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ÖSTERREICHISCHES INSTITUT FÜR WIRTSCHAFTSFORSCHUNG

Austria 2025:

Innovation: A Motor of Growth and Employment in the Rural Economy

Franz Sinabell, Fabian Unterlass (WIFO),
Peter Walder (BOKU), Jochen Kantelhardt (BOKU)

Research assistance: Dietmar Weinberger (WIFO)

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AUSTRIAN INSTITUTE OF ECONOMIC RESEARCH

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Internal review: Andreas Reinstaller (WIFO) • Research assistance: Dietmar Weinberger (WIFO)

Abstract

Innovation is the motor of growth and employment. This is true for all sectors in the economy including agriculture. Howerver, the state of knowledge about the innovation system in Austrian agriculture is relatively scarce. In order to address this deficiency, two aspects were investigated in depth in this study. Firstly, an overview is presented about the state of the agricultural innovation system relative to other countries. Austria is lagging behind countries like the Netherlands or Switzerland with respect to important variables like research expenditures. In the second part of the study results are presented that are based on a survey among Austrian farmers. They show that substantial innovations were made only by a minority of farmers in a four year period. The study presents and discusses options to enhance the innovative capacity of farms in Austria.

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1 Introduction

In general, innovation activities of companies are a key element of productivity increases (OECD, 2013, 13). Proper innovations are also critical for modern agriculture, since they are an essential criterion for increasing competitiveness and economic prosperity of the enterprises and closely related to sustainable agriculture (EC, 2016, sp). Productivity gains and sustainable innovative improvements related to products, services and production processes are the key to produce healthy and tasty food with attributes consumers are willing to pay for while simultaneously reducing negative impacts on workers' health, animal welfare and the natural environment. Given that 'smart' agricultural production systems are an EU policy goal, it is of great interest to understand how a framework can be developed that allows managers to be innovative and to develop their businesses further. This is also reflected in the emphasis on innovation as an overriding objective in the current Austrian Rural Development Program (BMLFUW, 2016, sp).

Policies promoting innovations are primarily motivated by the insight that higher productivity critically hinges on a well-functioning innovation system. Reports published by the OECD and EUROSTAT laid the ground for a systematic treatment of innovation in the economy (OECD, 2002; OECD and EUROSTAT, 2005). Because of the eminent role of innovation for high-income countries, considerable efforts are made to measure it in a systematic manner (OECD, 2010). A large number of indicators is regularly collected in order to identify whether progress takes place and in order to rank countries according to various metrics (e.g. patents, trademarks, educational attainment, scientific publications, IT equipment, broadband penetration, R&D expenditures, venture capital, entrepreneurship, e-government etc.).

Agriculture is special in many ways: Most farms are tightly integrated in global value chains and specialized to combine inputs which embody many innovations (e.g. hybrid seeds, agro-chemicals, special machinery) to produce outputs that are most frequently commodities that are traded in a standardized manner on worldwide markets. Many other farms, however, are integrating many links of the value chain. While others have outsourced these links, their integration attempts to make a profitable use of resources available on the farm (most importantly labour) or make efforts to create products and services that can be sold with (sometimes very high) premiums for special customers. Indicators that are most frequently used to measure innovations in manufacturing firms like the number of patents, trademarks, R&D expenditures, or research staff are not very useful in the context of agriculture. Agriculture is mainly viewed as an adopter (or user) of innovations that were developed elsewhere. Many public resources are therefore made available to support public research and development on inputs and techniques that are useful for agricultural production and to enhance the innovation adoption capacity by supporting training, knowledge transfer, educational and IT infrastructure.

In recent years, the OECD published reports on the agricultural innovation system for a number of countries (i.e. USA, Australia, Canada, Netherlands, Brazil, Turkey) (OECD, 2015abc and 2016ab). These country studies are organized according to the structure proposed in a framework for analysing the role of the government in agriculture (OECD, 2013). Compared to the situation in the countries covered in these studies, the state of knowledge about the Austrian innovation system is very scant. Only one recent and compact study covers a range of aspects in a systematic manner (Rosenwirth and Pinter, 2014).

The purpose of our study is to contribute to the existing literature on agricultural innovation systems in two ways: Firstly, we describe major elements of the Austrian innovation system in the context of studies from other countries. Doing so we refer to the position of Austria relative to other countries in section 2 of this report. The main purpose is to provide the reader with important context information which is important to understand the third section of this report. This section is devoted to present the results of a study which aims at measuring the innovative efforts of farmers in Austria. Three steps were made to do that: In the first step, a questionnaire was designed that is as consistent as possible with the way to measure innovation at firm level in the Community Innovation Survey (CIS). The purpose of our design is the capturing of idiosyncratic features of farms in Austria. The output of this effort is an online questionnaire. Major elements of it are described in section four. The second step was to conduct a survey among 500 Austrian farms in 2016. The empirical findings thereof are analysed in a third step. Descriptive statistics and major results are provided in section five. In the final chapter we summarize the findings, reflect them in the context of other studies and present an outline of future steps that may help to improve our understanding of the innovation system in agriculture.

2 Setting the scene: innovation in agriculture

2.1 Section Outline

This chapter presents key elements of the Austrian innovation system in agriculture and reports empirical findings from the literature on innovation in agriculture. Innovations are central prerequisites for productivity advances in any sector. For centuries, the agricultural sector was the main driver of innovations in society (crop and livestock production, intentional crop and animal breeding, ploughing and the development of tillage systems, irrigation, crop rotations, etc.). Since the middle of the nineteenth century the role of agriculture has shifted towards being mainly the adopter (or user) of technologies that were developed elsewhere like the use of fuel powered vehicles and systematic breeding techniques. The innovative efforts in agriculture shifted mainly towards practical implementations of new technologies developed elsewhere on the farm. The great changes took place in the 20th century, when agriculture was fundamentally altered by the spread of mineral fertilizers, plant protection products, targeted breeding methods in animal husbandry and plant production, and mechanization. The scientific foundations for these fundamental

changes have been laid since the middle of the 19th century. Ever more efficient production processes have resulted in savings of resources – in particular labour – of about 2% per year over decades (Sinabell, 2016).

Concurrently to innovations developed at public or privately-run research stations and agricultural machinery industries and chemical industries innovations have been developed directly on farms. Due to better information systems, the rate of adoption of them has accelerated in recent years. Well known examples include variants of clamp silos for silage storage in livestock production that are less labour intensive and cheaper compared to tower silos. Another technical innovation that was developed by a farmer is Ernst Weichsel's self-loading wagon. This case is special because a patent was granted for this invention whereas many other improvements and innovations developed by farmers like organic farming systems or special tillage practices are not protected by intellectual property rights. In many cases it is even impossible to protect the intellectual property rights (except through secrecy). This is not specific for the agricultural sector, but pertains to it as well. Many innovations or modifications are not patentable. Many of them cannot be protected through trademarks or other measures of intellectual rights protection due to their idiosyncratic characteristics.

Most frequently innovations are directly visible in products like mobile phones. This is not the case with many innovations in agriculture. The appearance and taste of apples, cereals, milk have hardly changed since the beginning of agricultural production. However, the ways in which these goods are produced is fundamentally different today.

The analysis of the innovation system in agriculture aims at identifying the decisive influencing factors for productivity advances and the prerequisites for new products, in order to promote continuous developments and improvements. In agriculture, technical progress has been going hand in hand with a reduction in manpower. Nobody will mourn the days when exhausting and dangerous physical work was replaced by machines. Today, however, the economic environment with high unemployment rates on the one hand and high willingness to pay for more labour-intensive agricultural specialties on the other hand offers the possibility of at least slowing the process of labour saving technical change by means of innovations in processes – also in terms of business models – and social innovations.

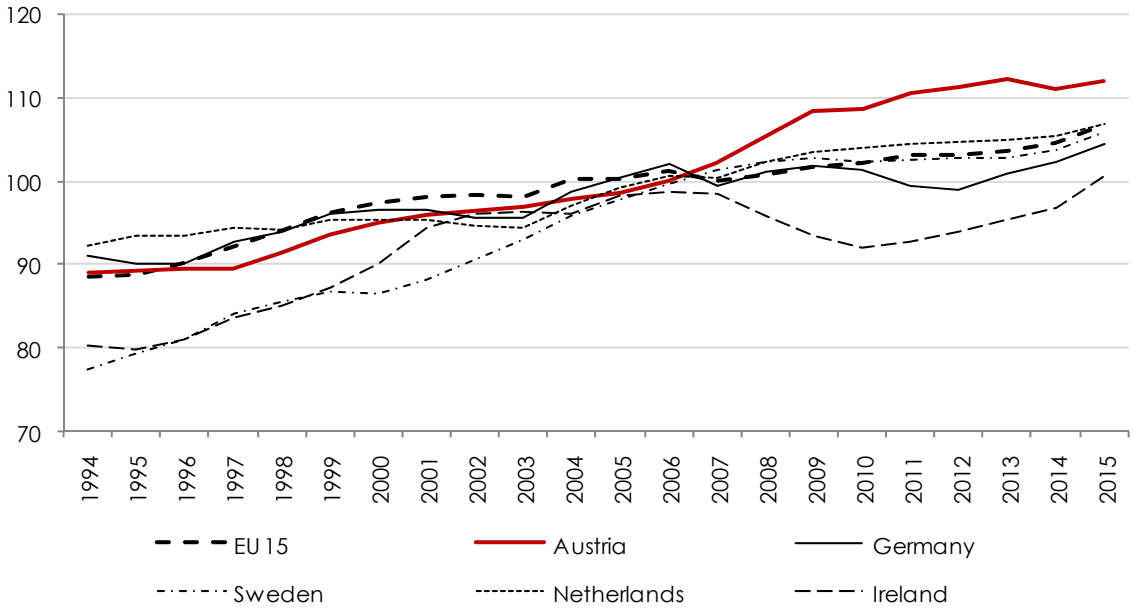
The following sub-sections describe aspects of the agricultural innovation system in Austria in an international comparison. Subsequently, empirical surveys are used to elaborate particularities in Austria and to show how strongly certain obstacles to innovation are perceived on farms.

2.2 The Austrian agricultural innovation system in an international context

The importance of the ever-evolving innovations in agriculture is clearly visible if one considers that less and less land and labour are used to produce almost the equivalent production volume of 14 million t of biomass per year in Austria (Kettner-Marx et al., 2016). The rate of

annual decrease in agricultural land was 1.5% and the decrease of the workforce (measured as full-time equivalents) was 2.3% between 1999 and 2013 (Sinabell, 2016). While land and labour intensity declined, the share of variable inputs and capital goods increased: The share of intermediate consumption of agricultural output rose from 54% to 61% and the share of depreciation rose from 23% to 26% during the same period. There is a substitution of the production factors land and labour towards capital and variable inputs. In addition, more and more inputs that were produced on the farms in previous times are now bought on the market. Apart from these changes, there are additional productivity gains which cannot be explained by changes in the tangible inputs. In Austria, a favourable development is observed. Evaluations for total factor productivity published by the European Commission show that Austria's TFP in agriculture is well above the EU-15 average (see Figure 1).

Figure 1: Development of total factor productivity EU-15 and in selected member states

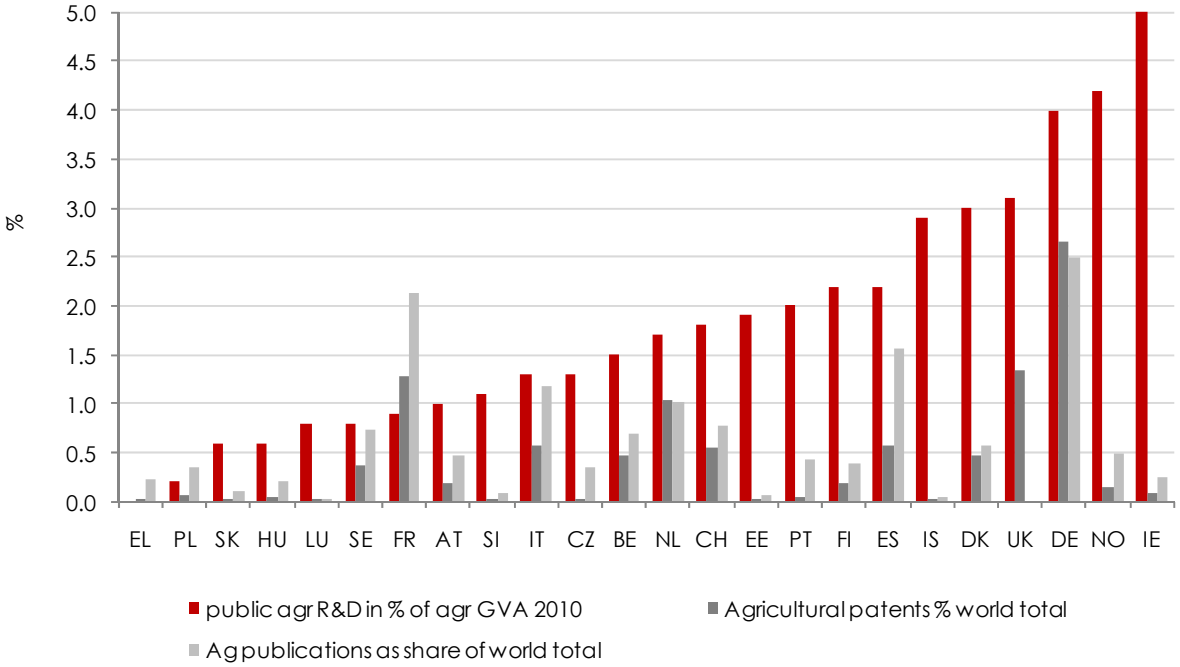


Source: own construction based on European Commission, 2016a.

One result of continuous productivity gains in agriculture is that nominal prices of agricultural products in Austria are now lower than they were in the early 1990s. In addition, important agricultural environmental indicators such as nitrogen emissions and the release of greenhouse gases show a decreasing trend of environmental impacts (Kettner-Marx et al., 2016). These observations are consequences of the fact that inputs in production are used more carefully and more purposefully. Austrian agriculture is following trajectories observed in the EU and many other countries.

The degree of innovation in an economy is often quantified by measuring inputs (e.g. research and development expenditure) and easily identifiable outputs like patents or scientific publications (OECD, 2010). Such surveys show that in the field of agricultural innovation Austria's position is in the camp of lagging countries and not in the league of countries with comparable size and economic development (see Figure 2). In this illustration, the percentage share of the respective country is measured on agricultural patents (dark gray) and quality-weighted publications (gray). The ordinate is scaled on worldwide counted patents and publications.

Figure 2: Ranking of input and outcome indicators on agricultural innovation of selected countries



Source: own construction based on OECD, 2013 (Fig. 2.3), 2016b (Fig. 7.21, 7.30). Note: included are EU member states (incl. the associated countries CH, IS and NO) that are part of the OECD. Columns show a) the share of publicly funded research and development on agricultural research relative to gross value added in agriculture in 2010; b) the share of each country of agricultural patents worldwide and c) the share of each countries scientific agricultural publications of the world total.

In the ranking of agricultural patents within EU member states (and associated countries) which are also OECD members, Austria was ranked 11th among Sweden and Belgium in 2016. Countries of similar size such as the Netherlands (4th place) or Switzerland (7th place) performed significantly better in this comparison (OECD, 2016b). One important reason for this is that Austrian companies which are input suppliers are only medium-sized. Among Austrian firms in the food processing sector there is only one multinational company with a small number of products and none with a large product portfolio. Another reason for this is that

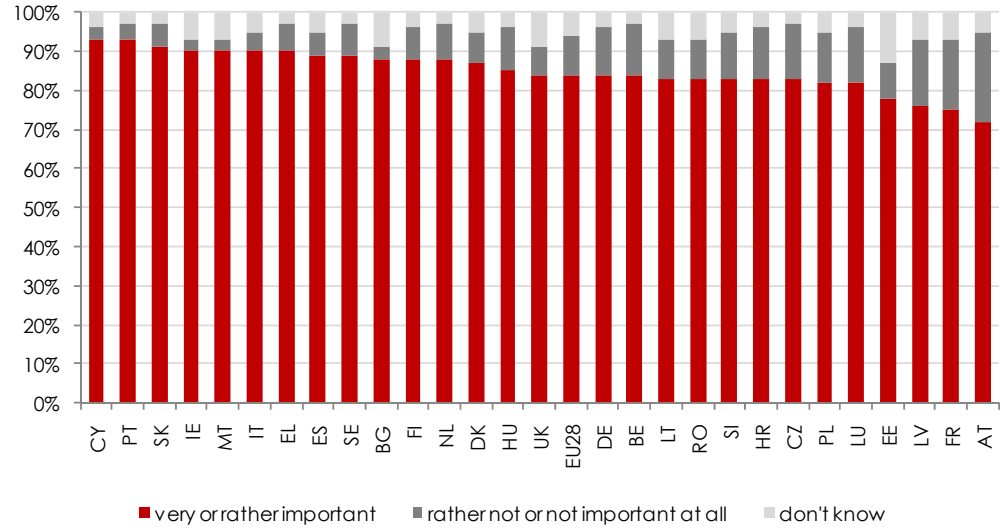
Austria also took the 11th position (OECD, 2016) in terms of the number and quality of scientific publications. The rankings of the Netherlands, Switzerland and Sweden are significantly higher based on this indicator.

A look at input indicators can partly explain this factual situation. Due to the given corporate structure, the public sector is particularly important in the financing of agricultural research (see red columns in Figure 2 which indicates government budget appropriations or outlays for R&D on agriculture as a % of agricultural gross value added in 2010). The expenditure was only about 1% of the value added in agriculture in 2000 and 2010 after a slight increase after 1990 (OECD, 2013). In the Netherlands, the corresponding share in 2010 was over 1.5%. This figure has to be assessed having in mind that agriculture's share of the value added in the economy is 1.6% in the Netherlands and only 0.8% in Austria. The comparison therefore shows that the Dutch agricultural sector is not only larger but even more research intensive (financed by public sources) than the Austrian one. Public research spendings in Finland (2.1% of agricultural value added) and Ireland (5%) were particularly high. The share of agricultural value added of gross domestic product is 0.7 (Finland) and 1.1 (Ireland), respectively. A further special aspect is also likely to come into play. In Austria, expenditure in the biotechnology sector is spent almost exclusively on health research (OECD, 2016b). In other countries, considerable expenditures are spent on research in agriculture.

The importance of public R&D in agriculture is eminent. Investments in agricultural research are particularly productive. Estimates from the US show that the rates of return on research are between 21% and 57% (OECD, 2016b). Results for Europe indicate that the internal rate of return is lower (Vollaro et al., 2017). Comparable studies for Austria are currently not available. One reason for lower rates of return in Europe may be the unavailability of systematic data on private R&D expenditures of private companies which were not included in this assessment. Another reason may be that the share of basic agricultural research has been bigger in the US compared to countries in Europe.

The low contribution of public agricultural research in Austria may lie in the sceptical attitude of the domestic population towards new technologies and innovations in agriculture. This was revealed by a recent EUROBAROMETER survey on priorities of the Common Agricultural Policy. In the international comparison, Austrians make the least positive assessment of research and innovation as a public service (see the dark column in Figure 3).

Figure 3: Assessment of the importance of research and innovation in agriculture as a priority of the agricultural policy



Source: own construction based on European Commission, Directorate-General for Agriculture and Rural Development, 2016b.

2.3 Special features of the Austrian innovation system in agriculture

The agricultural innovation system comprises not only research institutes and firms in the upstream sectors that provide innovative inputs. Farms producing agricultural goods and providing services are a central component of the agricultural innovation system. The indicators given in the previous section are not a suitable measure for measuring innovations developed and implemented on farms themselves. The reason is that the indicators cover only publicly funded research and development expenditures and two types of outputs, namely patents and scientific publications.

In Austria's agriculture, there are almost exclusively small farms, some of which are operated and managed by less than one full-time equivalent of farm labour. The resources are far from sufficient to carry out intensive research and development under such conditions, which is why agriculture in Austria – as well as in other countries – is regarded as an adopter and user of innovations developed in mechanical engineering, seed farming, the agri-chemicals industry or universities and research stations.

In the course of a field study to further elucidate the specific situation in Austria (Walder, et al., 2016 and Walder et al., s.a.) some findings already known in the literature (OECD, 2016a) were investigated in the Austrian context. One of the peculiarities in Austria is the great importance of environmentally friendly production methods. Such systems mainly rely on old seed varieties, low productive livestock, and little chemical inputs. The typical route of innovation transfer to agriculture via input suppliers therefore is limited. Services that are close to the primary agricultural production, such as holidays on farms, direct marketing of

products or green care as social innovation, significantly contribute to the added value of Austrian agriculture. The special market conditions in Austria with a high share of leisure time and the small geographical distance of most agricultural enterprises to urban centres facilitate the diversification of agricultural activities. Compared to countries such as the Netherlands, Finland and Sweden, activities in the service sector are very strong and self-marketing and on farm processing of products play important roles.

Another feature of the Austrian innovation system is the role of agricultural associations and of the chamber of agriculture. While commercial consultants are the most important supplier of agricultural consulting in countries such as the Netherlands or the United Kingdom as well as in the north of Germany, capacity building is mainly provided by agricultural organizations and among farmers themselves in Austria (as is also the case in France and Finland; OECD, 2013). Such activities are supported by the Rural Development Program (the so-called Second Pillar) of the Common Agricultural Policy (CAP) with a series of measures. The new policy instrument 'European Innovation Partnership' is an attempt to break down the barriers between applied research and implementation in agricultural practice. Networking and knowledge diffusion plays a particularly important role (Rosenwirth and Pinter, 2014). For instance, research institutes funded by the Federal Ministry of Agriculture (e.g. Higher Research and Education Center Raumberg-Gumpenstein, BLT Wieselburg or the Federal Institute of Agricultural Economics) put a strong focus on applied research and knowledge transfer towards the farm community.

The measures for networking among farmers are diverse. The most innovative products or solutions developed by farmers themselves are presented and honoured at working group meetings, master training circles, competitions, performance inspections, excursions and field visits. Such activities create forums that enable others to gain inspiration for the imitation or further development of their own farm. For example, the programme "Innovationsoffensive" ('information offensive') of the Chamber of Agriculture and its affiliate LFI ('rural further education institute') focus on awareness raising of farmers and their consultants regarding new and innovative pathways and provide structured support for the implementation of new approaches. The best way to do this is by means of demonstration farms in an authentic dialogue between practitioners. In some associations where organic farms are organized, members participate regularly in such events. This effectively accelerates the dissemination of knowledge, increases the acceptance of innovative approaches and new solution arise from the interaction with professional colleagues.

3 Towards measuring agricultural innovation in Austria

3.1 Problem statement

There exist already established survey instruments for measuring innovations at the individual company level. In Europe, the most well known is the Community Innovation Survey (CIS). In the European Union, such surveys have been conducted on a regular basis since 1993 based

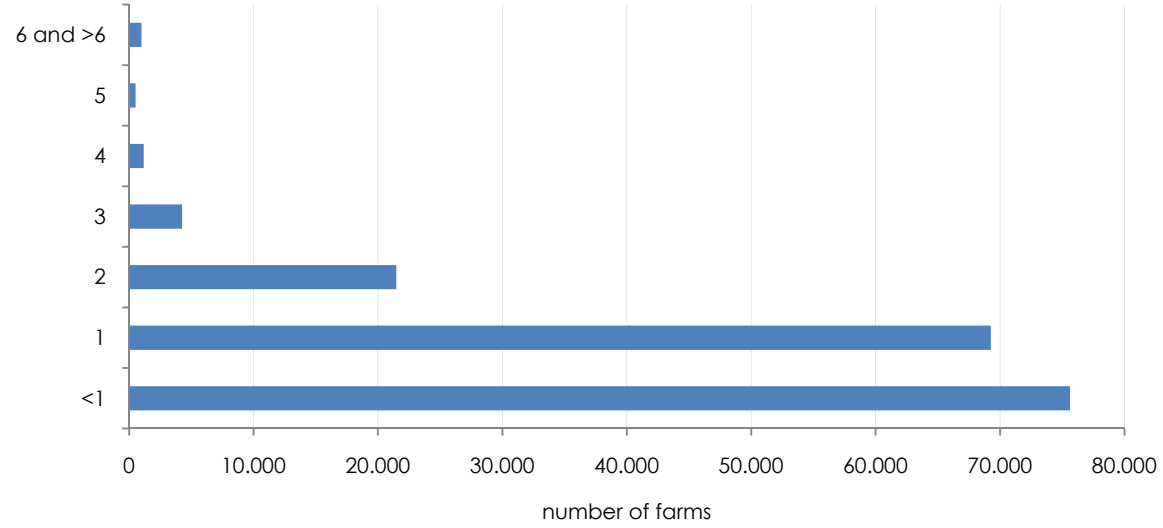
on a harmonised methodology. The CIS is a survey of innovation activities in enterprises and its concept is documented in the Oslo Manual (published in 1992; the third edition is OECD and EUROSTAT, 2005).[1] The innovation statistics derived from it are part of the EU science and technology statistics. Standardized surveys are carried out every two years by EU member states. A number of ESS (European Social Survey) member countries are contributing to the statistics as well. Because compiling CIS data is voluntary to the countries, the country coverage varies across survey waves (EUROSTAT, 2017). The selection of industries that is covered by the survey is depending on the discretion of the member state. In Austria, enterprises with less than 10 employees are not covered (Statistik Austria, 2016), in Germany the smallest enterprises have 5 employees (Rammer, et al., 2017).

In a recent study Kritikos, Hafenstein and Schiersch (2017) looked at the innovative capacities and activities in German firms with less than 10 employees. They used an approach developed by Crépon, Duguet and Mairesse (1998) to evaluate the effect of R&D activities on the productivity of the firms using data of the IAB-Betriebspanel (Ellguth, Kohaut, Möller, 2014). They found that the proportion of innovative companies was 50 percent. Innovations were introduced less frequently in smaller firms.

When we look at agriculture in Austria, the situation is special compared to other sectors even if we compare farms only with small firms in manufacturing or services. In the last exhaustive survey among Austrian farms in 2010 Statistik Austria counted slightly more than 170,000 enterprises in the agricultural and forestry sector. Among them slightly less than 100,000 had at least 1/2 person working on it (Statistik Austria, 2016). This implies that almost 60% of Austrian farms employed less or were run by less than 1/2 person fully employed. Among those farms that employ or were are run by at list 1/2 person (97,693 farms) there are 999 which have six or more employees or members of the owners working on the farm. For the whole sample, this means that only 0.6% of farms have more than 5 persons working at least 1/2 time employed on a farm and forestry enterprise in Austria (Figure 4). Farms in Austria are therefore really small compared to other enterprises in the economy.

[1] The legal basis for the collection of these statistics is Regulation 995/2012 implementing Decision 1608/2003/EC concerning the production and development of Community statistics on innovation. Metadata and methodological information on the most recent survey from 2014 are available at: http://ec.europa.eu/eurostat/cache/metadata/en/inn_cis9_esms.htm (accessed 2 Aug 2017).

Figure 4: Number of persons regularly employed in Austrian Agriculture and Forestry in 2010



Source: Statistik Austria, 2010 (table 4.9). Note: "regular employment" is an employment of at least 1 day per week.

The harmonised CIS is designed to provide information on the innovativeness of sectors by type of enterprises, on the different types of innovation and on various aspects of the development of an innovation, such as the objectives, the sources of information, the public funding, the innovation expenditures etc. The CIS provides statistics broken down by countries, type of innovators, economic activities and size classes (EUROSTAT, 2017).

This section discusses how a questionnaire to measure innovation activity at farm level should differ from existing surveying tools in research on agriculture and other sectors like the CIS. Starting from a workshop, experts and their specific knowledge and experience are used in a subsequent step. The agriculture-specific questionnaire developed on the basis of this empirical data has the following characteristics: First, it is not assumed a priori that innovations are primarily intended to improve the economic performance but may focus on other targets, e.g. working conditions or the quality of the environmental endowment. In addition, the questionnaire also investigates the importance of natural resources and social aspects. Consequently, a holistic, multidimensional assessment of agricultural innovation is necessary to take account of the specific situations in agriculture. The reason for such a broad approach is that farms can be better understood from a *household perspective* and not only from the perspective of a profit maximizing operation.

A necessary condition for the adequate design of incentives and for advising farmers is an adequate measurement of agricultural innovations (Läpple et al., 2015). This in turn requires a holistic approach which is the only way to ensure that targeted recommendations can be made for policy makers and interest groups representing farmers. In research on agricultural innovations a systems approach is more frequently applied (Bokelmann et al., 2012). We follow these routes in our empirical analysis by involving experts as an important source in the

phase of designing a survey instrument that is widely consistent with the CIS but contains additional farm specific amendments. In our view, innovation can only be adequately covered if the knowledge of experts who deal with agricultural innovators on a daily basis is used in the research process.

In the next sub-section, existing approaches for measuring agricultural innovation are presented. In the following sub-section, our research approach is described in detail. The findings of the empirical phase which identify the essential elements of the questionnaire are presented afterwards. Prior to presenting the questionnaire in detail, we discuss our findings and draw conclusions for the measurement of agricultural innovations.

3.2 Innovations in agriculture and how to measure them

The Community Innovation Survey (CIS) measures the innovation activities of enterprises in the manufacturing sector and is a standardized survey instrument applied in EU member states (EUROSTAT, 2017). Our aim is to use key concepts of this approach to measure the innovative capacity in agriculture. Although a certain degree of consistency with the CIS should be given by our survey in order to compare findings across sectors, the items from CIS cannot be adopted one-by-one for agriculture. Innovations have another role in agriculture. This applies, for example, to patents. Furthermore, while expenditures on research and development are often used as a proxy for innovation activities in the current literature, they are ill-suited for the measurement of agricultural innovation, particularly at the enterprise level (Ariza et al., 2013, 187). Furthermore, the CIS does not include important topics which are viewed to be essential for farms.

Agricultural economic studies on the measurement of innovation and the assessment of impact factors on innovation at the level of operations are, to date, rather rare. Researchers often look at this subject from a technical angle like Ariza et al. (2013, 188) and Läpple et al. (2015, 2 ff). Innovation is viewed as multidimensional which is consistent with the definition of the Oslo Manual (OECD and EUROSTAT, 2005, 46). According to it innovation may not be limited to aspects of technical progress (i.e. in terms of pure inventions). However, both cited studies remain highly technology centred in the selection of the indicators or they are analyzing the researched innovations with respect to the respective technology frontier. Diederen et al. (2003, 34ff) conclude that in addition to cost reduction, improving working conditions, environmental performance and animal welfare also play important roles. However, their hypotheses are mainly economic and their approaches do not take into account these other factors. A similar emphasis in the evaluation of innovations is taken by Karafillis and Papanagiotou (2011, 3076f). They attempt to explain total factor productivity by using an innovation index based on engineering methods. Information on the extended dimensions of agricultural innovation is provided, for example, by the study by Mandolesi et al. (2015, 29), which integrates both management processes and consumer expectations as well as animal welfare and biodiversity aspects. Their target group are members of the value

chain of low-input milk. Table 1 shows a summary of the studies cited. The overview presents also the selected indicators therein and the studied innovation types.

Table 1: Summary of innovation type and indicators from the cited literature

Study	Indicators	Type of innovation
Ariza et al., 2013	index based on number and degree of innovation related to the technology limit	process / technology
Läpple et al., 2015	compound indicator: (1) innovation adoption (2) acquisition of knowledge (3) continuous innovation	process / technology
Diederen et al., 2003	implementation of important innovations	various types
Karafillis and Papanagiotou, 2011	agricultural technologies	process technology

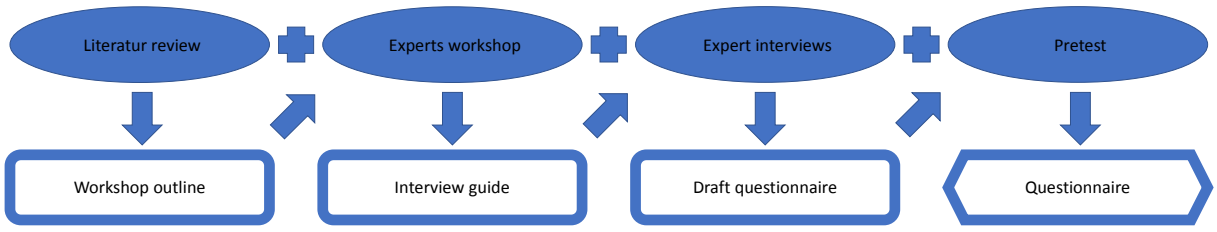
Source: own construction.

The surveyed literature shows that agricultural innovations are very diverse and encompass all types of innovation (and intensities). At the same time, it is very difficult to assess the heterogeneity of agricultural innovations, so that studies are mostly limited to process innovation. However, this may be because process innovations account for 80% of the agricultural innovations according to Diederen et al. (2003, 34). With regard to the degree of innovation (i.e. how 'large' or intensive the innovation is) Hauschildt and Salomo (2005, 4 ff) find that this can usually be detected only imprecisely and point to the need to supplement the project perspective with a portfolio perspective which is only done in a few studies.

3.3 Preparing a design of an innovation questionnaire

In order to develop a questionnaire that accounts for the specific situations in agriculture, in addition to the results of the literature we decided to build on the expertise of professionals who are routinely working on agricultural innovations. This decision was made in order to ensure that the final questionnaire is adequate for a holistic innovation measurement (see Figure 5).

Figure 5: Study design and outputs



Source: own construction.

The interaction with these experts started with a workshop. This not only served to define the main focus of the final survey instrument, but also contributed to an aggregation of topics and questions for individual interviews of further experts.

In summer and autumn of 2015 six in depth interviews were made. The evaluation followed the approach suggested by Meuser and Nagel (1991, 451ff). In our interviews, we refrained however from intensively referring to innovation. Since the primary purpose of the interviews was the identification and delineation of a holistic survey instrument, the aim was to achieve the highest possible heterogeneity and variation of the knowledge backgrounds of the experts. The selection of interviewees was not made a priori, but developed gradually on the basis of existing material (see Flick, 2005, 109). Two of the interviews were conducted directly with farmers who have implemented extensive innovations on their farms. Objectives, motives, innovation processes and knowledge diffusion of agricultural innovations turned out to be the most important topics of the interviews.

3.4 Insights based on expert interviews

We used the central results of the workshop and the in-depth expert interviews for drafting a questionnaire. These first insights as well as several pretests of our draft questionnaire revealed that surveys on innovation in agriculture should be designed to accommodate the diversity of situations on farms as good as possible in order to collect the entire range of possible innovations. Although radical innovation is usually visible and clearly identifiable, many innovations on farms are far more incremental, even if they involve subtle changes. While previous studies focused on *process innovation*, inspired by the recommendations of the experts in the face to face interviews the "core questionnaire" differentiates between three innovation types:

- products and services innovation
- production process innovation
- organization and market(ing) innovation

We followed the recommendations of experts and participants of the pre-tests to refrain from abstract terms and scientific jargon. The question blocks of the questionnaire are supplemented by several examples of farms in Austria, which cover the framework of possible innovations very extensively.

Agricultural innovations are often used to increase competitiveness and productivity. However, the expert interviews also showed that other aspects such as biodiversity and animal welfare often play a decisive role when new procedures are implemented on a farm:

> "[...] When I see it from the operational side, our goal was to produce as much diversity as possible. To produce food we like to consume ourselves [...] "(interview partner 4, in the following IP4, 2015).

> "[...] by means of checklists [we] check the status of animal welfare - this is a [deliberate] process, because one might become unaware due to the daily routine [...]" (IP1, 2015).

On the basis of these findings, the topic "natural resources" is addressed in several instances in the first three parts of the questionnaire, including the additional modules in the "Motives and Reasons" section for innovations. It addresses not only economic aspects but also quality of live motives are raised. Since, in the context of innovations, the topic "quality of life" is also described as very relevant by experts, this is taken into account in the first part of the questionnaire.

Furthermore, networks and collaborations are particularly important for innovation activities in small-scale family businesses, as the following quotations show:

> "[...] on the one hand there was the promotion and the [farmers' market] was founded and [Organization XY] actively promoted this development. [...] and we had good press coverage " (IP4, 2015);

> "[...] person XY has recognized [...] that it does not [...] that his financial means would not be sufficient - however, together we can achieve this [...] together with combined our resources and clearly defined who does what [...] together with the food retailers "(IP5, 2015);

> "[…] and they interrogate each other and new topics arise […] and they puzzle over something and discover […]"(IP6, 2015);

The central topic on the scope of "networks and cooperation" is considered in a separate set of questions. Additionally, it is taken into account as an innovation type (as a subcategory of organisational innovation) in the core questionnaire.

Innovations in agricultural holdings, however, are not exclusively deliberate changes that are pursued in their own interest. They are often necessary because of legal requirements, association guidelines or driven by demands from customers. This is illustrated by the example of a statement on flowering areas:

> "[...] Keyword bees: we make some blooming Austria [... company XY] there is also bee program. This is worked out there [in this company] and broken down in the sense of: "This must be observed [...]" (IP2, 2015).

The experts also point out that innovations in the field of animal welfare often necessitate further complementary innovations if, for example, problems arise in the treatment of diseased animals. In the questionnaire, such composite aspects are comprehensively considered by asking them both motives and obstacles to innovation. Based on the focus group and in-depth face-to-face interviews the questionnaire was structured to cover all the aspects that were identified to be important in the Austrian agricultural innovation system. An overview is provided in Table 2.

Table 2: Structure of the questionnaire on innovation in Austria

Entree	core questions	additional modules	socio-demographics
income	type of innovation	fundamental goals	gender
quality of life	cooperation	impediments	age
resources	degree of innovation	motives	education
	reasons for non-innovation	information sources	technical training
		personal development	type of farm
		resource status change	full time / part time

Source: own construction.

The research design described here and the questionnaire based on it reflect both the high complexity of agricultural innovations and innovation processes, as well as their numerous interdependencies with other actors in the value chain. It is clear that in addition to economic issues, other topics are also important such as natural resources, social aspects with regard to the family owning a farm and cooperation with other farmers. A holistic questionnaire should take such aspects into account.

Our face-to-face interviews suggest that a questionnaire which is developed only using recommendations found in the literature should be extended to include expert knowledge to further accentuate the themes of the questionnaire. Thus, the content validity can be examined, whereby it is possible to depict the reality in greater detail. However, other quality criteria, such as construct validity, cannot be tested by these examination steps. For such a purpose a logical and substantive analysis of the survey instrument respectively its items is necessary (Bortz and Döring, 2006, 202).

4 A questionnaire for innovation in agriculture

4.1 Identification of the sample and data collection

One of the features of our research design is that we intend to obtain results that can be compared with results from the CIS. We assume that a typical respondent of the CIS is working in an executive department of an enterprise and has a university degree and is likely familiar with R&D activities. In the case of farmers we have to acknowledge the fact that only a minority of them has a university degree. It was therefore viewed as a risk to conduct the survey in an un-assisted manner. However, personal interviews which would allow an

interaction between interviewers and respondents to clarify how questions should be interpreted were too costly.

We took the choice to design the interview concept as a semi-assisted questionnaire. Our sample were farmers who are part of the Farm Accountancy Data Network (FADN) system in Austria. FADN is an instrument for evaluating the income of agricultural holdings and of impacts of the Common Agricultural Policy[2]. FADN's legal basis for the organisation of a network across countries was established by Council Regulation 79/65. An annual survey is carried out by each EU Member States. At the EU level, selected results of these surveys are collected at services of the EU Commission. Derived from national surveys, the FADN is the only source of microeconomic data from farms that is harmonised. The bookkeeping principles are the same in all countries. Holdings are selected to take part in the survey on the basis of sampling plans established that guarantee representativeness for the regions involved. The survey covers agricultural holdings above a size which is considered to be commercially viable. FADN aims to provide representative data along three dimensions: region, economic size and type of farming.

In Austria, farmers of the network are collecting the bookkeeping data with the assistance of consultants of the accountancy service firm LBG Österreich Gmbh Wirtschaftsprüfung und Steuerberatung[3] (dubbed FADN consultants in the reminder of the text). During a regular visit of FADN consultants on the farm, farmers were asked to fill in an online survey. In case a farmer needed assistance, the consultant who was trained for this purpose could help to overcome problems in accessing the website and getting started with the survey. In order to fit the survey on innovations into the regular procedures of bookkeeping data collection the decision was made to keep it as short as possible. It was designed in such a way that most respondents of the pre-tests were able to complete it in 20 minutes.

The sample of farmers of the innovation survey is therefore identical to the sample of FADN-farms in 2016 in Austria. Because farmers were not obliged to respond and LBG consultants were not asked to nudge farmers to take part, the number of responses was lower than the number of farms in the sample. In order to motivate farmers to take part in the survey, a lottery was offered (ten subscriptions of a choice among three farm magazines). The survey is available at: https://survey.itkt.at/index.php?sid=23287, a transcript of the survey in English is in the appendix.

4.2 Core elements of the questionnaire for measuring innovations in agriculture

The starting page of the survey provides practical information about the purpose, the handling of privacy issues and indicates contacts in case further information is needed. None of the respondents contacted one of the persons listed. We interpret this that there were no major troubles to understand the elements of the survey.

[2] http://ec.europa.eu/agriculture/rica/

[3] http://www.lbg.at

On the second page of the survey, respondents were asked to indicate their role in the enterprise (owner, operator, family member) and whether they agree that additional information from the LBG dataset could be used as additional information in our analyses.

The third page focused on the level of satisfaction with the farm's economic performance, the quality of live and the state of the (natural) environment compared to 2011. An alternative to asking for the level of satisfaction would have been to ask about indicators like the levels of profits, nutrient balances and number of sick days in 2011 and 2015. We made the deliberate choice *not* to ask for variables at a cardinal scale because of prior knowledge. Two characteristics of agricultural production have to be kept in mind when performance indicators are measured:

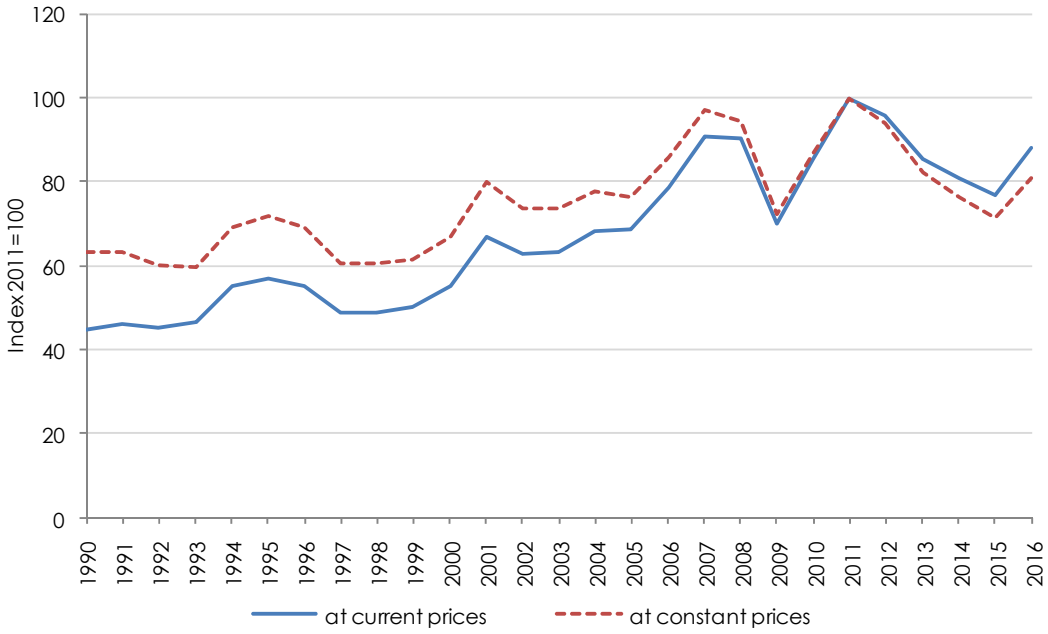
- farmers are price takers: even prices high value specialised products (like organic hay milk) are linked to commodity prices that are very volatile;
- farmers operate in the natural environment and are exposed to whether extremes (be they adverse or favourable).

Because of these factors comparisons make only sense when averages of several years are compared. Apart from this, in early 2016, when the survey was conducted, we knew already that incomes in the agricultural sector had declined over four consecutive years since 2011. Knowing this, we thought by asking about the satisfaction with incomes - given this sector specific adverse shock - would give us more insights than asking what we know already from other sources.

The effect of whether conditions that cannot be foreseen can be shown using the nitrate balance as an example. 2011 was a year with a relatively low surplus of nitrate. A surplus of 0 indicates that the inputs of nitrogen and the withdrawals in the harvested crops are balanced. A surplus indicates nutrient leakage into surface and groundwater and atmospheric losses. In the year 2011 plant growth was relatively high which implies that most fertilizer substances were transformed in the harvested crops, the surplus was therefore low. In the following years, the harvested amount was rather volatile with the effect that the surplus was volatile as well.

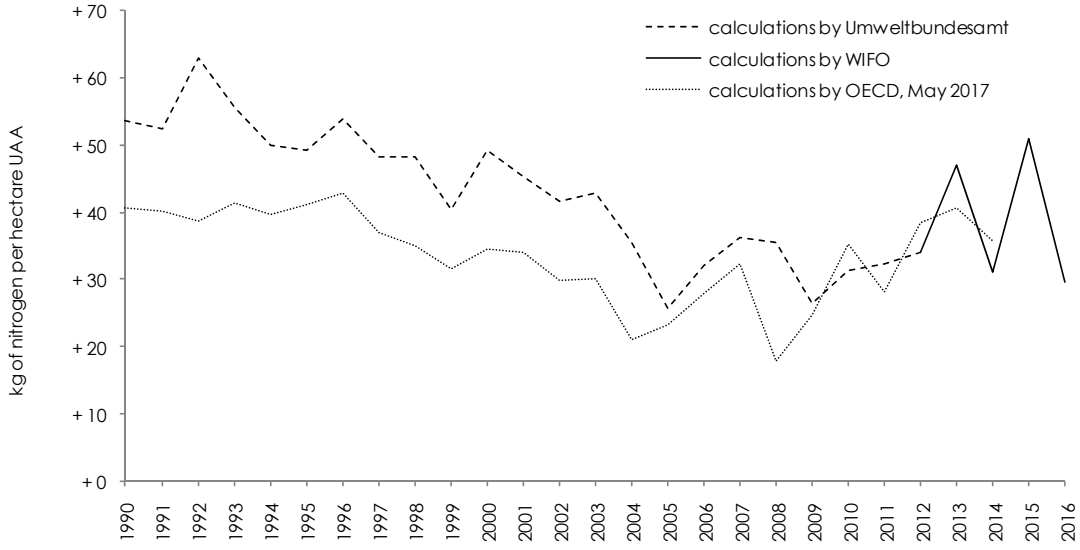
When the survey was designed, it was not yet known how many responses we might expect. Given the large heterogeneity of farms, the fact that not all market prices moved into the same direction and due to the diversity of natural conditions they are operating in we had to expect considerable noise when asking for concrete figures.

Figure 6: Factor income in agriculture in Austria (index 2011=100)



Source: own construction based on Economic Accounts of Agriculture, Statistik Austria, 2017.

Figure 7: Nitrate balance of agriculture in Austria (using different methodologies)



Source: own construction based on Kletzan, et al., 2017.

After asking the level of satisfaction with the farm's economic performance, the quality of live and the state of the (natural) environment compared, respondents were asked whether they newly introduced or significantly changed at least one of each of the following items:

- product or service
- process for preparing / delivering products and services
- practices in the delivery of equipment or sales of products
- systems for supporting the production of products or the provision of services
- organization of cooperation of family members and employees
- organization of the purchase of equipment or production inputs
- arranging the distribution of the products or the provision of
- advertising products/services
- quality assurance measures
- measures for hedging of prices or similar risk management measures
- strategic partnerships

If the respondents indicated the introduction (or significant change) of one of these items, they were asked to list corresponding examples as a text statement. For each of these examples, we additionally asked them whether it was …

... developed alone,

… developed in cooperation with someone outside the company

… adapted but externally developed

… developed by someone else but implemented newly on the farm

Furthermore, for each of the listed examples they indicated whether the new (or significantly modified) product / service / process / form of organisation was

…nowhere else available

… outside my neighbourhood already available

… within my neighbourhood already available

In the case of NO new or NO significantly changed products / services / processes / / form of organization, the interviewees were asked about impediments and why they did not introduce any of them (multiple answers allowed):

…... there was no need, since innovations were implemented already before 2011

…... innovations could not be financed

…... the legal framework has not allowed it

…... lack of good ideas and solutions

…... the effort would have been too great in comparison to the benefit

…... uncertain consequences and unpredictable success for the company

…... no interested in new products / services / procedures / forms of the company organization

…... other reasons

In the rest of the survey characteristics of the farm, educational attainment of the respondent, and production system were asked. We also asked them to give a personal assessment on their quality of live, situation of the family and the economic performance of the farm, as well as the environmental situation and aspects of animal welfare and biodiversity related to the farm.

After these questions, the respondents could either finish the questionnaire and register the answers or opt in to answer further questions. The three different modules focused on:

- a ranking of nine statements according to their preferences (economic performance, situation of family, cultural landscape, biodiversity, traditional production systems, community goals, working conditions, resource endowment, self-determination)
- innovation barriers
- information sources

Apart of these modules, motivations for innovations on farms were asked in the survey.

The transcription of the survey into English is in the appendix of this manuscript.

4.3 From survey results to data

The questionnaire was implemented as an online survey and responses were stored in a data base. In order to work with it, the registered data have been extracted from the online tool and were imported to the software STATA for further data cleansing and analyses. Figure 8 summarises the main steps of data processing.

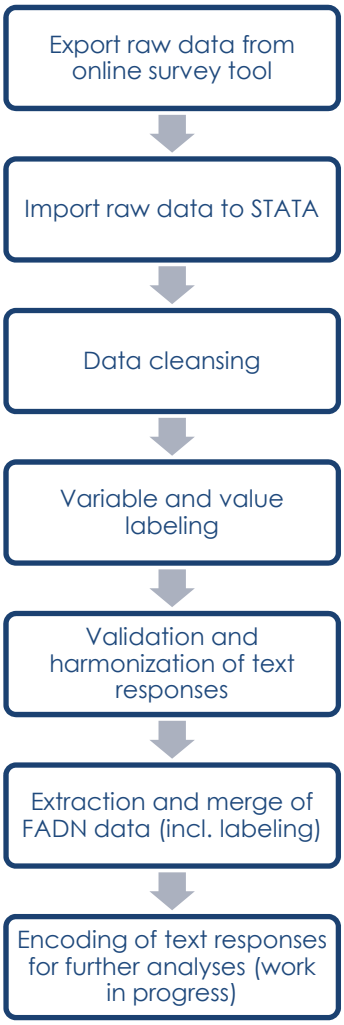
The command-based STATA software allows for complete documentation of all data manipulation steps. Each modification is automatically registered by the respecting command line and can be easily reproduced by just importing the raw data and starting the STATA-code again.

Before importing data into stata, as a first step the data had to be cleaned concerning variable format and data structure. For instance, some of the integer variables have been identified as string variables due to mis-specified responses by the interviewees (for instance, if the respondent entered characters instead of numbers). Furthermore, empty variables which have been caused by the online tool due to the technical reasons had been deleted. Due to technical reasons (related to the optional question modules not all respondents had to fill in) we also had to merge some variables containing answers to the same question.

Data cleansing also included the deletion of duplicates (in 14 cases one and the same respondent started the survey twice) and of incompletely filled-in responses. We dropped 23 cases which only answered the introductory questions but did not go on any further. We also checked whether any of the respondents just clicked through the questionnaire but did not

make any efforts to seriously answer the questions. We did not find any striking pattern in the responses that made it necessary to make additional deletions. After dropping these observations, our dataset contains 419 useful observations. But not all of these respondents filled in all the questions. Finally, data cleansing also included filling up variables if only the answer "yes" has been registered in the online tool (e.g. filling in zeros for tick-box questions with multiple options, i.e. if the answer was "no") in order distinguish it from missing values.

Figure 8: Flow-chart of working steps in data processing



Source: own construction.

In the next step, we renamed the variables to get rid of the technical wording of the online tool and included variable labels which allow linking the dataset to the original questionnaire. We also assigned value labels to the relevant variables (e.g. 1 = "yes", 0 = "no", etc.) in order to ease working with the dataset. Variable labels and value labels are available in both English and German (in concordance with the respective questionnaire).

In the case of text responses, we checked the data for validity and plausibility. This holds for instance for the contact details (incl. address, email-addresses and phone numbers) in order to render possible inquiries if we had any questions for clarification. However, up to now no clarifications were seen to be necessary. Typos or misspecified answers have been corrected (e.g. year of birth '52' was replaced by '1952') and the filled-in responses have been harmonized (e.g. in the case of phone numbers and addresses).

In order to complement our analyses we extracted the corresponding data from the FADN database for those farms which agreed that their data may be merged. In a first step, we checked whether the respondents have filled in correct FADN ID numbers required for merging the data. In some cases we had to correct the FADN IDs due to typos. This was possible in most cases because we had address information (if filled in).

In a final step, we codified some variables to render further analyses possible. This holds in particular for the variables containing innovation examples innovations at the farms (i.e. new products, processes, etc.). The responses are coded to identify similar responses and to assess the novelty of the mentioned innovations. One of the main issues here is the consistency in the codification. Verifying serious analyses requires that similar responses (for instance, different forms of tillage) are identified as similar while different responses (e.g. tillage vs. livestock breeding) are identified as different. One of the targets of this exercise is a structured codification scheme that allows quantitative analyses and the identification of the most often mentioned fields of innovation. However, generating a consistent codification scheme is not trivial task.

Table 3 summarises the number of observations for each block of questions. The verbatim of the questions is given in the appendix of this manuscript. The number of question is corresponding the number given in the questionnaire. The code is used in the analytical data set.

Table 3: Overview of responses for question

code	question	n	code	question	n	code	question	n
F01	frontpage	362	F13	11	191	F25	23	239
F02	frontpage	377	F14	12	368	F26	24	239
F03	1	386	F15	13	349	F27	25	239
F04	2	386	F16	14	225	F28	26	239
F05	3	385	F17	15	212	F29	27	248
F06	4	382	F18	16	239	F30	28	250
F07	5	315	F19	17	239	F31	29	263
F08	6	154	F20	18	239	F32	30	263
F09	7	148	F21	19	239	F33	31	243
F10	8	370	F22	20	239	F34	32	243
F11	9	291	F23	21	239			
F12	10	197	F24	22	239			

Source: own compilation.

5 Agricultural innovation in Austria in the spot light

5.1 Descriptive results of the Austrian agricultural innovation survey 2016

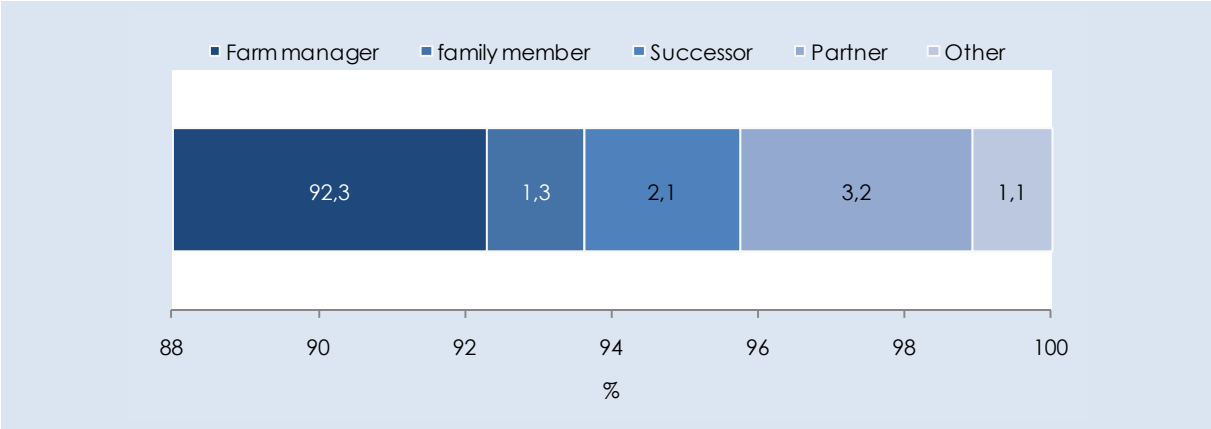
As described in the previous chapter, the interviewees were informed about the survey by their FADN accounting consultant. They either filled in the online survey completely by themselves or with assistance of the consultant. Whether or not assistance was given was not coded in the survey.

Who answered the questions?

The person filling in the questions was mainly the farm manager (92%) who in most cases is also the only owner or the owner of a farm together with his or her partner. In case the manager was not available the partner or another family member or the successor answered the questions. In total 377 persons answered this question.

Respondents were asked about their educational attainment at the end of the questionnaire. The majority of those who were responding to the introductory questions did not answer this question. Of those who responded, more than 80% had a professional training in agriculture. In this group, three quarters have made an agricultural apprenticeship and most of them have a master's degree. They are therefore qualified to train apprentices themselves. More than a quarter of those with professional training in agriculture either were trained on a five-year college or had an agricultural university degree. The majority of the 16% of respondents who do not have a professional agricultural training took courses or participated in training programmes related to agriculture.

Figure 9: My role in the company is …



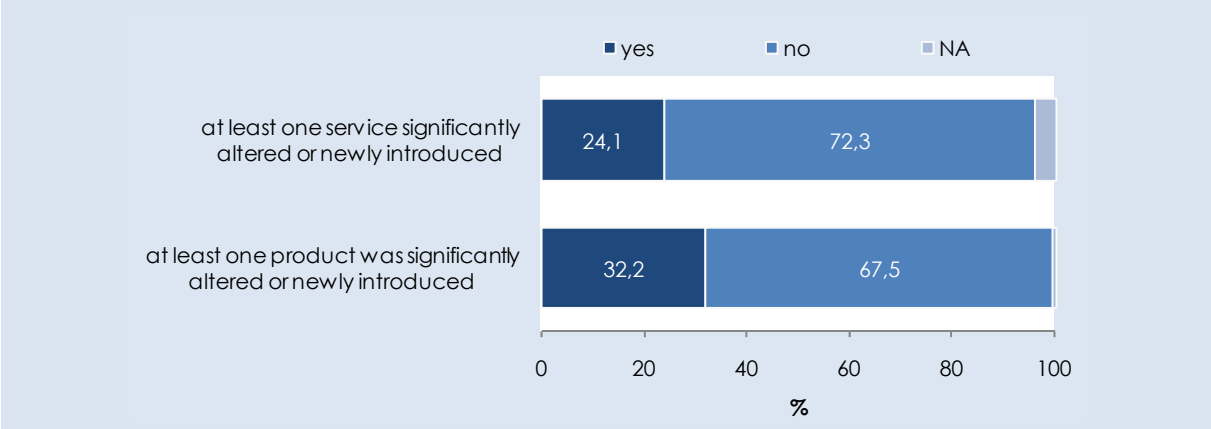
Source: own construction.

Were innovations made between 2011 and 2015 (question 4 of questionnaire in appendix)?

In the majority of cases, neither a product (68%) nor a service (72%) was newly introduced or altered. The very low numbers of non-respondents (0.3% and 3.7%) indicate that the question was easily to understand and to answer. The question relating to products as well as those relating to services was answered by 382 persons. The numbers of innovators are:

- Every third respondent indicated that a new product was introduced or significantly changed.
- Every fourth respondent indicated this with respect to a service.

Figure 10: Innovations made between 2011 and 2015



Source: own construction.

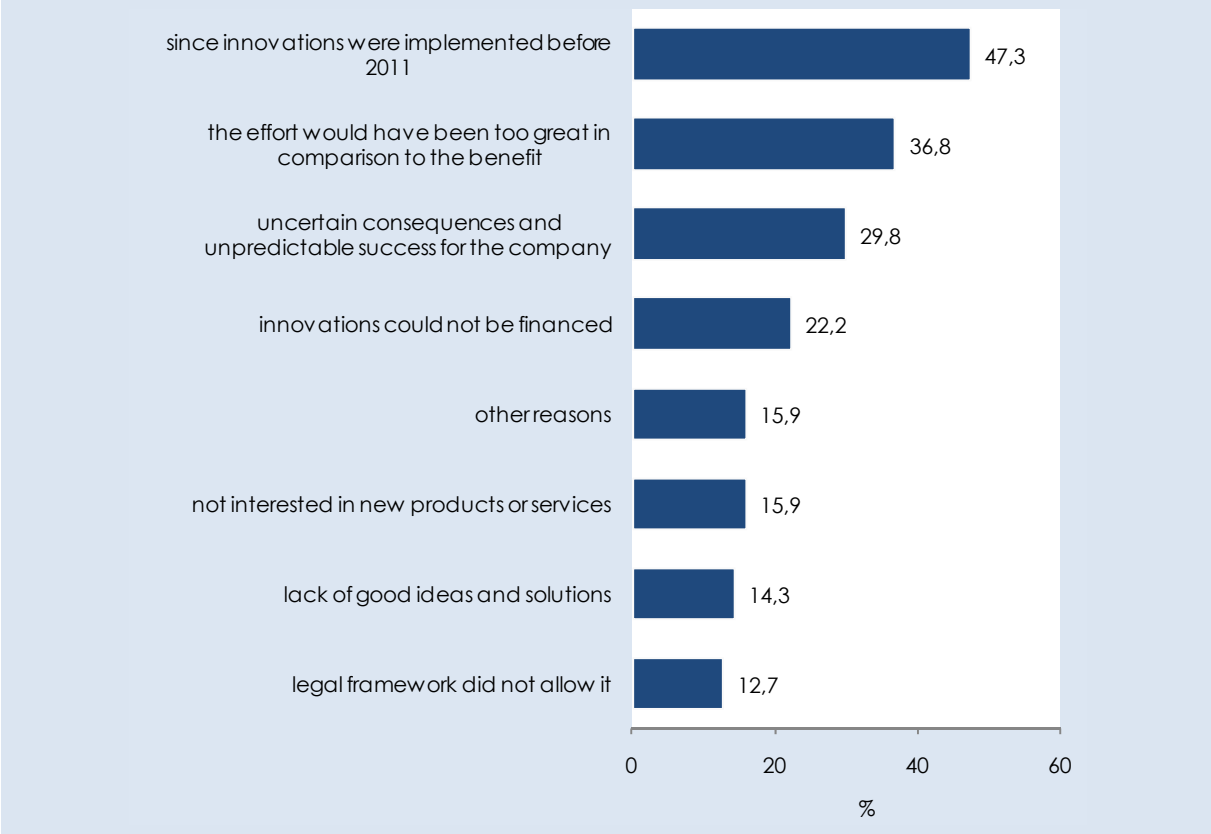
What were the reasons for NOT introducing new or significantly modified products or services between 2011 and 2015 (question 5 of questionnaire in appendix)?

Respondent could choose between eight different options why they had not innovated between 2011 and 2015. Multiple answers were possible.

A large number of respondents (149) indicated that NO innovations were introduced during the reporting period because significant changes were made prior to 2011.

The most important reason for not innovating was an un-acceptable cost-benefit ratio. The second most important obstacle was the uncertainty about the benefits or the success of an innovation. Ranked on the third place was the lack of being able to finance an innovation. A lack of interest or good ideas and legal impediments were ranked similarly, however to a lesser degree.

Figure 11: Reasons for NOT introducing new or significantly modified products or services between 2011 and 2015



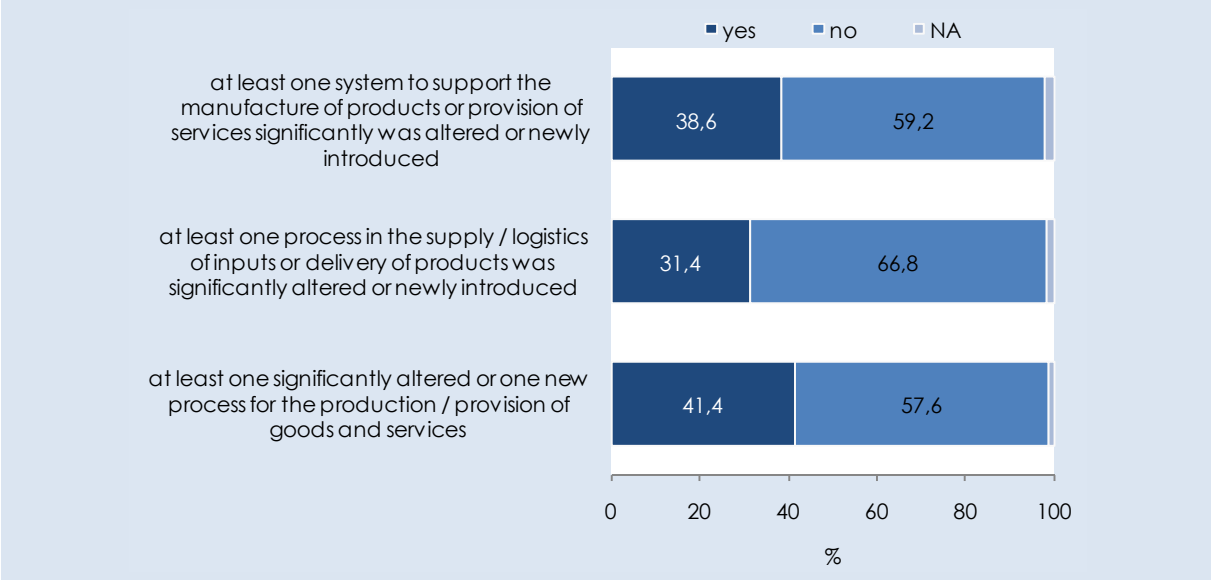
Source: own construction.

What kind of innovations other than products and services were made between 2011 and 2015 (question 8 of questionnaire in appendix)?

The number of persons giving an answer was 370. Put into the context of the previous questions, the high number of respondents indicates that many changes have been made on typical farms. Of those responding to this question,

- 41% indicated that they introduced at least one significantly altered or one *new process* for the production / provision of goods and services;
- 31% indicated that at least one process in the *supply/ logistics* of inputs or delivery of products was significantly altered or newly introduced; and
- 39% indicated that at least one *system to support* the manufacture of products or provision of services significantly was altered or newly introduced.

Figure 12: What kind of innovations other than products and services were made between 2011 and 2015

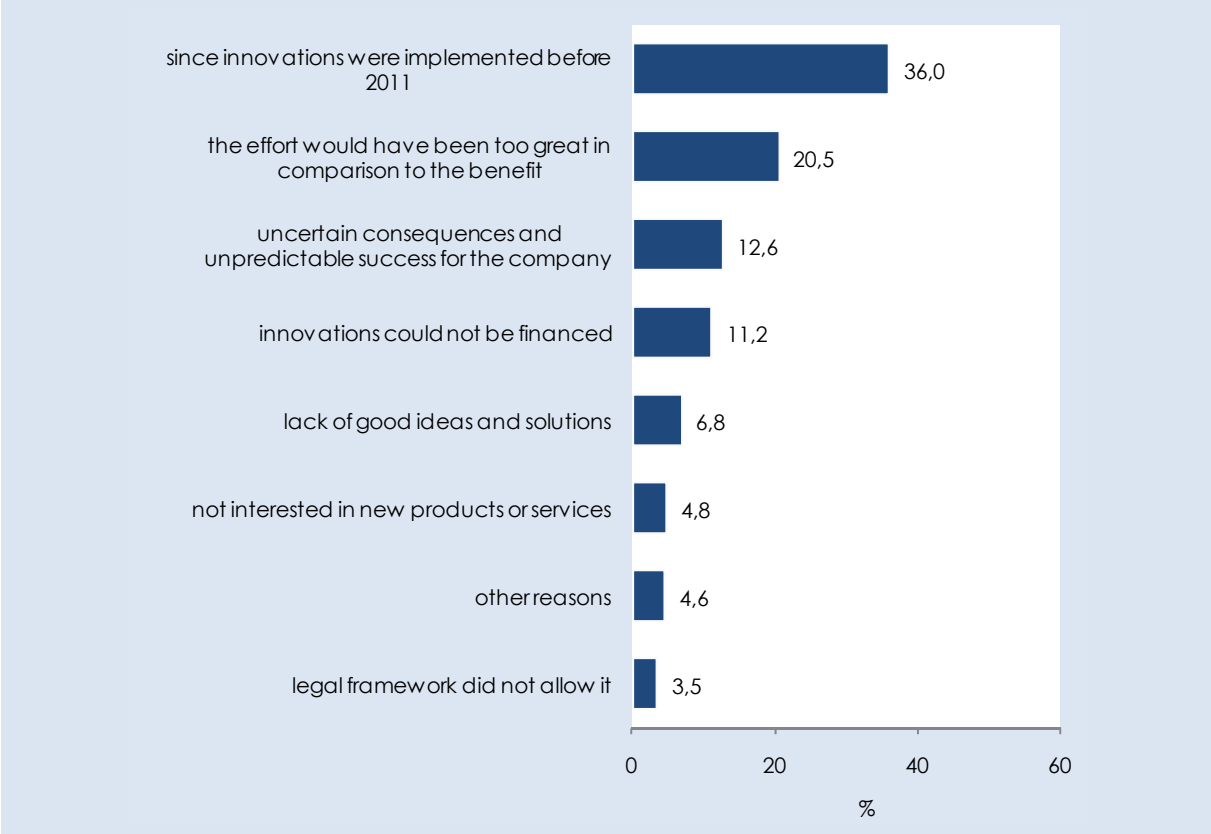


Source: own construction.

What kind of impediments are or were present that prevented that processes / supply and logistics measures / support systems were introduced or significantly modified (question 9 of questionnaire in appendix)?

The answers to this question are very similar to those of the question on the reasons for NOT introducing new or significantly modified products or services between 2011 and 2015. There are only two notable differences: a bad cost benefit ratio was still the most important reason not to innovate but to a much lesser extent and the legal framework was less frequently indicated as an impediment.

Figure 13: Reasons for NOT introducing new or significantly modified innovations other than products or services between 2011 and 2015



Source: own construction.

Which changes took place between 2011 and 2015 (question 9 of questionnaire in appendix)?

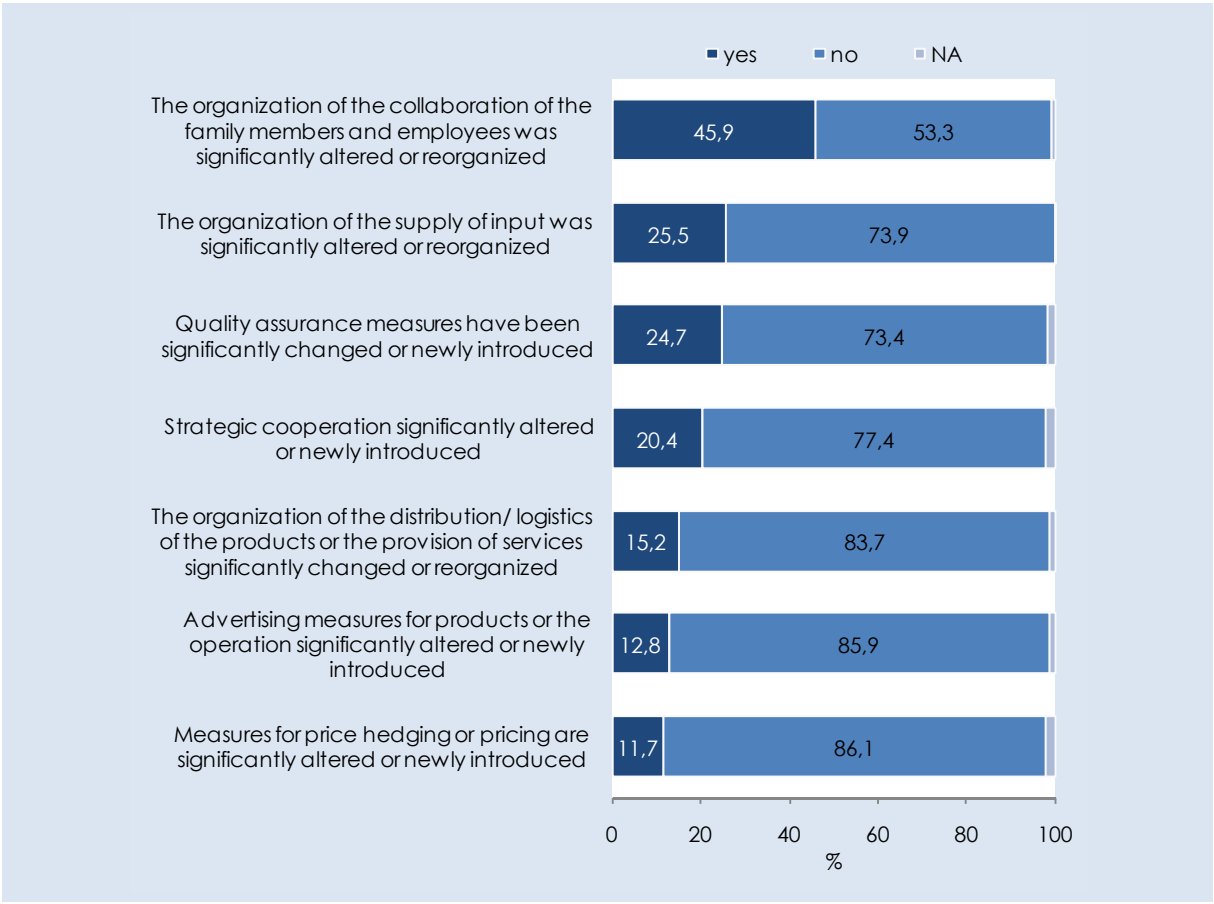
Respondents could indicate whether one or more of seven options applied. These options are listed below in decreasing order:

- The organization of the collaboration of the family members and employees was significantly altered or reorganized. - This option was ticked by 46% of those responding. This high number indicates that frequent changes in the organisation between household members take place.
- The organization of the supply of input was significantly altered or reorganized. - This option was ticked by a quarter of the respondents.
- Quality assurance measures have been significantly changed or newly introduced. This option was ticked by almost the same number of the respondents.
- Strategic cooperation significantly altered or newly introduced. This option was ticked by every fifth respondent.

- The organization of the distribution/ logistics of the products or the provision of services significantly changed or was reorganized. This option was ticked by 15% of the respondents.
- Advertising measures for products or the operation significantly altered or newly introduced. This option was ticked by 13% of the respondents.
- Measures for price hedging or pricing are significantly altered or newly introduced. This option was ticked by 12% of the respondents.

The reasons for not making any change in the list were asked in question 13 of the questionnaire (see appendix). The answers are very similar to those of question 6. The most important reasons not to innovate are that innovations were made prior to 2011 and too low cost-benefit ratios.

Figure 14: Which changes took place between 2011 and 2015



Source: own construction.

How strongly have you been hampered by the following factors when introducing innovations on your enterprise (question 28 of questionnaire in appendix)?

This question is intended to identify those factors that make it really hard for farmers to innovate. Nine options were offered in the questionnaire where respondents could indicate, "very strongly agree", "strongly agree", "agree little", "do not agree at all". When we make two categories out of these four, we are able to identify those factors, that are "strong" or "very strong" impediments for introducing new products and services:

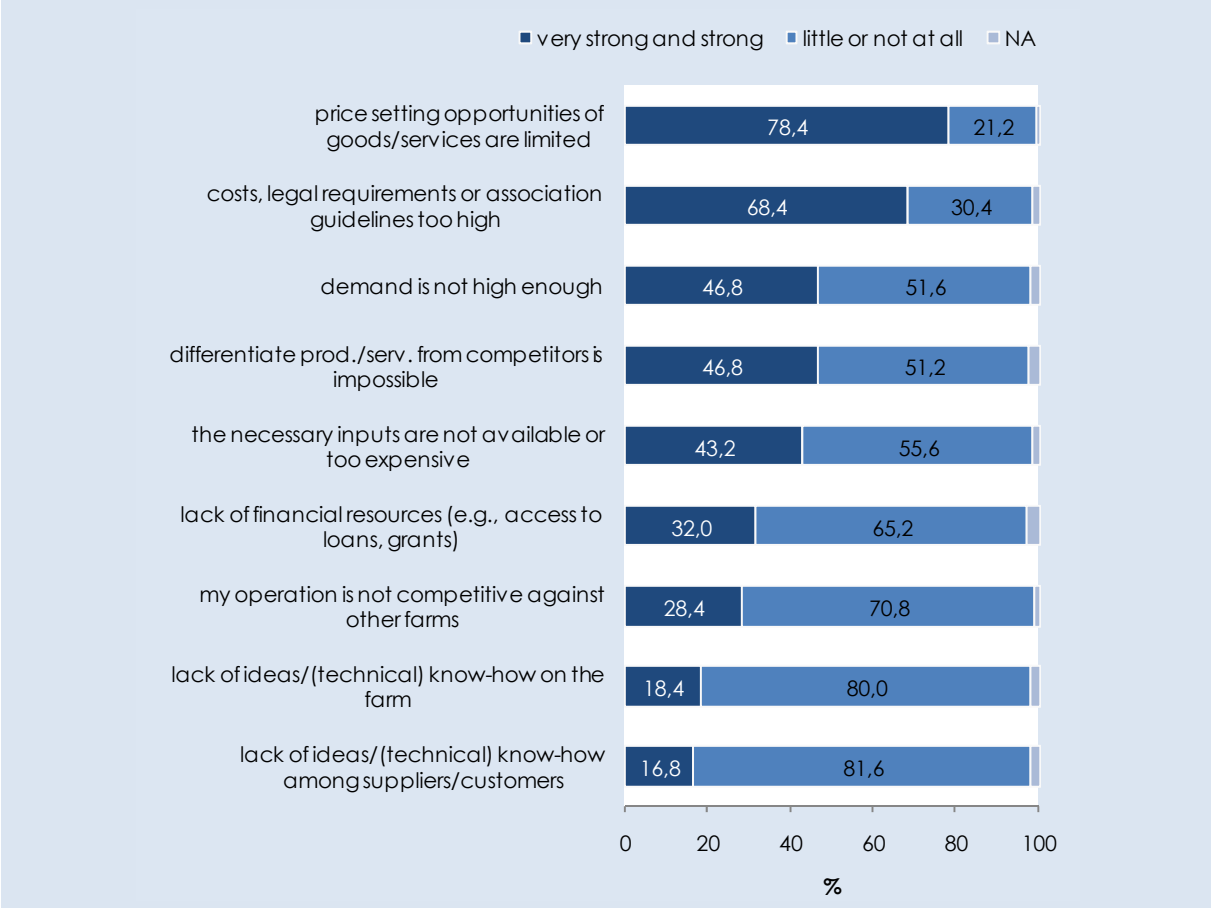
- the possibilities of price setting of goods / services are limited;
- the costs, legal requirements or association guidelines are too high.

Lacking demand and difficulties to separate the own products and services (for example, quality) from the competition are relatively balanced between agreement and disagreement.

The majority of respondents did not agree to the following statements (in decreasing order):

- to differentiate products/services from competitors is impossible
- the necessary inputs are not available or too expensive;
- there is a lack of financial resources (e.g., access to loans, grants);
- my operation is not competitive against other farms;
- there is a lack of ideas or (technical) know-how on the farm;
- there is a lack of ideas or (technical) know-how among suppliers or customers.

Figure 15: How strongly have you been hampered by the following factors when introducing innovations on your business?



Source: own construction.

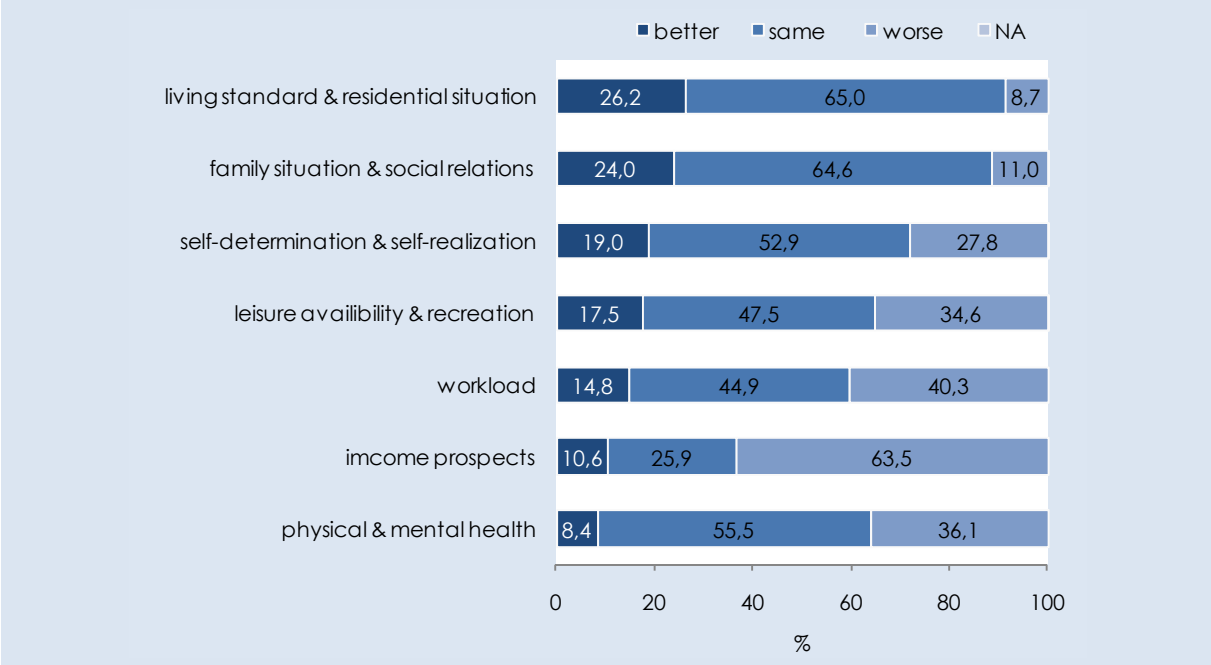
Respondents were asked, how they assess their personal situation in 2015 compared to 2011 with regard to a number of areas *(question 29 of questionnaire in appendix)*. The areas for which an assessment of "worse", "same" and "better" was possible are:

- physical and mental health;
- workload;
- living standard and residential situation;
- leisure availability and recreation;
- family situation and social relations;
- income prospects;
- self-determination and self-realization.

For almost all areas, "just the same" was the pre-dominant answer. The only area where "worse" is overwhelming "just the same" is "income prospects". As discussed in the previous section, this is no wonder given that four years in a row the majority of farmers suffered income losses. Areas in which "better" scored relatively large are "family

situation and social relations" and "living standard and residential situation" but "just the same" was surpassing "better" also in these areas.

Figure 16: How do you assess your personal situation in 2015 compared to 2011 with regard to the following areas?



Source: own construction.

How do you rate your farm's contribution in 2015 compared to 2011 with regard to the following areas (question 29 of questionnaire in appendix)?

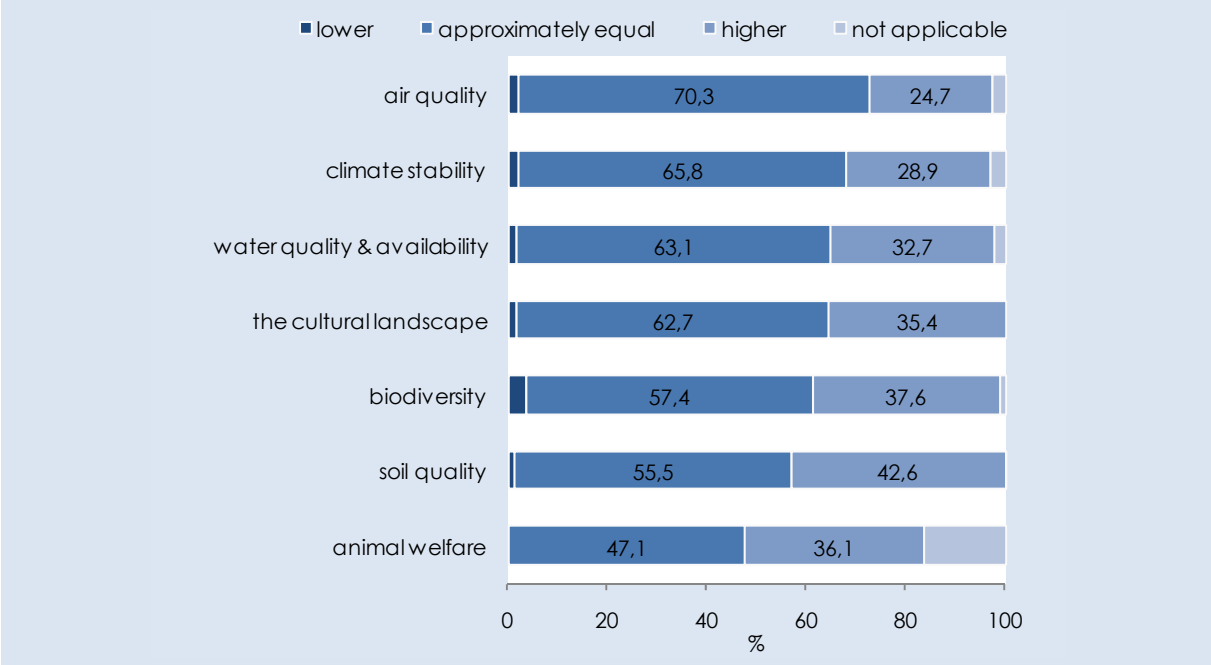
In this question interviewees were asked to make an assessment about environmental areas. The environmental media covered in this question were:

- improving the cultural landscape
- improving biodiversity
- improvement of water quality and water availability
- improvement of air quality
- improving soil quality
- improvement of climate stability
- improvement of animal welfare

"Approximately equal" is the dominating answer in all the areas. In decreasing order, farmers state a "higher" contribution with respect to: soil quality, biodiversity, animal welfare, cultural landscape, water quality and availability, climate stability and air quality. However, not a single area "higher" was surpassing "approximately equal". The results can be explained by the fact that a programme period of the agri-environmental programme ended in 2015 that had started in 2008. It is plausible to

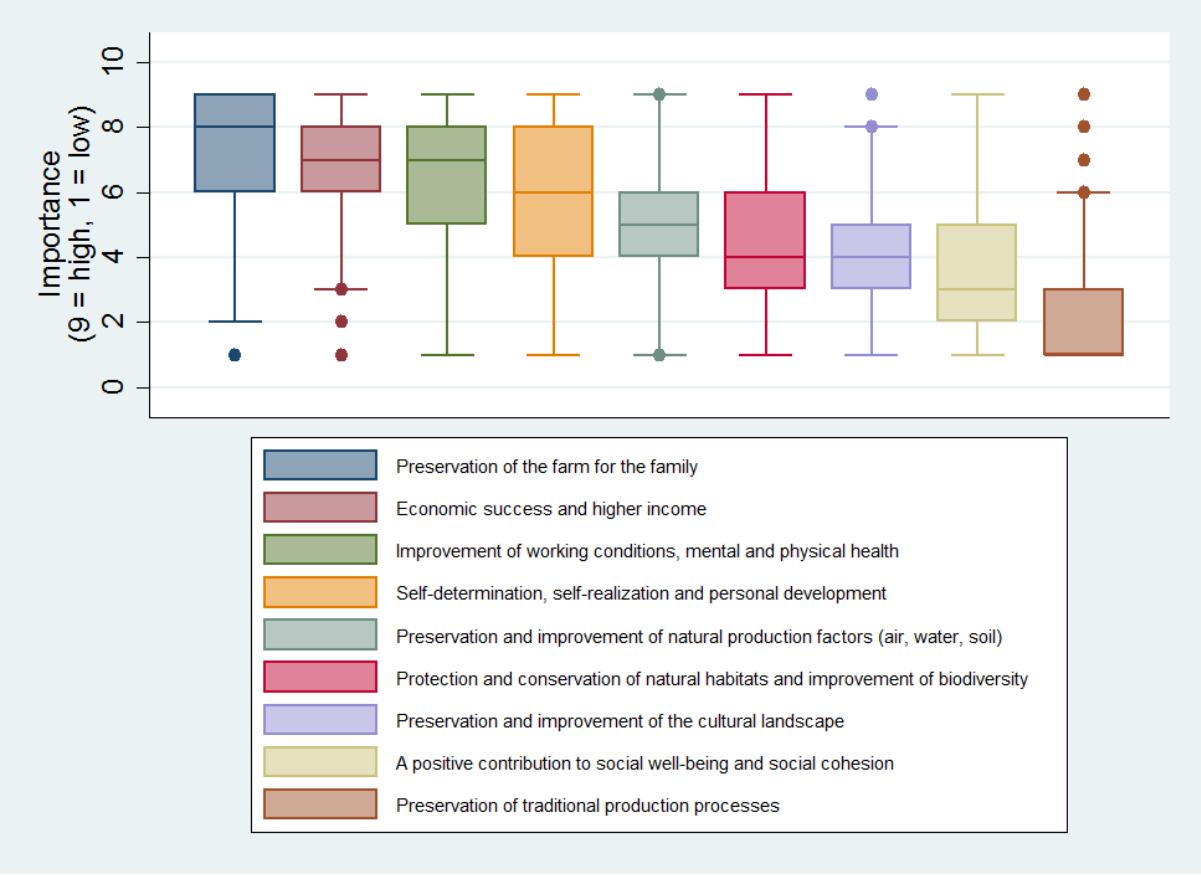
assume that farmers changed their practices from 2007 to 2008 but then continued with the same practices throughout the period 2011 to 2015.

Figure 17: How do you rate your farm's contribution in 2015 compared to 2011 with regard to the following areas?



Source: own construction.

Figure 18: Detailed results on the attitudes of respondents towards family, economy, community and environment



Source: own construction

The importance of information sources for the introduction of innovations on the farm was asked in question 31 (see questionnaire in the appendix).

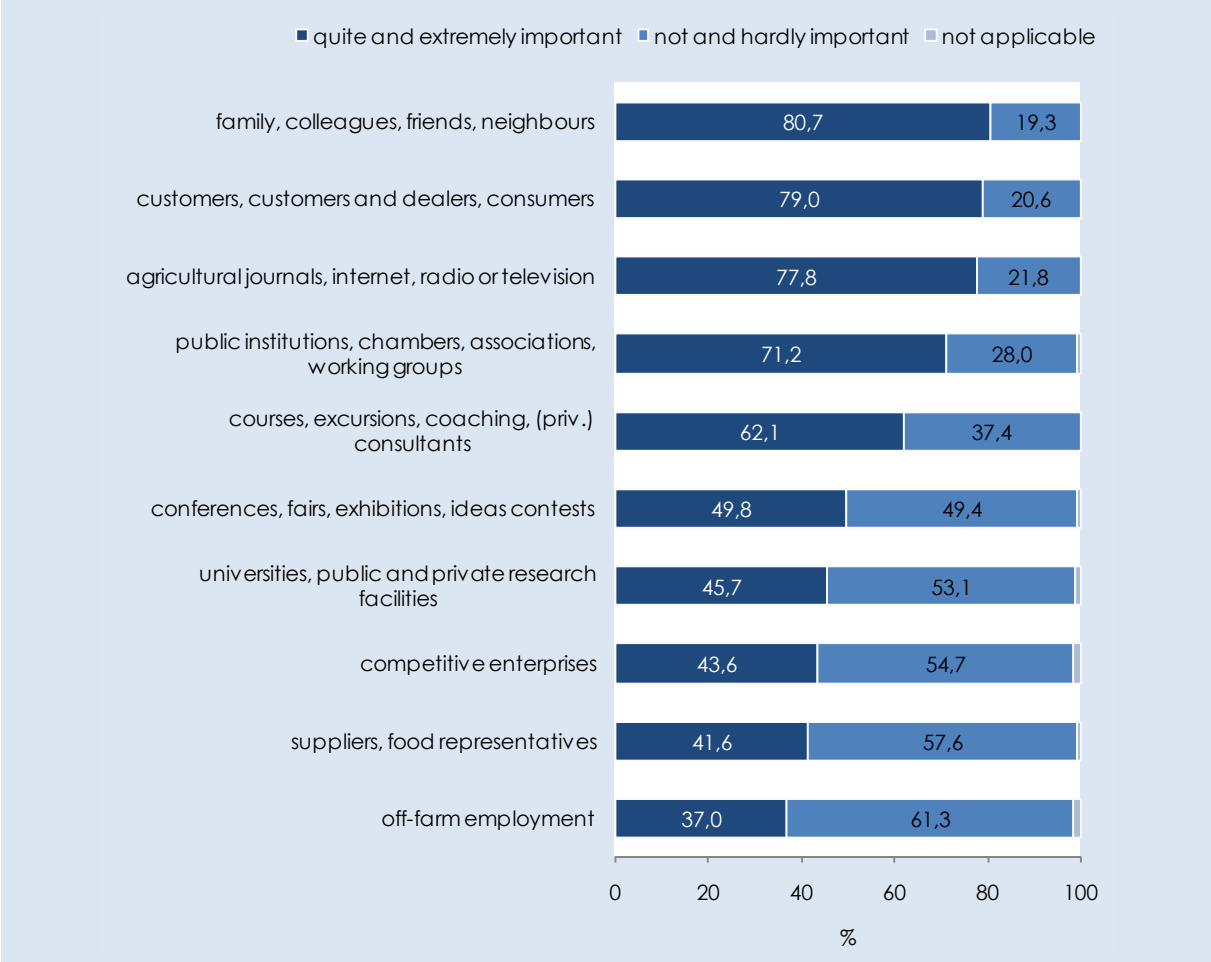
With this question a priority of information sources for Austrian farmers can be derived. The ranking indicates the current importance as an information source and not the foundations of innovations on the farm. The options offered in the questionnaire were:

- family, colleagues, friends, neighbours
- suppliers (e.g., machine trade, construction industry), food representatives
- customers, customers and dealers, consumers
- competitive enterprises
- universities, public and private research facilities
- conferences, fairs, exhibitions, ideas contests
- agricultural journals, internet, radio or television
- public institutions, chambers, associations, working groups

- off-farm employment
- courses, Excursions, Coaching (private consultants and consultants)

The results show that personnel interaction with family members, friends, neighbours, customers, dealers and consumers are the most important sources of information. The motivation to innovate therefore comes primarily from personal and social relations with those people, farmers are interacting personally and professionally. Agricultural journals, the chamber of agriculture with its affiliates and excursions, personal coaching and courses are ranked next. The other information sources are ranked not or hardly important by the majority of respondent. The least important source of information of most farms is "off-farm employment". This result is interesting because experts indicated during the in depth interviews that many famers transfer business practices they observed during phases of employment in other sectors to their farms. Obviously such a knowledge transfer is only possible for those farmers who were, have been or are employed elsewhere. The frequency of off-farm employment was not measured in the survey. According to the recent farm structure survey, more than every second farm is operated part time.

Figure 19: Importance of the following information sources for the introduction of innovations on your farm



Source: own construction.

In question 32 farmers were asked to indicate how important specific reasons were to introduce innovations on their farm (see questionnaire in the appendix).

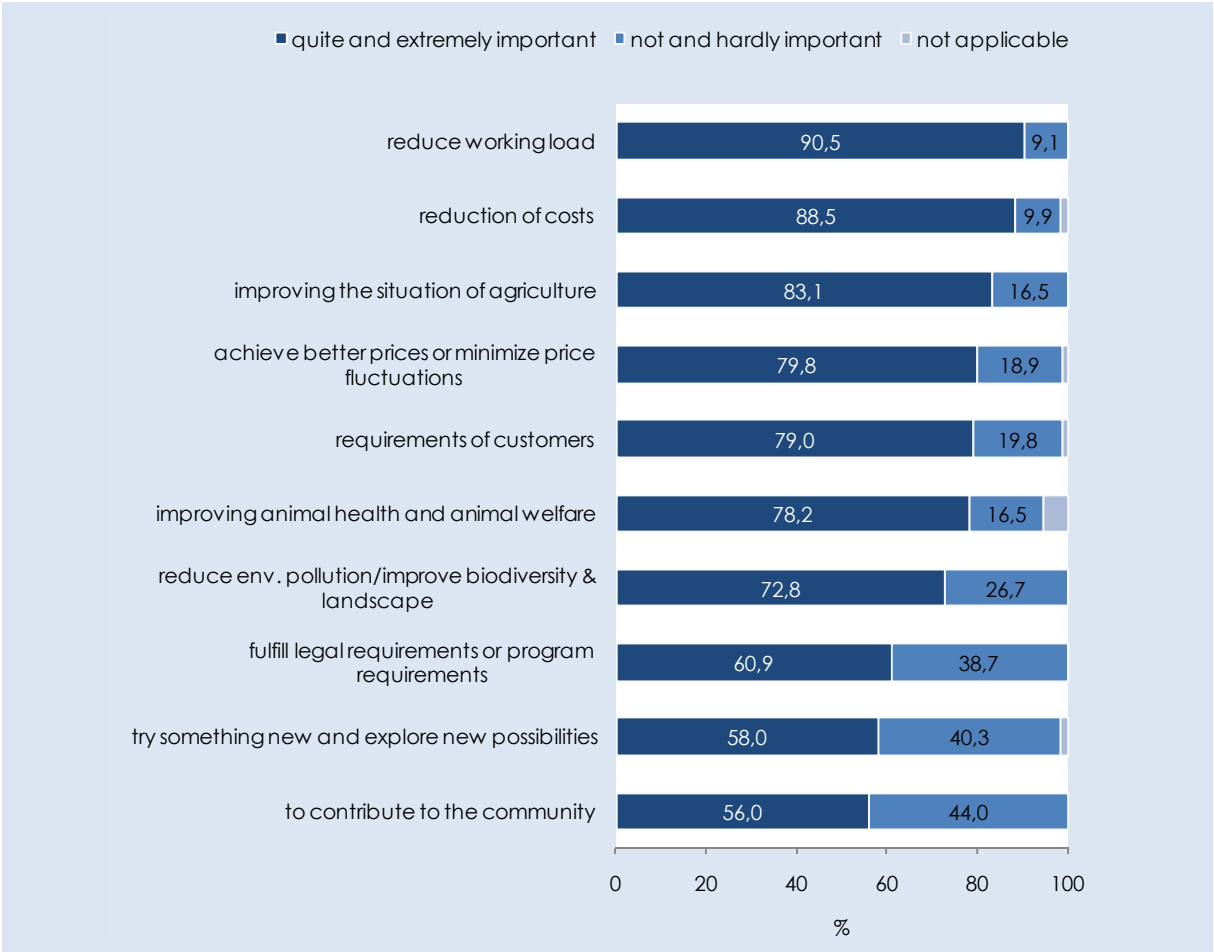
Answers to this question can be interpreted to give a ranking of the most important factors that motivate farmers to introduce new products/processes etc. on their farm. The options offered to the respondents in the questionnaire were:

- achieve better prices or minimize price fluctuations
- requirements of customers
- reduction of costs
- reduce working load
- try something new and explore new possibilities
- fulfill legal requirements or program requirements

- reduce environmental pollution and improve the state of biodiversity and cultural landscape
- improving animal health and animal welfare
- improving the situation of agriculture
- to contribute to the community

The answers show that in any case the largest share goes to "quite important" and "extremely important" whereas only a minority goes to "not important" or "hardly important". The answers clearly indicate that most respondents are concerned about their situation as price takers with only a small set of options to adjust: Reducing efforts of labour, costs and price volatility are the most important motives to introduce changes on the farm. It is interesting that "improving the situation of agriculture" is ranking only slightly higher than "requirements of customers". Relatively less important items are to "try something new and explore new possibilities" and "to contribute to the community".

Figure 20: How important were the following reasons to introduce innovations on your farm



Source: own construction.

An important insight that we made when we developed the questionnaire on innovations in Austrian agriculture is that short run profit maximisation is just one element farmers are caring about. Other aspects like quality of life, awareness to nature are important as well. The most important motive of farmers as shown by our results is the long run stability of the farm. Managing the farm in a way that it survives in an uncertain natural and business environment is ranking top among priorities of decision making.

The time horizon of a typical Austrian farm is therefore a long one. Consequently, many aspects that are characteristic for households are eminent for farmers. The situation of the family and the sequence of generations is among the highest concerns. Because farms are so small, a severe illness or the death of a member of the workforce on the farm makes fundamental changes necessary. In a third of the cases observed by our survey, radical or substantial changes in the organisation of the work have been made during the last five years. Given the capacities a typical farm has such changes require a significant amount of resources which can therefore not be used to make further innovations.

5.2 Empirical findings on innovation barriers and how to overcome them

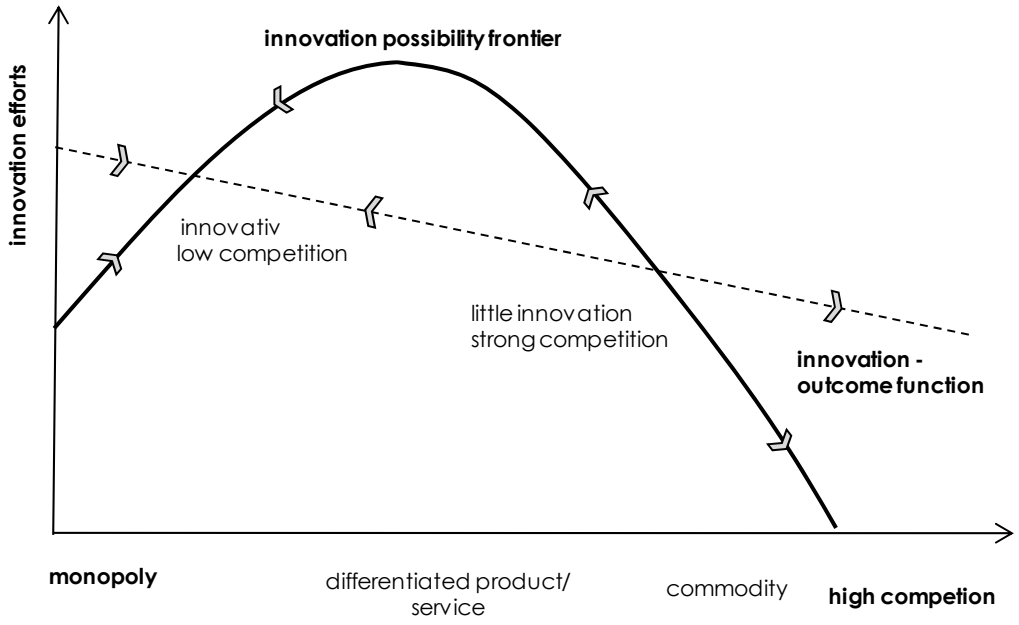
Peneder (2014) presented a concept that shows a correlation between innovation efforts and the pressure of competition. The horizontal axis of this conceptual representation shows the competitive pressure. It is particularly high for firms or farms producing interchangeable and internationally traded commodities. These include inter alia sugar beet, wheat or milk from conventional production. On the other end of the spectrum, there exist no monopolies in agriculture. A high concentration exists only in some areas like animal breeding (e.g. the pure breeding of pigs, queen breeding in bees) but even in these markets the entry barriers are low compared to monopolies in manufacturing industries.

According to Peneder's (2014) concept, a high independent innovation performance is to be expected in those segments in which differentiated products are offered, i.e. where producers can occupy niche markets. Producers of such goods and services make great efforts to make their products distinguishable from the competition (indicated on the vertical axis of Figure 21). These efforts are successful if price increases are achievable compared to standard products.

According to Peneder's model, it is to be expected that producers of any interchangeable goods are less innovative. A good example of this is milk: Producers of conventionally produced milk from GMO-free feeding had a price of 30.8 cents / kg (3.7% fat) in Austria in March 2017. Genetically-free hay milk produced according to the criteria of organic farming had a price of 48.9 cents / kg. The quality premium was therefore almost 60%. In Austria's eastern neighbouring countries where GM-free milk and organic milk are scarce, the average price for milk was about 2 cents or 7% lower than the price for conventional milk in Austria (Agrarmarkt Austria, 2017). In this example, the price differences of quality attributes can be

measured well. An interesting aspect is that a typical consumer will not be able to identify differences in taste between these variants of milk.

Figure 21: Relationship between innovation efforts and competitive pressure



Source: own construction based on Peneder, 2014.

Table 4 shows the assessment of the extent to which lack of delimitation potentials have an inhibiting effect on innovation.

Table 4: Lack of product differentiation as an innovation obstacle

	innovation obstacle: product differentiation is not possible			
	very strongly agree	strongly agree	somewhat agree	don't agree
	new / significantly modified product was introduced			
applies	7%	24%	51%	17%
does not apply	18%	39%	38%	5%
	innovation in production processes and provision was made			
applies	13%	30%	46%	10%
does not apply	15%	37%	39%	9%

Source: own construction; n = 251.

How important product differentiation is can be assessed based on the responses of farmers in the survey. In the upper half of Table 4 a distinction is made between farms where new or significantly modified products were introduced ("applies") or not ("does not apply") in the last four years. Among the respondents who did not introduce any new features, the assessment was widespread perception that there the lack of differentiation possibilities was a very strong

or strong impediment. Those who actually have introduced product or service innovations have seen little or no hindrance because of impediments to product differentiation.

Significantly fewer differences exist between the groups that have introduced or have not introduced innovations in production and provision procedures. Nonetheless, the first group (farmers who were innovative) responded that a lack of differentiation has little or no effect. In the other group (the non-innovators), more than 50% very strongly or strongly agree that a lack of product differentiation possibility was an innovation obstacle. However, the table reveals that the share of innovating farms feeling strong competitive pressure is higher for *production process innovations* than for *product or service innovations*. We conclude from this result that more farms tend to focus on cost reduction (through changes in production processes) if they are not able to differentiate their products (or services) given the competitive environment. This is the behaviour we would expect from of a typical producer in a commodity market where firms are price takers.

6 Conclusions and outlook

In Austria, there is currently no systematic screening of the agricultural innovation system comparable to the studies on the Netherlands, Australia, the USA and many other countries (see OECD, 2015a-d, 2016ab). In connection with a first assessment made by Rosenwirth and Pinter (2014), our research provides an overview but more in-depth analyses are necessary to better understand the innovation system.

The findings of the attitude of the Austrian population to the role of agricultural policy with regard to innovations in agriculture are sobering: Austria is ranking lowest in a recent Eurobarometer survey on the preferences for agricultural policy topics. One possible reason may be that the population is connotating specific practices such as genetic engineering, pesticides or over-fertilization with innovation. The general public obviously does not know that animal-friendly production systems and ecologically valuable management systems are the result of innumerable innovations, which have been developed to a significant proportion of farmers themselves. However, without scientific underpinning and public support we would hardly expect the extent we can observe.

Because of the farm structure in Austria, the possibilities are limited to achieve competitive advantages by means of scale effects. Due to it Austria can not afford to be behind in innovation, but must make a special effort to be better there than other countries in order to compensate for the structural disadvantage.

An innovation policy that focuses on agriculture needs to take account of different regional patterns in farm structural development. In the East of the country and in regions around urban centres (Vienna, Linz, Bregenz, Graz) the rate of farm exits is relatively high. In central Alpine regions there is almost no change in farm structure, the exit rate is very low. In such regions, farms cannot reap economies of scale because growth in land is nearly impossible due to prohibitive transport costs and growth in intensity is hardly possible because of

environmental regulations. Innovations that improve working conditions and save labour for farm activities are likely to generate a higher pay off when combined with innovations in diversification and complementary activities to farming. In regions with strong structural change, farms growing in size of land may be better off when innovating in processes that make scale economies more likely.

A comprehensive look at the present situation is a necessary prerequisite to identify the most effective measures to achieve such a location specific innovation strategy. For such an attainment, our research makes an important contribution by looking at practical situations on Austrian farms.

Our findings confirm the trade-offs that are discussed in the economic literature. Farmers in Austria are forced to make hard choices concerning the strategy of their business. They can either do what price takers are forced to do, i.e. reducing costs or they can make efforts and investments with uncertain returns to develop differentiated products. This route is taken only by a minority of farmers. Our data show that most farms are aware of these two options and are acting accordingly.

Austrian farmers are less interested in short run profit maximisation than in the long term profitability. To pass the farm to children is the strongest motive of farmers participating in our survey. Quality of life and the awareness to nature are important goals for many farmers, as well. Therefore the time horizon of a typical Austrian farm is a long one. Aspects that are typical for households and less typical for firms are important for many farmers. Because of the long time horizon, big investments are made not very frequently. Once such investments are made, capacities on the farm are charged with adjusting to the new situations and processes need to adapt to a new equilibrium. Many respondents indicate that during such periods further innovations on the farm are not made for some while. The programme of rural development supports many of such investments in agriculture. Having in mind that the windows of opportunity for innovations are relatively small, such investment projects should be checked for their innovativeness. More innovative investment projects should get a higher probability of being supported by public money.

Further research efforts need to be made before more detailed policy conclusions can be drawn. When we focus just on factors that prevent innovations, preliminary findings can be reported: legal and administrative requirements and uncertainty about the cost-benefit ratio of changes on the farm are ranking as the two most important impediments. Addressing just these two elements would very likely help more farmers to adjust to the needs of the market. The cost, among the cost of obtaining information and high uncertainty about the benefits are causing the biggest head-ache for farmers in Austria. For firms outside the agricultural sector special instruments or approaches were developed such as business angels or private equity financing for specific projects or venture capital instruments (Peneder and Schwarz, 2007). Such possibilities should be more widely used in agriculture. To develop special information material like a brochure with a title "how to finance innovative projects in agriculture" should be on the agenda of extension services.

A lack of good ideas, a lack of good examples that show options of innovations that can be implemented on the farm are not among the barriers that prevent innovations in Austria. This finding is encouraging, because it shows that farmers have adequate access to a broad range of useful information sources. Among them are farm journals and the advisory system offered by the chamber of agriculture and peers that open their farm for excursions are very important. Strengthening the Austrian agricultural innovation system therefore may require to further improving the quality of these elements of the innovation system.

The survey results indicate that according to farmers perceptions scientific research is not significantly contributing to their innovative capacities. We know from the economic literature that publicly funded research is a major source of innovations in agriculture. The two perceptions need not necessarily to be contradicting each other. We interpret these findings that there is a chance of even making publicly funded research more effective by bringing applied agricultural research closer to the farms than was done previously. Actually, agricultural policy has provided new instruments (the European Innovation Partnership) in the current programme of rural development to achieve this. Whether this instrument is actually closing the gap between applied research and farmers is up to be evaluated in the coming years. If this approach is not performing well, new instruments should be employed.

The descriptive presentation of the interviews among farmers is consistent with the theoretical framework outlined in the previous section: Companies that implement innovations can clearly differentiate products against the competition. The way in which causality works must be underpinned by further econometric assessments. Such further analysis seems necessary, in particular since there exists a broad range of other motives and reasons for agricultural innovations besides economic considerations.

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APENNDIX

WIFO ÖSTERREICHISCHES INSTITUT FÜR WIRTSCHAFTSFORSCHUNG

BOKU

INNOVATIONS IN AGRICULTURE

Questionnaire

The Austrian Institute for Economic Research (WIFO) and the University of Natural Resources and Applied Life Sciences (BOKU) are investigating prospects for Austrian agriculture up to the year 2025. Together with the LBG Austria the importance of innovations for farms, farmers and the environment is investigated. We are looking into the period from 2011 to 2015 and ask all voluntary bookkeeping companies in Austria. We ask you to support this study and to participate in our survey.

We will raffle 10 subscriptions of a trade journal among the participants (you can choose from the following: "Progressive farmer", "DLZ magazine" and "top agrar Austria";

For further information, please do not hesitate to contact us:

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Use of data:

Your data will be strictly confidential and will not be passed on to third parties. The results will not allow any conclusions to be drawn on individual farms. An analysis of your questionnaire will be provided to you - and only to you - if you wish. You will then see how your operation ranks compared with other farmers in our sample. An anonymous evaluation of all companies is used exclusively for scientific analyzes. Your details can not be traced.

To make the survey as simple as possible, we have reduced the survey to the core elements of the study. If you agree, important key figures for your company are used by LBG Austria in an anonymous manner to supplement the analysis.

Please select only one of the following:

□ I hereby agree to the fact that data on my farm is provided by LBG Austria in an anonymized form.
My LBG number is:

_____

□ I do not want to announce my LBG number, but still participate in the survey.

My role at the company is:
Please select only one of the following:
□ farm manager
□ Not farm manager; My function is: _____

We would like to invite you to a brief general assessment of your personal situation and of your business

1 How satisfied were you with the **economic success** of your company?
Please select the appropriate answer for each point:

In 2015 I was with the economic success of my company ...
□ extremely satisfied
□ quite satisfied
□ mediocre satisfied
□ hardly satisfied
□ not satisfied

Compared to 2011 I was in 2015 with the economic success of my company ...
□ much more satisfied
□ more satisfied
□ equally satisfied
□ less satisfied
□ much less satisfied

2 How satisfied were you with your **quality of life**?
Please select the appropriate answer for each point:

2015 I was with my life quality ...
□ extremely satisfied
□ quite satisfied
□ mediocre satisfied
□ hardly satisfied
□ not satisfied

Compared to 2011 I was in 2015 with my life quality...
□ much more satisfied
□ more satisfied
□ equally satisfied
□ less satisfied
□ much less satisfied

3 How satisfied were you with the **state of the environment and nature** on your farm? If you are holding farm livestock, please also include animal welfare and animal health in your estimation.
Please select the appropriate answer for each point:

In 2015 I was with the state of environment and nature on my farm ...
□ extremely satisfied
□ quite satisfied
□ mediocre satisfied
□ hardly satisfied
□ not satisfied

Compared with 2011 I was in 2015 with the condition of environment and nature on my company ...
□ much more satisfied
□ more satisfied
□ equally satisfied
□ less satisfied
□ much less satisfied

The next questions are about innovations and changes on your company in the years 2011 to 2015. We are interested in innovations and changes in products, services, processes and the organization of the company.

Please describe whether you have made new or significantly altered goods or services.

4 In the years 2011 to 2015, ...
Please select the appropriate answer for each point:

	YES	NO
at least one **product** was significantly altered or newly introduced. Examples: soya cultivation, mangalitsa-pigs, home-made pesto, biologically produced instead of conventional milk	□	□
At least one **service** significantly altered or newly introduced. Examples: pension horses, "Heurigen", machine services, a swimming pool for agri-tourism, supplying electricity or heat to customers	□	□

→ At least one "no" in response: please Also answer question 5.
→ At least one "yes" as answer: please also answer questions 6 and 7.

5 You have not introduced or significantly modified any new **goods** and / or **services** in the years 2011 to 2015. Please state reasons for this. (*Several reasons possible*)
Please select all that apply:

□ There was no need, since innovations were implemented before 2011.
□ Innovations could not be financed.
□ The legal framework did not allow it.
□ Lack of good ideas and solutions.
□ The effort would have been too great in comparison to the benefit.
□ Uncertain consequences and unpredictable success for the company.
□ I am not interested in new products or services.
□ Other reasons _____

6 You have introduced or significantly modified **goods** and / or **services** between 2011 and 2015. Please give concrete examples of this.
Please give examples below:

a)

_____

_

b)

_____

_

c)

_____

_

7 Please describe the significant changes or new products or services for your company in the years 2011 to 2015.
*Answer this question only for the entries you chose in question **6**.*

Please select the appropriate answer in both columns for each example.

	The product / service was developed...				**When I introduced the new/ or significantly changed product / service to my farm it was...**		
	by me alone	by me in cooperation with someone outside the company	externally and adapted by me	by someone else and introduced without changes	available nowhere else	already available outside my neighborhood	already available within my neighborhood
Product / service as per 6 a)	☐	☐	☐	☐	☐	☐	☐
Product / service as per 6 b)	☐	☐	☐	☐	☐	☐	☐
Product / service as per 6 c)	☐	☐	☐	☐	☐	☐	☐

Please describe whether you have newly introduced or modified **processes** for the production of products or the provision of services.

8 In the years 2011 to 2015,
Please select the appropriate answer for each point:

	YES	NO
I introduced at least one significantly altered or one new process for the production / provision of goods and services. Examples: conversion to plow less soil cultivation, conversion to continuous grazing, the use of new technologies such as milking robots, roof extraction in the drying of hay, a manure trailer with distribution of hose tubing, beginning with agri-tourism, machine services for other farms, poly- tunnel	☐	☐

at least one process in the supply/ logistics of inputs or delivery of products was significantly altered or newly introduced.
Examples: the purchase of fertilizer in loose form instead of in bags, the sale of products with the post office's food box □ □

At least one system to support the manufacture of products or provision of services significantly was altered or newly introduced.
Examples include: improved computer programs for accounting, a faster data connection, on-board computers on the tractor, automated feeding systems, GPS systems for ground handling, electronic reservation and booking system for farm holidays □ □

→ At least one ***"NO"*** as answer: please Also answer question **9**.
→ At least one ***"YES"*** as answer: please also answer questions **10** and **11**.

9 You have in the years 2011 to 2015...
… no process for the production / provision of products and services ... and / or
... no process in the field of supply/ logistics of input or sales of products ... and / or
... no system to support the manufacture of products or providing services ...
…… significantly altered or newly introduced.
Please state reasons for this. (*Several reasons possible*)
Please select all that apply:

□ There was no need, since innovations were implemented before 2011.
□ Innovations could not be financed.
□ The legal framework did not allow it.
□ Lack of good ideas and solutions.
□ The effort would have been too great in comparison to the benefit.
□ Uncertain consequences and unpredictable success for the company.
□ I am not interested in new processes or methods.
□ Other reasons _____

10 In the years 2011 to 2015, you have at least...
... a process for the production / provision of products and services ... and / or
... a procedure in the field of supply/ logistics of input or sales of products ... and / or
... a system to support the manufacture of products or providing services ...
…..Significantly altered or newly introduced.
Please give concrete examples of this.
Please give examples below:
a)
_____
___b)
_____
___c)

_____

11 Please describe the significant changes or new processes for your company in the years 2011 to 2015.
*Please answer this question only for the entries you chose in question **10**.*
Please select the appropriate answer in both columns for each example.

	The process was developed...				**When I introduced the new/ or significantly changed process to my farm it was...**		
	by me alone	by me in cooperation with someone outside the company	externally and adapted by me	by someone else and introduced without changes	available nowhere else	already available outside my neighborhood	already available within my neighborhood
Procedure according to 10 a)	☐	☐	☐	☐	☐	☐	☐
Procedure according to 10 b)	☐	☐	☐	☐	☐	☐	☐
Procedure according to 10 c)	☐	☐	☐	☐	☐	☐	☐

Please describe whether you have newly introduced or modified procedures for the organization of your company in the years 2011 to 2015.

12 In the years 2011 to 2015,...
Please select the appropriate answer for each point:

	YES	NO
The organization of the collaboration of the family members and employees was significantly altered or reorganized. Examples: new farm workers at the farm, distribution of tasks on old and young family members	☐	☐
The organization of the supply of input was significantly altered or reorganized Examples: On-line purchase instead of in the warehouse, purchasing by producer association instead of shops	☐	☐
The organization of the distribution/ logistics of the products or the provision of services significantly changed or reorganized Examples: direct sales to consumers instead of delivery to dairy, participation in an online platform, sale via a specialized service provider	☐	☐
Advertising measures for products or the operation significantly altered or newly introduced	☐	☐

Examples: Facebook account for distribution, newsletter, prospectus, advertisements in (local) newspapers

Quality assurance measures have been significantly changed or newly introduced Examples: participation in quality assurance program, ISO certification of a process / product	□	□
Measures for price hedging or pricing are significantly altered or newly introduced Examples: purchase of futures or price hedging on the sale of grain, actions for products or services, loyalty bonuses for customers	□	□
Strategic cooperation significantly altered or newly introduced Examples: company cooperation, long-term acceptance contracts, establishment / accession to a producer association, association with customers of products	□	□

→ At least one ***"NO"*** in response:
Please also answer question **13**.
→ Mind. A ***"YES"*** in reply: please also answer questions **14** and **15**.

13 In the years 2011 to 2015,
... the organization of cooperation between family members and employees ... and / or
... the organization of the procurement of equipment ... and / or
... the organization of the distribution of the products or the provision of services ... and / or
... the advertising measures for products or the operation ... and / or
... quality assurance measures ... and / or
... measures for price fixing or price setting ... and / or
... strategic cooperation ...
……not significantly altered or newly introduced / organized.
Please state reasons for this. *(Several reasons possible)*
Please select all that apply:

□ There was no need to implement innovations before 2011.
□ Innovations could not be financed.
□ The legal framework has not allowed it.
□ Lack of good ideas and solutions.
□ The effort would have been too great in comparison to the benefit.
□ Uncertain consequences and unpredictable success for the operation.
□ I have no interest in new methods or methods.
□ Other reasons: _____

14 In the years 2011 to 2015,
... the organization of collaboration between family members and employees ... and / or
... the organization of the supply of input... and / or

... the organization of the distribution/logistics of the products or the provision of services ... and / or
... the advertising measures for products or the operation ... and / or
... Quality assurance measures ... and / or
... measures for price hedging or pricing... and / or
... strategic cooperation ...

…… significantly altered or newly introduced / organized.

Please give concrete examples of this
Please give examples below:
a) _____

b)

_____

c) _____

15 Please describe the significant changes / innovations of the company organization for your company in the years 2011 to 2015.
*Answer this question only for the entries you chose in question **14**.*
Please select the appropriate answer in both columns for each example.

	The form of farm organization was developed...				**When I introduced the new/ or significantly changed organization of my farm it was…**		
	by me alone	by me in cooperation with someone outside the company	externally and adapted by me	by someone else and introduced without changes	available nowhere else	already available outside my neighborhood	already available within my neighborhood
Organization according to 14 a)	☐	☐	☐	☐	☐	☐	☐
Organization according to 14 b)	☐	☐	☐	☐	☐	☐	☐
Organization according to 14 0 c)	☐	☐	☐	☐	☐	☐	☐

27 Please assess the importance of the following points for the management of your business and list the objectives according to their importance.
Please number each box in order of importance, starting with 1 (to 9)

- ☐ Improvement of working conditions, mental and physical health
- ☐ Self-determination, self-realization and personal development

- Preservation of the farm for the family.
- Preservation and improvement of natural production factors (air, water, soil)
- Protection and conservation of natural habitats and the improvement of biodiversity
- A positive contribution to common good and social cohesion
- Preservation and improvement of the cultural landscape
- Preservation of traditional production processes
- Economic success and higher income

28 How strongly have you been hampered by the following factors when introducing innovations on your business?
Please select the appropriate answer for each point:

	very strong	***strongly***	***little***	***not at all***
The possibilities of price setting of goods / services are limited.	□	□	□	□
To separate your own products and services (for example, quality) from the competition is impossible.	□	□	□	□
Demand is not high enough.	□	□	□	□
My operation is not competitive against other farms.	□	□	□	□
There is a lack of ideas or (technical) know-how on the farm.	□	□	□	□
There is a lack of ideas or (technical) know-how among suppliers or customers.	□	□	□	□
There is a lack of financial resources (e.g., access to loans, grants)	□	□	□	□
The costs, legal requirements or association guidelines are too high.	□	□	□	□
The necessary inputs are not available or too expensive.	□	□	□	□

29 How do you assess your personal situation in 2015 compared to 2011 with regard to the following areas?
Please select the appropriate answer for each point:

	Worse	***Remained the same***	***Better***
Physical and mental health	□	□	□

Workload	□	□	□
Living standard and residential situation	□	□	□
Leisure availability and recreation	□	□	□
Family situation and social relations	□	□	□
Income prospects	□	□	□
Self-determination and self-realization	□	□	□

30 How do you rate your company's contribution in 2015 compared to 2011 with regard to the following areas?
Please select the appropriate answer for each point:

	Less	***Approximately equal***	***Higher***	***Not applicable***
Improving the cultural landscape	□	□	□	□
Improving biodiversity	□	□	□	□
Improvement of water quality and water availability	□	□	□	□
Improvement of air quality	□	□	□	□
Improving soil quality	□	□	□	□
Improvement of climate stability	□	□	□	□
Improvement of animal welfare	□	□	□	□

31 Please indicate the importance of the following information sources for the introduction of innovations on your farm.
Please select the appropriate answer for each point:

	Not important	***Hardly important***	***Quite important***	***Extremely important***
Family, colleagues, friends, neighbors	□	□	□	□
Suppliers (e.g., machine trade, construction industry), food representatives	□	□	□	□
Customers, customers and dealers,	□	□	□	□

consumers				
Competitive enterprises	□	□	□	□
Universities, public and private research facilities	□	□	□	□
Conferences, fairs, exhibitions, ideas contests	□	□	□	□
agricultural journals, internet, radio or television	□	□	□	□
Public institutions, chambers, associations, working groups	□	□	□	□
Off-farm employment	□	□	□	□
Courses, Excursions, Coaching (private consultants and consultants)	□	□	□	□

32 Please state how important the following reasons were to introduce innovations on your farm.
Please select the appropriate answer for each point:

	Not important	***Hardly important***	***Quite important***	***Extremely important***
Achieve better prices or minimize price fluctuations	□	□	□	□
Requirements of customers	□	□	□	□
Reduction of costs	□	□	□	□
Reduce working load	□	□	□	□
Try something new and explore new possibilities	□	□	□	□
Fulfill legal requirements or program requirements	□	□	□	□
Reduce environmental pollution and improve the state of biodiversity and cultural landscape	□	□	□	□
Improving animal health and animal welfare	□	□	□	□
Improving the situation of agriculture	□	□	□	□
To contribute to the community	□	□	□	□

Information about yourself and your company

Note: If you have declared your LBG operating number on page 2, go
→ *Please refer to page 15!*

16 Gender:
□ female
□ male

17 Year of birth:

_____

18 Highest completed education:
Please select only one of the following:

□ Compulsory school
□ Vocational education
□ Vocational middle school
□ AHS
□ BHS
□ University-related educational institution
□ University / University of applied sciences

19 Do you also have a special agricultural education?
□ Yes → Please continue with question **20**
□ No → Please continue with question **21**

20 What agricultural training (s) did you have?
Please select all that apply:

□ Agricultural apprenticeship
□ Agricultural apprenticeship with master craftsman examination
□ Agricultural middle school
□ Agricultural Studies (Uni / FH)
□ Special agricultural courses
□ Other agricultural training: _____

21 The company is ...
□ the main occupation
□ the secondary occupation

22 Predominant operating area:
Please select only one of the following:

□ Field crops
□ Permanent crop operation
□ Feed farm

□ Fattening farm
□ Agricultural mixed operation
□ Forestry

23 Size class based on the total standard output:
Please select only one of the following:

□ 8,000 to <15,000
□ 15,000 to <30,000
□ 30,000 to <50,000
□ 50,000 to <100,000
□ 100,000 to <350,000

24 Operating location
In which district is your business located? _____

25 Size according to agricultural area:
Please select only one of the following:

□ Less than 5 ha
□ 5 to less than 10 ha
□ 10 to less than 20 ha
□ 20 to less than 30 ha
□ 30 to less than 50 ha
□ 50 to less than 100 ha
□ 100 to less than 200 ha
□ 200 ha and more

26 The farm is certified as an organic farm:
□ Yes
□ No

You have completed the questionnaire. Thank you for your valuable support!

Please indicate whether you would like to be informed about the results of the study, would like to participate in the raffle and whether you are available for any questions.

Please select all that apply:

□ I would like to be informed about the results of the study by e-mail.
→ E-mail address please specify below!
□ I would like to be informed about the results of the study by post.
→ Please specify postal address below!
□ I would like to participate in the raffle of 10 subscriptions of a trade journal.
→ Please specify the postal address or the desired trade journal below!
□ I agree that I will be contacted by e-mail to answer any questions
→ E-mail address please specify below!
□ I agree to be contacted by phone to answer any questions
→ Please provide the telephone number below!

The information is only used for possible queries, the sending of the results and any winnings and for NO other purposes.

E-Mail:

_____

Mailing address:

_____

Phone:

_____

Desired trade journal:
□ Advanced farmer
□ DLZ magazine
□ top agrar Austria
□ I am already receiving these journals. (Please contact me for an alternative offer if I am drawn in the raffle).

Thank you for your efforts!

For further inquiries, we are at your disposal:

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