# Applied and planned risk management strategies of Austrian farmers

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**Abstract**

This article presents results on Austrian farmer`s perceptions of risk management measures as well as currently applied and planned risk management strategies. A postal survey of Austrian farmers (N = 486) has been conducted to provide data for the analysis of differences with respect to farm types (cash crop farms, permanent crop farms, forage-growing farms, intensive livestock farms, mixed crop and livestock farms and forestry enterprises), farming methods (organic and conventional farms), employment situation (full-time and part-time farms), and geographic location (mountain farms and non-mountain farms). The results indicate that all subgroups of farmers expect the strategy of financial management to be most effective in coping with risks. Organic, part-time and mountain farmers are more confident in the strategy of off-farm diversification, on average. In comparison with their part-time colleagues, full-time farmers regard farm expansion and insurance as well as cost and revenue management to be more effective. All subgroups of farmers plan to increasingly pursue risk management strategies of adaptive capacity building, cost and revenue management, financial management, and on-farm diversification.

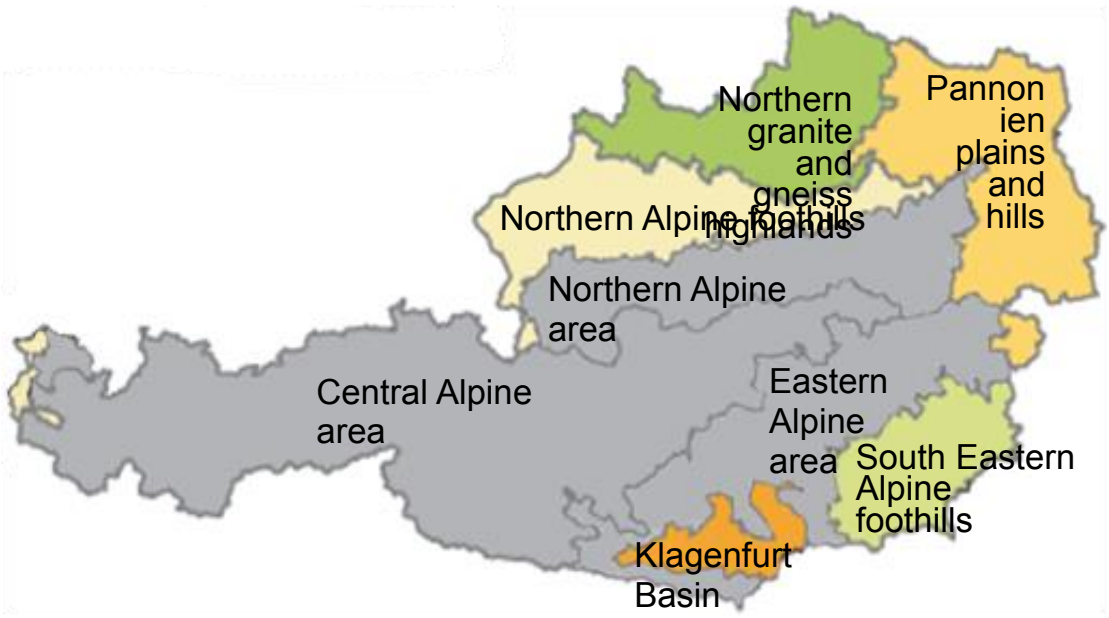
## 1. Introduction and research questions

Landscape, soil and climate conditions usually determine different pathways of agriculture, reflected by different farm types and production intensities. Hence, eight main agricultural production areas with typical patterns of land use and agricultural production are distinguished in Austria. (Wagner, 1990a and 1990b; see Figure 1). The alpine area represents 63% of the total Austrian territory of 84,000 km² and is dominated by forestry, grassland and pastures as well as extensive livestock and milk production. In total, 166,300 agricultural holdings are in Austria of which 38% are classified as mountain farms (BMLFUW, 2015) producing under adverse natural conditions and receiving less-favored area payments from the CAP (Groier, 2016). Mixed crop and livestock farms characterize the agriculture in the Northern Alpine foothills. Intensive forage and milk production is dominating in the West whereas intensive livestock, vegetable and cash crop production is prevailing in the East of the country. The granite and gneiss highlands north of the river Danube experience continental climate and farmers usually specialize in potato, rye and poppy production. Intensive cash crop production with grains, vegetables, fruit and wine is dominating in the Pannonien plains and hills in the North-Eastern part of Austria. Wine and fruit i.e. apple production prevails in the Southern Alpine foothills. The Klagenfurt basin – although located in the southern alpine area – experiences Atlantic climate and farmers mainly specialize on grain and fruit production (Wagner, 1990a and 1990b).

The agricultural pathways are also determined by the economic potential of the farms as well as by personal preferences of the farming families. Austrian agriculture is characterized by mainly small scale farms; the average utilized agricultural area (UAA) is 18 ha per farm. In Austria, 57% of the agricultural holdings cultivate below 20 ha and about 55% are run part-time i.e. the farming couple spends more than 50% of the working time in an off-farm employment (BMLFUW, 2015).

Part-time farms usually extensify agricultural production to balance on-farm and off-farm work (Groier, 2016). In comparison with other European countries, organic agriculture as a certified farming method has been already promoted with public financial support in 1992. With the EC accession of Austria in 1995, the CAP subsidy schemes were applied to organic agriculture as well (Larcher, 2009). The number of organic farms increased from 880 in 1989 to 21,810 in 2013 representing 13% of all agricultural holdings in Austria (Groier, 2016).

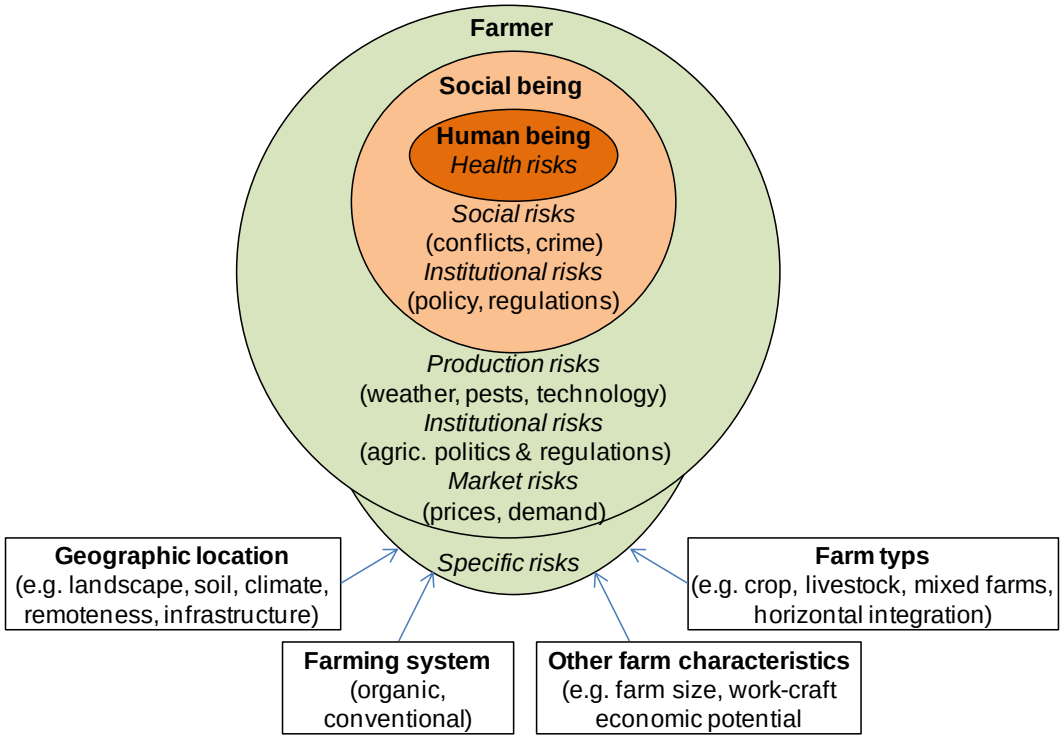
Figure 1: The main agricultural production areas of Austria




Source: Statistik Austria 2016, modified

The risk environment of farmers is graphically shown in Figure 2. Farmers are both biological human beings facing health risks and social beings living with others in personal and institutional relations based on common values, rules and regulations. Social risks like personal conflicts, non-compliance, crime or disadvantages from governmental and international laws and regulations may occur. Farmers are also confronted with a broad range of professional risk sources. Depending on the analytical perspective, risk sources can be distinguished between those being unique for farming as an entrepreneurial activity and specific risk sources due to farm type, farming methods, farm location and other farm characteristics. In particular the specific risk exposure of the farm requires the development of an appropriate and concise risk management strategy, which is a fundamental entrepreneurial activity in agriculture. Considering the retrenchment of political and public risk management measures for agriculture, the awareness of risks and effective risk management has become more important at the farm level, but also for farm extension services.

Figure 2: Illustration of farmer´s risk environment




Source: own description

In general, risk management strategies can be classified in risk avoiding, risk reducing, risk transferring or risk retaining. Each strategy consists of a number of concrete risk management measures such as use of irrigation systems and storage facilities, diversifying income or buying insurance products. The combination of different measures in an appropriate and successful risk management strategy serves two main aspects: first, it has to meet the individual security needs and secondly, it has to synergize with the long-term orientation of the farming family. A literature review reveals a huge variety of empirical models including different variables explaining risk management in agriculture. According to their theoretical framework authors analyzed farmers´ risk management strategies in dependency of either a single factor (e.g. farm size, Wauters et al., 2014) or they included variable sets addressing psychological and social factors as well as socio-demographic characteristics of the farmers and farm structure (e.g. Flaten et al., 2005; Lien et al., 2006; Meuwissen et al., 2001; van Duinen et al., 2015). In this paper we want to focus on risk management strategies according to different pathways of agriculture, represented by farm types, farming methods and farm geography. Regarding these relations Meuwissen et al. (2001) found that risk management strategies to reduce price risks were relatively less relevant to Dutch managers of dairy farms and insurances to those of mixed farms. Managing risks via diversification strategies was most important to pig farmers and via stabilization of income to dairy farmers. Flaten et al. (2005) found that Norwegian organic farmers see flexibility in production and marketing as well as collecting information as important risk management measures. In contrary, debt management, cooperative marketing and veterinary services were more important to conventional farmers. The authors also show geographical differences: farmers located in favored areas without regional policy priority paid more intention to flexibility and less importance to insurance than farmers in areas with regional policy priority (Flaten, et al., 2005). Significant differences in risk management between full-time and part-time farmers in Norway were reported by Lien et al. (2006). Part-time dairy farmers considered off-farm investment, off-farm work, surplus machinery capacity,

storage, and debt management as more important than their full-time colleagues. Full-time crop farmers paid more importance to good liquidity, use of risk reducing technologies, cooperative marketing, use of economic consultancies, enterprise diversification and use of production contracts.

The aim of this article is to provide empirical results of Austrian farmer´s perceptions on already applied and planned risk management strategies by:

i) farm type (cash crop farms, permanent crop farms, forage-growing farms, intensive livestock farms, mixed crop and livestock farms and forestry enterprises),
ii) geographic location of the farm (mountain farms and non-mountain farms),
iii) farming method (organic and conventional farms), and
iv) employment situation (full-time and part-time farms).

The article is structured as follows. In section 2, we describe the empirical methods used. Section 3 is dedicated to the results. After describing the sample we present and discus the results with regard to the perceived efficiency of risk management measures and the perceptions of risk management strategies according to different pathways of agriculture. Finally in section 4, we draw some conclusions.

## 2. Material and methods

The data for the analysis presented in this article result from a postal survey of Austrian farmers, conducted between January and March 2015. A four pages questionnaire was sent to a stratified sample of 2000 farmers. The strata refer to the Austrian farm type classification of the IACS[1]: cash crop farms, permanent crop farms, forage-growing farms, intensive livestock farms, mixed crop and livestock farms, and forestry enterprises. The questionnaire contained five sections on i) general attitudes towards farming, entrepreneurship and risk, ii) experiences and perceptions of risk sources, iv) perceptions of risk management measures, currently applied and planned risk management measures, and finally v) socio-demographic and farm characteristics. Methodologically the survey followed the psychometric paradigm (Slovic, 2007) focusing on the perceptions of individuals measured by socio-economic scaling. Accepting the limitations of survey technics in the social sciences in principle, e.g. strategic-responses, social-desirability, the strength of this approach is to embrace perceptions as the result of complex mental processes, considering specific contexts. Its weakness is the limited comparability of contextualized results. By the end of March 2015, a total number of 502 questionnaires was returned. After excluding 16 incomplete questionnaires, a sample of 486 questionnaires was available (response rate 25%). The data were manually recorded in a SPSS data sheet and analysed by using IBM SPSS 21. This article provides results for section iv, i.e. perceptions of risk management measures, currently applied and planned risk management measures. Hence, 38 different risk management measures based on international literature (e.g. Patrick et al., 1985; Martin, 1996; Meuwissen et al., 2001; Flaten et al., 2005; Schaper et al., 2010) were listed and farmers were asked to assess each of it with regard to the perceived effectiveness in controlling risk on a Likert type scale with 1 = very ineffective, 2 = rather ineffective, 3 = partly (in)effective, 4 = rather effective, 5 = very effective. Additionally, farmers should indicate which risk management measures they have been already implemented on their farms and which ones they plan to continue or to implement in the following five years at first time. We present a descriptive analysis of the data and an explorative factor analysis (principal

[1] IACS refers to Integrated Administration and Control System (German: INVEKOS) based on Council Regulation (EEC) No 73/2009 and Commission Regulation (EC) No. 1122/2009. It differentiates seven farm types: cash crop farms, permanent crop farms, forage-growing farms, intensive livestock farms, mixed farms crop and livestock, forestry enterprises and horticultural enterprises. The horticultural enterprises were excluded from the study, because of the small number in the database.

component method including varimax rotation) to summarize information on farmer´s perceptions of risk management measures in a smaller number of related risk management strategies (factors). Kaiser-Meyer-Olkin measure (KMO) of sampling adequacy of 0.893 suggests a good quality of the data set for factor analysis. In order to determine the appropriate number of factors latent root criterion with eigenvalue above 1.2 and visual scree plot test were used. Factor solutions with 6, 7 and 8 factors were tested. Finally, we decided for the 8 factor solution, because this set was best-shaped, most feasible and best interpretable. A total variance explanation of 53% is seen as satisfactory for an empirical social science study.

In further analysis, all risk management measures with a rotated factor loading of ≥0.4 were subsumed under the respective factor (see Table 1). In order to develop an indicator for the perceived effectiveness in controlling risk of the management strategies represented by one of the eight factors, the scores of the risk management measures belonging to each factor were averaged. Similarly, the level of risk management strategies currently applied and the level of planned risk management were defined as quotients of the number of applied (planned) risk management measures of a factor divided by the total number of management measures belonging to this factor. On basis of this data, we explored the differences among groups, defined by farm type, farming method, employment situation and farm geography. As the data are not normally distributed, non-parametric tests were employed. The Mann-Whitney test was used for pair-wise comparison of organic and conventional farmers, full-time and part-time farmers, and mountain and non-mountain farmers. The Kruskal-Wallis test was employed for analyzing differences by farm types, followed by a series of pair-wise comparison using the Mann-Whitney test with Bonferoni correction.

## 3. Results and discussion

In this section we present and discuss the results of the statistical analysis. In section 3.1, we describe the sample according to different pathways of agriculture represented by farm type, farming method, employment situation and geographic location. Section 3.2, is on the perceived efficiency of risk management measures and the results of factor analysis. According to different pathways of agriculture we present the perceptions of risk management strategies in section 3.3, and the levels of applied and planned risk management in section 3.4.

### 3.1 Sample description

This sample contains 25 permanent crop farms (5.1%), 54 forestry enterprises (11.1%), 236 forage-growing farms (48.6%), 47 mixed farms (9.7%), 105 cash crop farms (21.6%) und 19 intensive livestock farms (3.9%). There is no response bias in respect to the farm types in the IACS data base according to a Chi Square test ($p \leq 0.05$). In contrast, the sample contains a higher percentage of full-time farmers (51.3%; IACS: 37.2%), organic farmers (22.3%, IACS: 16.5%) and mountain farms (49.1%; IACS: 41.2%).

### 3.2 Perceptions of risk management measures and strategies

In total, 38 risk management measures were presented to the farmers requesting to evaluate the effectiveness in managing risks. Table 1 presents the average scores of the evaluation and the standard deviations of each risk management measure (see column 2 and 3). On average, the highest scores on effectiveness were given to financial risk strategies i.e. keeping debt low (4.06), obtaining liquidity (4.03), and producing at lowest possible costs (3.83). Farmers, on average, also gave relatively high scores to risk management strategies related to the established portfolio of extension services and agricultural education i.e. using legal advice services (3.83), information services (3.73), agricultural consultant services (3.63), financial advice services (3.56), training in

agricultural production and marketing (3.64), and training in farm management (3.57). Production risk management strategies are perceived by farmers to be rather effective and include: preventive plant protection and animal health care (3.80), production of valuable quality products (3.75), adopting production technology to climate change (3.53), flexibility in respect to market changes (3.55), and participation in the Austrian agri-environmental program (3.63). Management strategies perceived by farmers as partly effective and partly ineffective in coping with risks have a strategic long-term management focus i.e. agricultural specialization is the one with the highest average score in that group (3.37), followed by off-farm employment of the farm mangers spouse (3.30), avoiding employment of off-farm workers (3.26), production diversification (3.17), off-farm work of the farm manager (3.09), production expansion (2.99), investing in on-farm businesses (2.96), extensifying production (2.82), and reducing farm investments (3.03). Other risk management measures are perceived as indifferent and include: buying insurance (3.27), increasing productivity (3.24), investing in and use of advanced production technology (3.17; 3.31), cooperative marketing (3.13), maintaining storage capacities (3.09), and long-term customer contracts (3.04). Contrary to the literature (e.g. Meuwissen et al., 2001; Flaten et al., 2005; Schaper et al., 2012), buying insurance products is not that important for farmers in Austria according to the results. This might be explained by the high level of insurance already held by the farmers (Larcher et al. 2016). Hedging by commodity futures contracts, options and futures received the second lowest average scores (2.60), probably due to little knowledge about this risk management tool among the Austrian farmers and due to small average farm sizes. This result is confirmed by the findings of the studies cited above. The risk management strategy with the lowest average score is investing in non-agricultural businesses (2.55), suggesting that using capital other than for farming is not favored by many farmers.

The explorative factor analysis reduced 38 risk management measures to bundles of eight distinct factors, each representing a risk management strategy. The grouping of a risk management measure to a factor is determined by a rotated factor loading of ≥0.4 (see Table 1). The interpretation of the factors is due to the subsumed risk management measures: factor 1 is named “adaptive capacity building and technology”. It has high loadings with risk management measures reflecting active adaptation processes of farmers to a changing natural environment as well as to changing market conditions and subsidy schemes. Adaptation activities of the farmers also include personal development of the farmers; training in agricultural production and marketing as well as training in farm management are high loading measures of this factor. The high loadings of using legal advice services and agricultural consultant service can be interpreted as using specific expert support in the adaptation process.

Factor 2 is very similar to factor 1; both have high loadings to risk management measures in respect to technology, training and advice, and both are strongly connected with agricultural production. This suggests unity, but both factors displayed stability in the six, seven and eight factors solution. Therefore, we assume two separate factors with the farmer´s orientation on expansion of the farming business being the main difference. While the adaptation process described by factor 1 does not give evidence for a specific long-term farm development perspective, the adaptation process of factor 2 is directed towards expansion of the farming business. Consequently, factor 2 is interpreted as “adaptation towards expansion and insurance”. Participation in the Austrian agri-environmental program might seem to contradict this interpretation, but this subsidy scheme containing 22 different measures is compatible with almost all strategies of farm development. This argument is supported by the fact that the participation in the Austrian agri-environmental program is also high loading on factor 7 “agricultural extensification” (see below). In respect to agricultural expansion, it might facilitate the achievement by providing additional financial resources.

Table 1: Perceived effectiveness of risk management measures and membership to the extracted factors according to the factor loadings

| | Perceived effectiveness | | Extracted factors[b)] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Average Score[a)] | SD | F1 | F2 | F3 | F4 | F5 | F6 | F7 | F8 |
| Flexibility in respect to market changes | 3,55 | 0,95 | **0,67** | 0,22 | 0,20 | 0,06 | 0,04 | 0,08 | -0,08 | 0,10 |
| Adapting production technology to climate change | 3,53 | 0,96 | **0,73** | 0,14 | 0,15 | 0,09 | 0,00 | -0,02 | -0,03 | 0,02 |
| Participating in regional development projects | 3,10 | 1,01 | **0,66** | 0,06 | 0,21 | -0,03 | 0,13 | 0,18 | 0,17 | 0,00 |
| Training in agricultural production and marketing | 3,64 | 0,91 | **0,72** | 0,26 | 0,21 | 0,07 | 0,08 | 0,08 | -0,08 | 0,01 |
| Preventive plant protection / animal health care | 3,80 | 0,90 | **0,55** | 0,34 | 0,04 | 0,22 | -0,20 | 0,09 | -0,02 | -0,12 |
| Using production technologies such as GPS | 3,31 | 1,07 | **0,46** | 0,33 | 0,31 | 0,08 | 0,02 | 0,19 | -0,16 | -0,08 |
| Using legal advice services | 3,83 | 0,95 | **0,48** | 0,35 | 0,14 | 0,22 | 0,05 | 0,18 | -0,04 | -0,03 |
| Training in farm management | 3,57 | 1,00 | **0,63** | **0,42** | 0,17 | 0,05 | 0,08 | 0,08 | -0,12 | 0,07 |
| Using agricultural consultant services | 3,63 | 0,92 | **0,42** | **0,54** | 0,01 | 0,11 | 0,09 | 0,11 | 0,09 | 0,09 |
| Buying insurance | 3,27 | 1,02 | 0,15 | **0,54** | 0,17 | 0,17 | 0,10 | 0,01 | 0,01 | 0,13 |
| Production expansion | 2,99 | 1,11 | 0,20 | **0,45** | 0,39 | -0,03 | 0,08 | 0,10 | -0,34 | -0,10 |
| Using information services | 3,73 | 1,01 | 0,24 | **0,58** | 0,15 | 0,18 | 0,03 | 0,10 | 0,01 | -0,07 |
| Investing in advanced production technology | 3,17 | 1,00 | 0,28 | **0,58** | 0,32 | 0,05 | 0,02 | 0,06 | -0,22 | -0,04 |
| Using financial advice services | 3,56 | 1,06 | 0,23 | **0,65** | 0,13 | 0,12 | 0,13 | 0,09 | 0,05 | -0,04 |
| Participation in Austrian agri-environmental program | 3,63 | 1,21 | 0,12 | **0,48** | 0,04 | -0,14 | -0,18 | -0,06 | **0,48** | 0,20 |
| Cooperative purchase of farm inputs | 3,45 | 1,04 | 0,31 | -0,07 | **0,50** | 0,24 | 0,02 | 0,05 | 0,09 | -0,02 |
| Maintaining storage capacities | 3,09 | 1,04 | 0,19 | 0,21 | **0,50** | 0,25 | -0,16 | -0,10 | 0,03 | 0,12 |
| Cooperative marketing of my products | 3,13 | 1,12 | 0,32 | -0,02 | **0,58** | 0,16 | 0,15 | 0,20 | 0,11 | 0,10 |
| Increasing productivity | 3,24 | 1,09 | 0,07 | 0,39 | **0,51** | 0,15 | -0,01 | 0,11 | -0,26 | -0,04 |
| Long-term customer contracts | 3,04 | 1,01 | 0,15 | 0,23 | **0,59** | 0,03 | -0,06 | 0,11 | 0,07 | -0,06 |
| Hedging by futures contracts, options and futures | 2,60 | 0,92 | 0,11 | 0,25 | **0,62** | -0,08 | 0,03 | 0,01 | -0,07 | 0,06 |
| Avoiding the employment of off-farm workers | 3,26 | 1,14 | -0,13 | -0,15 | 0,14 | **0,46** | 0,07 | -0,05 | 0,24 | -0,10 |
| Maintaining equity capital | 3,79 | 0,93 | 0,24 | 0,22 | 0,22 | **0,53** | 0,03 | 0,06 | -0,09 | 0,20 |
| Keeping debt low | 4,06 | 1,06 | 0,11 | 0,15 | 0,06 | **0,76** | 0,05 | 0,07 | 0,11 | 0,04 |
| Obtaining liquidity | 4,03 | 0,93 | 0,26 | 0,20 | -0,02 | **0,73** | 0,07 | -0,02 | -0,05 | 0,08 |
| Producing at lowest possible cost | 3,83 | 1,02 | 0,02 | 0,29 | 0,10 | **0,42** | 0,13 | 0,03 | -0,14 | -0,17 |
| Investing in non-agricultural enterprises | 2,55 | 1,08 | 0,15 | -0,08 | 0,33 | 0,08 | **0,55** | 0,16 | -0,08 | 0,16 |
| Off-farm employment the farm manager | 3,09 | 1,29 | -0,01 | 0,06 | -0,07 | 0,04 | **0,76** | -0,03 | 0,12 | 0,01 |
| Off-farm employment the farm managers mate | 3,30 | 1,25 | 0,04 | 0,25 | -0,05 | 0,13 | **0,69** | -0,06 | 0,14 | -0,09 |
| Voluntary work in agr. professional associations | 2,94 | 1,05 | 0,18 | 0,10 | 0,06 | 0,00 | -0,05 | **0,84** | 0,08 | 0,04 |
| Voluntary work in agr. cooperatives | 2,69 | 1,01 | 0,15 | 0,14 | 0,14 | 0,05 | 0,04 | **0,84** | -0,03 | 0,08 |
| Production extensification | 2,82 | 1,01 | 0,05 | 0,02 | 0,03 | -0,05 | 0,14 | 0,01 | **0,69** | -0,07 |
| Reducing farm investments | 3,03 | 0,97 | -0,15 | -0,08 | -0,03 | 0,23 | 0,12 | 0,10 | **0,59** | -0,09 |
| Production specialization | 3,37 | 1,06 | 0,19 | 0,02 | 0,23 | 0,16 | -0,02 | -0,01 | 0,17 | **-0,75** |
| Production diversification | 3,17 | 1,10 | 0,17 | 0,05 | 0,26 | 0,19 | -0,08 | 0,10 | -0,01 | **0,68** |
| Investing in on-farm businesses | 2,96 | 1,31 | 0,35 | -0,07 | 0,29 | 0,07 | 0,33 | 0,10 | 0,15 | **0,41** |
| Production of high-priced quality products | 3,75 | 1,03 | 0,34 | 0,32 | 0,29 | 0,15 | 0,06 | -0,03 | 0,06 | 0,21 |
| Compensating financial straits with forestry income | 3,02 | 1,08 | 0,28 | 0,31 | -0,15 | 0,06 | 0,31 | -0,02 | 0,04 | -0,11 |

a) Average scores measured on a Likert type scale with 1 = very ineffective, 2 = rather ineffective, 3 = partly (in)effective, 4 = rather effective, 5 = very effective.

b) The extracted factors are: F1 = adaptive capacity building and technology, F2 = adaptation towards expansion and insurance, F3 = cost and revenue management, F4 = financial management, F5 = off-farm diversification, F6 = farm community service, F7 = agricultural extensification, F8 = on-farm diversification; membership to a factor with loadings ≥I0.4I (bold).

Source: Survey of Austrian farmers 2015, N = 486; own calculations

Factor 3 “cost and revenue management” has high loadings with measures of transferring price risks like long-term customer contracts and hedging by future commodity contracts, options and futures as well as with measures of reducing price risks or sharing costs (cooperative purchase of inputs and marketing; maintaining storage capacities).

The coherence of high loading risk management measures in factor 4 addressing financial issues like keeping debt low, obtaining liquidity and maintaining equity capital justifies the term “financial management”. Measures of keeping input expenses low like avoiding the employment of off-farm workers and producing at lowest possible costs are also included in this factor. This strategy can be seen as part of a rather conservative farm management style.

The interpretation of factor 5 as “off-farm diversification” is obvious. The risk management measures off-farm employment of the farm manager and of his/her spouse are high loading as well as investing in non-agricultural enterprises. Off-farm diversification can be a strategy of stabilizing small farms by non-farming income and therefore should be typical for part-time farms. But it may also come along with production extensification when handing over the farm to a successor, already employed in a non-agricultural sector.

Factor 6 represents “farm community service” and includes two risk management measures in respect to honorary functions in the context with agricultural organizations. In Austria, honorary functions in agricultural professional organizations as well as in cooperative processing and marketing of agricultural products (e.g. dairy) have a long tradition. Holding such a function provides the possibility of networking and influencing the economic and political environment of agriculture actively. Farmers with honorary functions may be able to gain relevant information earlier than farmers not involved. Therefore, the engagement in agricultural organizations can serve as a risk management strategy of farmers.

Factor 7 represents “agricultural extensification” and is high loading on reducing farm investments, participation in the Austrian agri-environmental program, and on production extensification. It represents a long-term strategy of the farm and is supposed to be correlated with organic farming and with farming in mountainous areas.

Factor 8 represents “on-farm diversification” and has a high positive factor loading with production diversification and a high negative one with its opposite production specialization. The risk management measure investing in on-farm businesses (e.g. tourism or direct marketing) is also included in the factor with a positive factor loading. On-farm diversification like agricultural extensification represents a long-term strategy of the farm, compatible with organic and conventional farming as well as with mountain and non-mountain farming. It is supposed to be less suited to part-time farms and to large scale intensive and specialized production.

### 3.3 Perceptions of risk management strategies according to different pathways of agriculture

Farmer’s perceptions of management strategies represented by the eight factors were analysed by using non-parametric Mann-Whitney and Kruskal-Wallis tests. In respect to farm types, significant differences indicated by the Kruskal-Wallis test (F1, F2, F3, F6, F7) could not be confirmed by the pair-wise Mann-Whitney tests. Consequently, the results on average scores by farm types presented in Table 2 only provide some qualitative information.

The other results in Table 2 show that the highest scores are given to the financial management strategy by most subgroups; the lowest scores are given to farm community service. The perceptions are significantly different between organic and conventional farmers for the strategies of agricultural extensification as well as off-farm and on-farm diversification. Organic farmers assess those significantly more effective than their conventionally producing colleagues. Off-farm diversification is also perceived more effective by part-time farmers and mountain farmers. In contrary to their part-time colleagues, full-time farmers, on average give higher scores to adaptation

towards expansion and insurance as well as to cost and revenue management. Non-mountain farmers regard the risk management strategies of adaptive capacity building and technology as well as cost and revenue management to be more effective, while mountain farmers score the effectiveness of agricultural extensification and off-farm diversification higher.

Table 2: Perceptions of risk management strategies according to farming method, employment situation and geographic location of the farm

| | Average Scores [a] in perceived effectively of risk management strategies | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | F1[b] | F2 | F3 | F4 | F5 | F6 | F7 | F8 |
| **Farm type** | | | | | | | | |
| Permanent crop farms | 3,82 | 3,55 | 3,21 | 3,73 | 2,66 | 2,70 | 3,01 | 3,28 |
| Forestry enterprises | 3,39 | 3,23 | 3,03 | 3,94 | 3,20 | 2,62 | 3,32 | 3,16 |
| Forage-growing farms | 3,47 | 3,40 | 3,02 | 3,79 | 2,95 | 2,82 | 3,21 | 3,12 |
| Mixed farms | 3,52 | 3,46 | 3,17 | 3,72 | 2,75 | 2,78 | 2,98 | 3,23 |
| Cash crop farms | 3,72 | 3,63 | 3,24 | 3,78 | 3,07 | 2,97 | 3,25 | 3,21 |
| Intensive livestock farms | 3,77 | 3,60 | 3,50 | 3,92 | 2,98 | 2,66 | 2,52 | 3,36 |
| **Farming method** | | | | | | | | |
| Organic farm | 3,63 | 3,56 | 3,14 | 3,83 | 3,19* | 2,82 | 3,47*** | 3,30(*) |
| Conventional farm | 3,54 | 3,43 | 3,12 | 3,83 | 2,93 | 2,80 | 3,08 | 3,15 |
| **Employment situation** | | | | | | | | |
| Full-time farm | 3,57 | 3,52(*) | 3,19* | 3,84 | 2,66 | 2,79 | 3,11 | 3,21 |
| Part-time farm | 3,53 | 3,39 | 3,05 | 3,77 | 3,31*** | 2,85 | 3,21 | 3,14 |
| **Farm geography** | | | | | | | | |
| Mountain farm | 3,50 | 3,45 | 3,02 | 3,83 | 3,05* | 2,75 | 3,31*** | 3,15 |
| Non-mountain farm | 3,59(*) | 3,46 | 3,21** | 3,76 | 2,88 | 2,87 | 3,06 | 3,19 |

a) Average scores measured on a Likert type scale with 1 = very ineffective, 2 = rather ineffective, 3 = partly (in)effective, 4 = rather effective, 5 = very effective.
b) F1 = adaptive capacity building and technology, F2 = adaptation towards expansion and insurance, F3 = cost and revenue management, F4 = financial management, F5 = off-farm diversification, F6 = farm community service, F7 = agricultural extensification, F8 = on-farm diversification.
Non-parametric Mann-Whitney test, pair-wise significant differences at *** p≤0,001; ** p≤0,01; * p≤0,05; (*) p≤0,1.

Source: Survey of Austrian farmers 2015, N = 486; own calculations

### 3.4 Levels of farm risk management according to different pathways of agriculture

Differences in the level of already applied and planned risk management of the subgroups of Austrian farmers were analysed by using non-parametric Mann-Whitney and Kruskal-Wallis tests. According to the number of risk management strategies, the differences are highest between full-time and part-time farms (see Table 3). Full-time farms have levels of using adaptive capacity building and technology, adaptation towards expansion and insurance, and cost and revenue management of 58%, 64%, and 43%, respectively. In contrary, part-time farmers use these risk management strategies in a significant lower level such as 47%, 54%, and 31%, respectively. Full-time farmers use seven of eight risk management strategies to a higher extend than part-time farmers, even those they do not perceive to be more effective than their part-time colleagues. This result may suggest that a higher dependency on farming as source of income leads to a higher awareness of risk and a more proactive risk management. The fact that only 52% of the part-time farmers indicate to use the strategy off-farm diversification is remarkable, because this strategy constitutes part-time farming. An explanation could be that off-farm diversification is more seen as mode of farming in general than as a specific strategy of managing risk. The level of financial management is significantly higher in conventional farms while a higher level in using off-farm diversification and agricultural extensification is observed in organic farms. While agricultural extensification can be regarded as main characteristic of organic farming, the relatively high level of off-farm diversification is surprising. With respect to the farm geography, results show that

extensification is more important for mountain-farmers than to non-mountain farmers, what is due to the natural circumstances of agricultural production of the two farm groups. In contrast, the level of using adaptive capacity building, cost and revenue management, and farm community service is lower in mountain farms. The subgroups by farm type analysed by the Kruskal-Wallis test indicated significant differences between F1, F3, F5, F7, and F8, but the pair-wise Mann-Whitney tests could not identify which farm types differ from each other.

Table 3: Level of currently applied farm risk management according to farming method, employment situation and geographic location of the farm

| | Average level[a)] of currently applied risk management strategies | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | F1[b)] | F2 | F3 | F4 | F5 | F6 | F7 | F8 |
| **Farm type** | | | | | | | | |
| Permanent crop farms | 63% | 62% | 40% | 63% | 15% | 27% | 54% | 28% |
| Forestry enterprises | 44% | 53% | 29% | 72% | 39% | 23% | 62% | 30% |
| Forage-growing farms | 51% | 58% | 36% | 70% | 36% | 33% | 58% | 30% |
| Mixed farms | 50% | 58% | 40% | 70% | 34% | 29% | 47% | 42% |
| Cash crop farms | 57% | 62% | 37% | 68% | 44% | 35% | 55% | 39% |
| Intensive livestock farms | 64% | 71% | 61% | 71% | 21% | 45% | 31% | 23% |
| **Farming method** | | | | | | | | |
| Organic farm | 56% | 61% | 38% | 66% | 44%** | 29% | 61%* | 37% |
| Conventional farm | 51% | 59% | 37% | 72%* | 34% | 33% | 53% | 32% |
| **Employment situation** | | | | | | | | |
| Full-time farm | 58%*** | 64%*** | 43%*** | 72% | 21% | 40%*** | 56% | 35% |
| Part-time farm | 47% | 54% | 31% | 68% | 52%*** | 26% | 54% | 30% |
| **Farm geography** | | | | | | | | |
| Mountain farm | 49% | 58% | 36% | 70% | 35% | 29% | 61%*** | 32% |
| Non-mountain farm | 56%** | 60% | 40%(*) | 70% | 35% | 37%(*) | 51% | 33% |

a) Average level is defined as average percentage of planned risks management measures in the total number of risks management measures of a factor.
b) F1 = adaptive capacity building and technology, F2 = adaptation towards expansion and insurance, F3 = cost and revenue management, F4 = financial management, F5 = off-farm diversification, F6 = farm community service, F7 = agricultural extensification, F8 = on-farm diversification.
Non-parametric Mann-Whitney test, pair-wise significant differences at *** p≤0,001; ** p≤0,01; * p≤0,05; (*) p≤0,1.

Source: Survey of Austrian farmers 2015, N = 486; own calculations

Table 4 displays the results of the farmer`s future plans for risk management. In comparison with the currently applied risk management the average level of strategies planned for the future of all subgroups of farmers is constant or increasing for the risk management strategies of adaptive capacity building and technology, cost and revenue management, financial management, and on-farm diversification. On average, all farmers concur in planning to reduce farm community service. In contrast, the level of the risk management strategies of adaptation towards to expansion and insurance, off-farm diversification and agricultural extensification vary among the subgroups. Organic farmers plan to raise the level of using the strategies of adaptive capacity building and technology and of adaptation towards expansion and insurance to a higher extend than conventional farmers, what could be interpreted as a consequence of increasing risk awareness in organic agriculture. Part-time farmers plan to pay slightly more attention to the risk management strategy of adaptive expansion and insurance as well as to agricultural extensification, what seems to be contradicting. An explanation might be that part time farmers are more heterogeneous and one group with expanding plans opposites another planning further extensification. Mountain farmers as well as non-mountain farmers plan to use the strategy of adaptation towards expansion and insurance and off-farm diversification more often than currently applied, but they also plan to reduce the strategy of agricultural extensification. In respect to farm type, the Kruskal-Wallis test

indicates significant differences between F1, F2, F3, F5, F7, and F8. Using the pair-wise Mann-Whitney tests, a significant difference could be found between intensive livestock farms and the other farm types. Livestock farmers plan a significant lower level of agricultural extensification than farmers of other farm types.

Table 4: Planned level of farm risk management according to farming method, employment situation and geographic location of the farm

| | Average level[a)] of risk management strategies planned for the future | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | F1[b)] | F2 | F3 | F4 | F5 | F6 | F7 | F8 |
| **Farm type** | | | | | | | | |
| Permanent crop farms | 63% | 53% | 45% | 63% | 26% | 35% | 59% | 33% |
| Forestry enterprises | 55% | 52% | 33% | 70% | 36% | 26% | 62% | 30% |
| Forage-growing farms | 58% | 59% | 40% | 73% | 38% | 31% | 54% | 31% |
| Mixed farms | 63% | 62% | 50% | 75% | 35% | 23% | 52% | 38% |
| Cash crop farms | 70% | 66% | 45% | 72% | 42% | 33% | 55% | 42% |
| Intensive livestock farms | 68% | 67% | 61% | 73% | 19% | 39% | 29%** | 23% |
| **Farming method** | | | | | | | | |
| Organic farm | 67%* | 65%(*) | 43% | 73% | 41% | 27% | 64%*** | 38% |
| Conventional farm | 59% | 58% | 42% | 73% | 36% | 32% | 50% | 32% |
| **Employment situation** | | | | | | | | |
| Full-time farm | 65%* | 63%* | 48%*** | 73% | 25% | 37%** | 53% | 36% |
| Part-time farm | 58% | 58% | 37% | 72% | 50%*** | 25% | 55% | 31% |
| **Farm geography** | | | | | | | | |
| Mountain farm | 56% | 59% | 38% | 74% | 36% | 27% | 59%*** | 33% |
| Non-mountain farm | 67%*** | 62% | 47%*** | 71% | 36% | 34% | 50% | 35% |

a) Average level is defined as average percentage of planned risks management measures in the total number of risks management measures of a factor.
b) F1 = adaptive capacity building and technology, F2 = adaptation towards expansion and insurance, F3 = cost and revenue management, F4 = financial management, F5 = off-farm diversification, F6 = farm community service, F7 = agricultural extensification, F8 = on-farm diversification.
Non-parametric Mann-Whitney test, pair-wise significant differences at *** p≤0,001; ** p≤0,01; * p≤0,05; (*) p≤0,1.

Source: Survey of Austrian farmers 2015, N = 486; own calculations

## 4. Conclusions

This article presents empirical results on famer's perceptions, applied and planned risk management measures in Austrian agriculture. Results show a coherent picture of the different pathways agriculture represented by farm types, farming methods, employment situation and geographic location and the risk management strategies of the farmers. The long-time farm orientation of the farmers matches quite well with the applied and planned risk management strategies. A factor analysis resulted in plausible groups of risk management strategies revealing financial management to be regarded as the most effective followed by adaptive capacity building and technology. Both indicate that farmers appreciate flexibility and innovation, either in production or with respect to farm assets and liquidity. These results support farm modeling studies that reveal plasticity of farm management, i.e. flexibility to changing environmental conditions, to increase resilience compared to more rigid management behavior (Rodriguez et al., 2011). The empirical results on famer's perceptions should support administration, policy makers and extension services in developing risk management policies and extension service products given increasing volatility on agricultural markets and climate change risks in the years to come. But it is crucial, that farmers have to be convinced in the effectiveness of a risk management strategy in order to implement it on the farm. Lack of knowledge about risk management measures, e.g. hedging by future contracts, options and futures leads to a low level of application as shown e.g. by Schaper et al. (2012). Policies and extension initiatives to enhance farmers' management capacities, skills, and

awareness appear useful according to farmer perceptions. Employing multivariate models more in-depth research with our rich data set will follow to improve our understanding on risk management in agriculture.

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