

SITUATION OF AGRICULTURAL INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) IN GERMANY

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The state of adoption and diffusion of information and communication technology in German agriculture is described using results from three independent questionnaire surveys, conducted in 2000/2001. The use of information technology is widely spread among German farmers, the majority of farms have a PC, use it to connect to the Internet and are frequent e-mail and web users. Even though many farmers have bought products for their private use online, there are still many obstacles hindering the use of e-commerce applications to buy and sell products for business purposes. E-commerce shares in farms' annual turnover are small. Open questions concerning the security of data and contracts on the Internet lead to reluctant participation in e-commerce. The vast majority uses the Internet to access information and the majority thinks the quality of this information is better than that received through traditional media channels.

1. Motivation of Research

The time when the Internet and e-commerce will belong to a farmers' everyday life will come for sure. But where do we stand today? How many farmers do currently use computers and the Internet and for which purposes? In what characteristics do early and late adopters of new information technology differ? Does adoption depend on the farm's enterprise mix? These and other questions concerning the diffusion and use of the Internet in the agricultural sector were the motivation for conducting several surveys among German farmers¹.

2. Survey methods

Three surveys were independently conducted among these farms to shed light on the situation of information and communication technology in German agriculture. All surveys were carried out with questionnaires that were either mailed to the potential respondents or brought to them as an enclosure in a regional agricultural newspaper (see table 1). Usually one can learn more about an innovation from its early adopters than from laggards. Each survey was therefore focused on large farms that are more likely to already have adopted new information and communication technology and which are more likely to be viable for the next few years.

¹ Two were conducted by the Department of Applied Agricultural Informatics and Management at the University of Hohenheim and one by the Department of Agricultural Economics at the University of Kiel, with support from a Kiel-based agricultural bookkeeping association, DATEV e.G., Agrar-Daten GmbH, Kiel, and farmpartner.com.

Where possible our results are interpreted before the backdrop of other surveys that were concerned with IT-adoption and diffusion in all of Germany. Specifically two studies are taken for comparison:

- (1) „Die ARD/ ZDF- Online Studie 2000: [Eimeren and Gerhard, 2000] and
- (2) „GfK Online- Monitor, 7th round” [GfK, 2001]

The respondents of the ARD/ZDF study were randomly sampled from all German online-users from the age of 14 years and up. GfK drew its sample from all Germans from 14 to 69 years of age living in a household with telephone connection. In contrast to the surveys of ARD/ZDF and GfK, our samples are not representative to a known population of potential IT-adopters.

One survey was conducted among 1189 farms in the state of Baden-Wuerttemberg and distinguished by their qualification to train agricultural apprentices. Of these, 483 (40.6%) returned usable questionnaires [Doluschitz and Pape, 2000a]. The second survey covered 5.707 farmers in Mecklenburg-Vorpommern and 10.419 in Sachsen. Questionnaires were circulated as enclosures to regional agricultural newspapers. The response rate was low (1.4%), only 228 analyzable answers were obtained [Doluschitz and Pape, 2000b]. The third survey covered 1.912 farmers from the northern states Schleswig-Holstein, Mecklenburg-Vorpommern and Lower Saxony and it yielded 888 (46.4%) usable responses. Additionally, 243 visitors of the biannual fair „Eurotier”, held at Hannover in November 2000, answered a shortened questionnaire. Thus 1.131 analyzable answers were obtained in total [Stricker, et al., 2001]. Table 1 gives an overview over the basic survey characteristics. For convenience we refer to the surveys as “BW”, “MVS” and “NG”, respectively (see table 1).

Table 1: Basic survey characteristics

	Baden- Wuerttemberg (BW)	Mecklenburg- Vorpommern and Sachsen (MVS)	Northern Germany (NG)	GfK	ARD/ZDF
Time	May – July 2000	July – Oct. 2000	Nov. 2000 – Feb. 2001	Dec. 2000 - Jan 2001	March - April 2000
Region surveyed	Baden- Wuerttemberg	Mecklenburg- Vorpommern and Sachsen	Schleswig- Holstein, Mecklenburg- Vorpommern and Lower Saxony	Germany	Germany
Number of responses	483	228	1.131	1.005	8.021
Method	Mail survey, standardized questionnaires	standardized questionnaires, as enclosure in regional agricultural newspapers	Mail survey, standardized questionnaires	Computer assisted telephone interview	Computer assisted telephone interview

Due to our methods we assume that farmers with higher interests in new information technology were more likely to answer and return our questionnaires and therefore their share

in respondents is likely to be high. The part of the third survey conducted on the fair “Eurotier” was conducted in a hall with agricultural computer software, web portals, research, education and training again leading to an overrepresentation of farmers interested in ICT.

3. Characteristics of the Respondents and their Farms

3.1 Respondents

The age distribution of the respondents is similar between the Baden-Wuerttemberg and northern Germany surveys, while the respondents from Mecklenburg-Vorpommern and Sachsen are older on average. The vast majority of the respondents, 71% in BW, 63% in MVA and 72.7% in NG, is between 30 and 50 years old. In the BW and NG surveys about one out of five (18%) respondents was over 50 years of age and roughly 10% are younger than 30 years. In MVS more than every fourth respondent (26%) is over 50 years old and 8% are younger than 30 years. The share of those not using a computer or the Internet rises with age in all three surveys.

In BW every fourth respondent has absolved at least basic agricultural job training. 70% were agricultural technicians and 25% held an academic degree (college of higher education or university). In MVS the majority of respondents (46.5%) had an university degree and 7.5% had a PhD-degree. More than a fifth (22%) of the MVS-respondents had a degree from a college of higher education, 13% are agricultural technicians and the rest has an agricultural or other vocational training. In northern Germany, the majority of respondents (32%) are agricultural technicians, 24% have an academic degree, and 31.3% had no professional training beyond basic agricultural job training.

A recent dissertation at the University of Kiel delivered proof for self selection in a survey conducted among agribusiness enterprises. Those firms with higher interest in information technology were more likely to return an answered questionnaire. We believe this to be true for our surveys as well [Jessen, 2003].

3.2 Farm characteristics

Almost three out of four farms (74.3%) surveyed in Baden-Wuerttemberg grow crops on their farmland. A little more than half (51.4%) keep cattle, almost a third (32.5%) keep pigs, very few (8.3%) keep poultry. In addition, 17% of the farms surveyed plant specialized crops. In contrary to the results from northern Germany, there were no differences in computer and Internet use across farm types.

More than four out of five MVS-farms (83%) grow crops on their farmland. A little more than half (52%) keep cattle, only a tenth (10%) keep pigs, very few (5%) keep poultry. In addition, 4% of the farms surveyed plant specialized crops. In comparison to the farms surveyed in Baden-Wuerttemberg, the share of crop producers is higher and those raising or fattening pigs and the share of farms growing specialized crops is smaller.

Almost all (92%) of the NG-farms were run by full-time farmers, 14% of which market their products directly to the consumer. On average, 2.3 people, of which 1.7 were family workers, work at the farms surveyed. The average farms' arable land was 146 ha, of which 113 ha were agricultural crop land. Those farms specialized in plant production on average have 243 ha of acreage of which 224 are agricultural crop land. Compared to all full-time farms in northern Germany, which have 52 ha of arable land on average, the farms in the NG-sample are rather large because of our sampling method.

4. Computer Access and Use

Computers are widely used on farms in Germany. Most of the farms surveyed own a computer 90% in BW, 95% in MVS, and 85% in NG. Many farms 42% in BW, 53.7% in MVS and 41% in NG own their computers for six to ten years (see figure 1), while only 10%

of the MVS-farms surveyed, compared to 17.5% in BW and in 22% NG, own their computers for more than ten years. This has two reasons: first, there were desparately few computers in the dilapidated former German Democratic Republic, to which Mecklenburg-Vorpommern and Sachsen belonged, and second, the boost to PC-diffusion by the Internet had not occured until 1995 when the Internet became accessible to the general public.

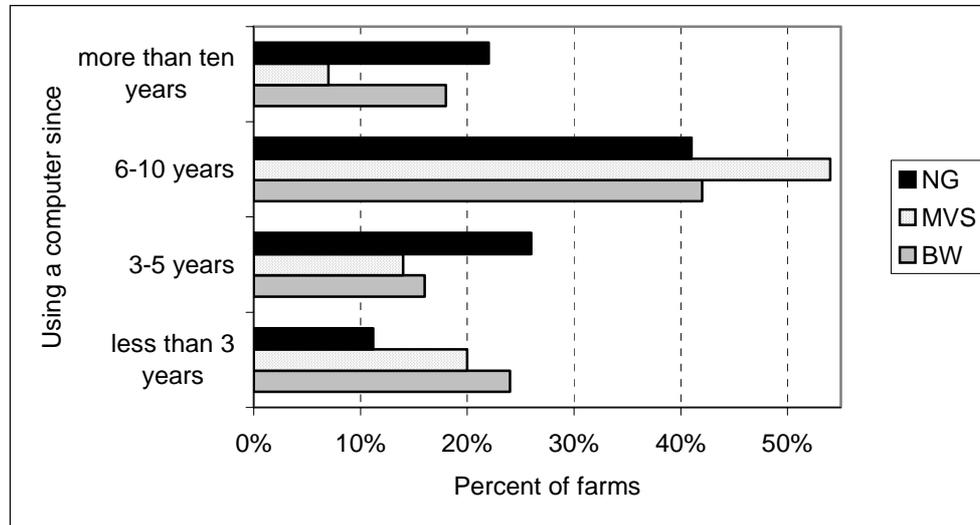


Figure 1: Years since farms own a personal computer for each individual survey

The majority of farms not owning a computer, 90% in Baden-Wuerttemberg and 70% in Mecklenburg-Vorpommern and Sachsen, indicated that they plan to purchase one, more than half of them within the year the survey was conducted.

The most widely used farm software is crop-planning programs in Baden-Wuerttemberg and bookkeeping software in northern Germany and Mecklenburg-Vorpommern and Sachsen. Figure 2 shows the different shares of farms in each region using software for typical agricultural applications. Obviously, farms in eastern Germany (MVS) are ahead of the others in adopting computer software for managing crop and livestock production. Pig management software however, is more widely used in BW than in MVS. This is due to the few farms (10%) in MVS that keep pigs in comparison to 33% in BW. Also noticeable are the small shares of northern Germany farms using crop and cattle management software (see figure 2).

The use of the specialized software depends on the production branches of the farms. On average 13.3% of the farms surveyed in northern Germany use a crop-planning program, while 30% of those farms specialized in plant production use this kind of software on their computers. The same is found with cattle and pig management programs, while 9.4% of all northern Germany based farms use a computer program to manage their cattle, 26% of the farms specialized in beef or milk production use cattle management software. Even every third farm specialized in pig breeding and pig fattening use a computer program to manage their pigs as opposed to only 10.5% overall.

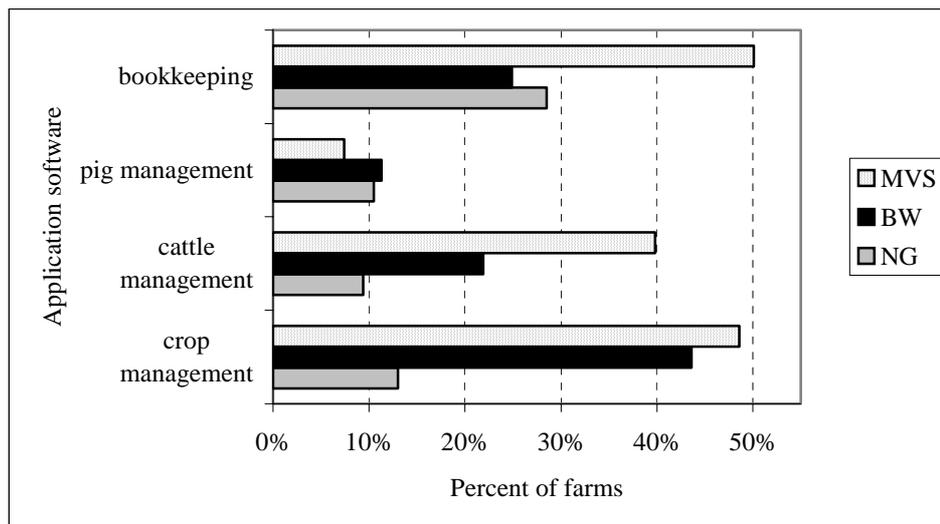


Figure 2: Software used by the farms surveyed

5. Internet access

The ARD/ZDF study from 1999 predicted one third of the German population to be online by the year 2001. Then in spring 2000 they found that already 29% of the German population were able to access the Internet. Thus the number of Internet-users has tripled from the year 1997 to the year 2000 [Eimeren and Gerhard, 2000]. The GfK study reports even higher figures: they report that 61% of the German population are able to access the Internet at the beginning of the year 2001, a rise of 10% from the year 2000.

Our results find that more than two out of three farms surveyed (63.8% in BW; 83.3% in MVS; and 69.3% in NG) have access to the Internet, confirming the GfK figure. The majority of connections, 75% each in BW and MVS, and 54.9% in NG were established within the preceding two years of the surveys. GfK found that 70.5% of the Germany Internetconnections were established within the 2 years prior to their survey. The vast majority of farms without a connection to the Internet plan to establish one in future 80% each in BW and MVS; and 88% in NG, most within a year. Our data showed that about 90% of the farms surveyed in all three regions will have established a connection to the Internet by the end of the year 2001. Therefore we have reason to believe that by now most or all commercially viable farms in Germany are online.

To access the Internet most farms, 77.6% in BW, 79% in MVS; and 67% in NG, use an ISDN connection and less than a third use a modem (22% in BW; 20% in MVS; and 32% in NG). The farms surveyed in northern Germany were also asked about their satisfaction with the usability, costs and speed of their Internet connections. Most indicated to be satisfied with the technology and only 4% said they were not satisfied. Only a minority of farms find the costs of Internet access too high (17%) and access speed too slow (23%).

6. Internet Use

Many studies have shown that the web and email are the most popular applications on the Internet, and farmers make no exception: they use web and email more often than any other Internet application. Sending and receiving Email is the dominant form of communicating: 91.3% of the NG-farms, 82% of the BW-farms and 73.3% of the MVS-farms use email. ARD/ZDF find that 82% of the German population with access to the Internet use email at least once a week. Looking at the frequency the surveyed farms use email again

shows the MVS farms are frequent users compared to the other farms surveyed. Many farms (15.6% in BW; 28.6% in MVS; and 22% in NG) use email every day, the majority uses it on a weekly basis (50.8% in BW; 30.4% in MVS; and 43% in NG) and between 14.3% (MVS) and 30% (NG) use it now and then, with BW taking an intermediate position (23%).

The three surveys differed in asking about the farms' uses of Internet applications. Table 2 gives an overview over the applications used and the frequencies of their use by farms in northern Germany

Table 2: Use of Internet applications in northern Germany

	n	Total users** (%)	Every day* (%)	2-3 times a week*	Once a week*	Now and then* (%)	Never (%)
E-mail	688	91.3	21.8	26.6	15.9	35.7	8.7
WWW	671	96.9	24.3	42.3	19.7	13.7	3.1
Online-banking	680	76.9	12.0	40.7	38.8	8.4	23.1
Weather-forecasts	665	78.9	9.1	19.2	15.2	56.4	21.1
Price information	670	86.9	3.8	18.0	20.8	57.4	13.1
Access other ag-information	681	93.0	3.5	15.5	23.1	58.0	7.0
Decision support information	643	67.5	2.8	8.5	11.1	77.6	32.5
Chat / discussion	653	30.0	10.7	13.8	15.3	60.2	7.0%
Buy resources	654	28.0	1.6	2.7	7.1	88.5	72.0
Sell products	651	19.2	5.6	3.2	4.0	87.2	80.8

* share of total users

**use the application now and then or more often

The subscription of e-mail newsletters is not very popular among farms in northern Germany. The majority has neither subscribed to a free (54%) newsletters nor to ones they have to pay for (94%). About 29% have subscribed to either one or two free newsletters, 5% subscribed to a newsletter they are charged for. The willingness to pay for this medium is obviously low.

Almost every sixth NG-farm (15.5%) and MVS-farm (15.6%) has its own website, while only 13% of the farms in Baden-Wuerttemberg use the web to present themselves. Due to self-selection among respondents, these percentages are likely to be higher than among all farms in the regions surveyed. The results in northern Germany indicate that farms that market their products directly are more likely to operate a website.

In BW and MVS the majority of farms surveyed (57,3% in BW and 68.1% in MVS) think the quality of the information provided on the Internet is better than that provided through traditional media channels. Over a third (35.3%) in BW and 23.8% in MVS think the quality of information from the Internet is just as good as information obtained through traditional media and only 3.3% in BW and 3.8% in MVS think it is worse.

7. E-Commerce use and perspectives

E-commerce is the use of the web for buying and selling products, services and rights over the Internet. The NG-farms were asked if they had bought products or services online for a) their businesses and b) for their private use. While only 22% of the NG-farms have bought products online for their businesses, 46.3% had bought online for private purposes. These figures are lower than those found by the GfK, where already over half (56%) of all German

Internet-users have bought products or services on the Internet in the year 2000. We assume that the smaller share of farms buying online in comparison to the share of the total German population buying online results from the differing age structure of the farms Internet users. Most of the farm managers (72.7%) surveyed were between 30 and 50 years old, only 9% were 29 or younger, while only 56% of all German Internet users are between 30 and 50 years old, 21% are 29 or younger.

Products for business-use bought online by the NG-farmers surveyed were products for general business use (62%), computer software (32%), general services (25%), computer hardware, agricultural equipment and others (each 23%). Products bought most often by the German population are books, software, CDs, tickets and presents. Nearly half (46.3%) of the farms with Internet-access in northern Germany have bought products online for their private use at least once, the majority (83%) of those who have bought online for their private use, have repeated their purchases.

The northern Germany farms were also asked about the product and services they would be willing to buy and sell online in future. Due to the heterogeneity of input products and their impact on product quality we assumed that there are immense differences in the willingness to buy input products online. Our assumption was clearly verified by the farms surveyed. The majority (81%) would never buy young cattle and piglets online. A majority of farms (41.9%) stated that they would regularly buy fuel and lubricants online. More than every third farm surveyed would buy pesticides (40%), replacement parts for agricultural machinery (37%) and energy (34%) online on a regular basis.

Farmers were also asked which products they would sell online. The answers in table 3 are sorted by rising shares of farms that would never sell a particular product online.

Table 3: Willingness to sell online by product groups

	n	Regularly (%)	Exceptionally (%)	Never (%)
Grain (1)	496	26.6	46.2	27.2
Rapeseed (1)	435	26.4	42.8	30.8
Cattle (2)	340	29.8	19.9	50.4
Pigs (3)	153	20.9	28.3	50.9
Machinery services	435	16.8	32.0	51.3
Fruit (4)	54	20.4	25.9	53.7
Poultry (4)	52	9.6	30.8	59.6
Potatoes (1)	241	13.3	22.8	63.9
Specialized crops (1)	226	15.5	20.4	64.2
Eggs, Milk, direct marketing products	331	13.0	16.9	70.1

(1) only farms with plant production

(2) only farms with milk- or beefproduction

(3) only farms with pigs

(4) only farms with „other” branches of production

For each product category, with exception of grain and rapeseed, most NG-farms are not prepared to ever sell their products online. To the open question: “Which other products and services would you like to sell online regularly?” we received many answers. Most often the northern Germany farms stated that they would like to rent holiday homes and sell used agricultural machinery online on a regular basis.

In Baden-Wuerttemberg 43% of the respondents and even 50% of the MVS-farms without computers and access to the Internet stated that they want to use the net for e-

commerce functions in the future. Of the BW-farms with computers but without access to the Internet, 79% intend to use e-commerce functions for their businesses in the future.

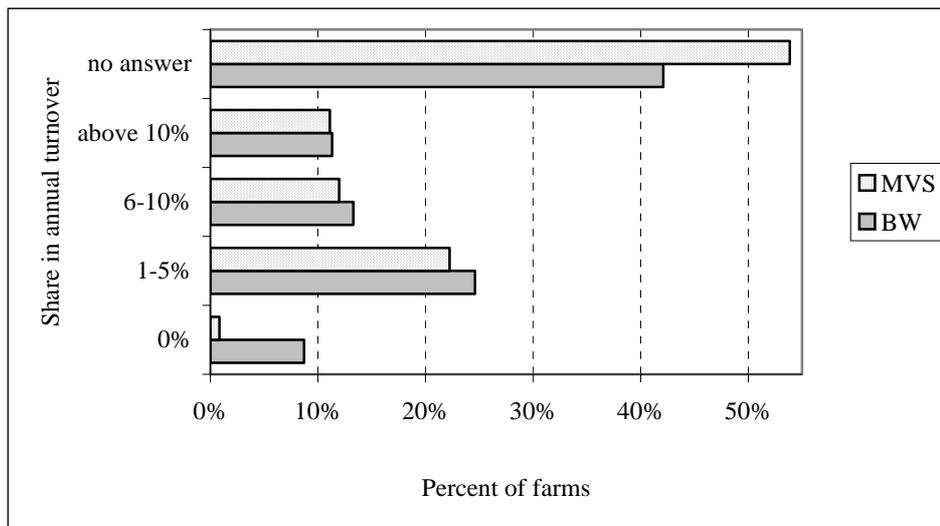


Figure 3: E-commerce shares in annual turnover in Baden-Wuerttemberg

The e-commerce shares in annual turnover were rather small at the time surveyed, the majority of farms did not answer the question (42.1% in BW and 53.8% in MVS) and most of those who answered indicated that e-commerce functions had a share of 1 to 5 percent in their annual turnover. But a clear trend appears: over two thirds of the BW-farms and more than three quarters of the MVS-farms that already use e-commerce functions intend to increase the use of the Internet for business transactions in the future.

The reasons that were stated most often in favor of integrating electronic business functions into northern Germany farms are the large number of business partners that can be found on the web, the possibility to bypass intermediaries, and time autonomy. The reasons stated most often against the integration of e-commerce functions were: products bought online cannot be inspected, absence of legal security of online contracts and signatures and the anonymity of business partners.

8. Summary and Conclusions

The wide use of information and communication technology in Germany has begun around 1990 and was accelerated by the opening of the Internet to the general public in 1995. The vast majority (between 85% and 95%) of farms surveyed had a computer, most for 6 to 10 year prior to the survey. Agricultural software used most often are crop management programs, bookkeeping software, cattle management- and pig management software.

Internet access is widely established among German farms, two thirds of all BW and NG farms and even 83% of all MVS farms have access. ISDN connections dominate modem access. Young farm managers with higher education are more likely to use the Internet than their older, less educated peers. Internet technology is well established and it works with sufficient speed at acceptable costs. E-commerce shares in farms' annual turnover are small. Open questions concerning the security of data and contracts on the Internet lead to reluctant participation in e-commerce. The vast majority uses the Internet to access information and the majority thinks the quality of this information is better than that received through traditional media channels.

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