Business Management and manager of the Research Center of Cooperatives at the University of Hohenheim, Schwerzstraße 46, 70593 Stuttgart, E-Mail: isabel.adams@uni-hohenheim.de.