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Scenarios for future agriculture in Finland: a Delphi study among agri-food sector stakeholders

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This article presents alternative scenarios for future agriculture in Finland up to 2025. These scenarios are the results of a large Delphi study carried out among Finnish agri-food sector stakeholders. The Delphi panel members gave their future view on desirable and probable futures. From these two dimensions, three scenarios were elaborated through the future images – the subjective future path and the importance analysis. The scenarios represent a technology optimistic "day-dream agriculture", a probable future as "industrialised agriculture" and an undesirable future path as "drifting agriculture". Two mini-scenarios are also presented. They are based on a discontinuity event as an unexpected impact of climate change and an analogy event as an ecological breakdown due to the expansive animal disease epidemics. In both mini-scenarios, the directions of storylines are dramatically changed. The scenarios support strategic planning introducing not only one forecast but alternative outcomes as a basis for future strategy and decisions. In this study the scenarios were constructed to address the opportunities as a desired vision and also the threats as to an undesirable future in the agricultural sector. These results bring to the table a Finnish agri-food expert community view of the future directions of relevant key issues in the agricultural policy agenda.

Key words: agricultural policy, agri-food sector, Delphi method, futures studies, scenarios, strategic planning

Introduction

There are significant changes and driving forces – such as trade liberalisation, technological development, the enlargement of the European Union (EU), environmental demands and the rise of modern biotechnology (breeding, genomics and genetic engineering) – which have an important impact on the agricultural sector (see e.g. Bruinsma 2003). These changes and the ongoing discussion of the role of agriculture in Finland increase the demand for information on alternative future developments in the agricultural sector at national and also at EU level. The agricultural policy premises come from the Common Agricultural Policy (CAP) which is complemented by supporting national strategy work. Because these premises

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are continuously reviewed and questioned (see Council of the European Union 2003), there is a need for clarifying the differing future views of the actors in agricultural policy (farmers, administration, agricultural research, non-governmental organisations, food industry, etc.) for long-range planning purposes. These opinions can be converted as alternative future scenarios that are presenting future views in desirability, probability and importance points of view.

These rapid changes, confronting policies and a turbulent operational environment emphasise the importance to adapt to challenges that the actors in the field are facing even on a short-term basis. In the face of this uncertainty, alternative future views contribute strongly to strategic planning envisioning the extremities of future development and enabling to adapt to future challenges. One technique that can facilitate this approach is the Delphi technique. Delphi as a research method has been widely used in futures studies. The general purpose of futures studies is to examine, evaluate and propose possible, probable and desirable futures (see e.g. Bell 1997a, b, Kuusi 1999, Kamppinen et al. 2002, Malaska 2003). Delphi as one of the main methods in futures studies is especially suitable for long range planning as expert opinions are usually the only source of information available (Turoff 1975).

In this study the possible futures refer to the various development paths and future states that may emerge from the present. Usually society or even a single actor can influence to the future development with specific measures in such a way that a desired path can be taken or an undesirable future path can be avoided (Kamppinen et al. 2002). In scenario planning the constructed scenarios can be especially desirable or quite the opposite, including problematic views. It is important to take the alternative future views into account when future decisions are made. When the human activities are described with scenarios, usually desirable and probable futures are concentrated on (Bell 1997a, Kamppinen et al. 2002). The desirable and probable future views are also decisive in this study. The plausibility of scenarios means that each of the described futures; desirable, the undesirable or the probable is a possible future state. In fact, in a scenario based strategic planning it is up to the actors in the field to commonly agree to the future direction and the necessary measures. This can be done based on the information that the scenarios deliver. Therefore, the three aspects of futures studies emphasise strongly the visionary element behind the scenario planning.

In this article, the main purpose is to present alternative future scenarios for Finnish agriculture. The scenarios are results from a large Delphi study carried out among Finnish agri-food sector stakeholders. These groups' perceptions of the future development of Finnish agriculture have seldom been compared (for example, on Finnish future oriented studies on agricultural development see e.g. Kola 1998, Kröger 2001, Aakkula et al. 2002, Puolanne and Wilenius 2002, Kaljonen and Rikkonen 2004).

The structure of the article is the following. The article starts by defining the expert method in the study, also from the Delphi literature point of view. Then, the article continues by presenting the structure and practices that have been used within this agri-food sector Delphi study. Finally, the Delphi results are presented as future images and alternative scenarios in sustainability point of view. The discussion follows.

Principles and essential features of a Delphi study and a scenario building process

There are at least three methodological ways of studying future according to Tapio (2002, see also Armstrong 2001); straightforward "business-as-usual" mathematical models, more sophisticated and policy-oriented "what if" models that are based on econometrics and statistical information (see an application in Lehtonen et al. 2005) and studying future prospects using expert based methods e.g. Delphi technique. For strategic planning

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purposes, it is beneficial to use both model-based and expert-based approaches in parallel with each other.

The Delphi method concentrates on assessing and forecasting the future. The users of the Delphi technique aim to explore alternative future images, possibilities, their probabilities of occurrence, and their desirability by tapping the expertise of respondents. Linstone and Turoff (1975, p.3) characterize Delphi as a method for structuring a group communication process in such a way that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem (see also Sackman 1975, Mohorjy and Aburizaiza 1997, Kuusi 1999, Rowe and Wright 2001, Tapio 2003). The Delphi method consists of experts' judgement by means of successive iterations of a given questionnaire, to show convergence of opinions and to identify dissent or non-convergence. Anonymity and feedback can be considered as two irreducible elements of a Delphi technique. Traditionally, a third feature, a consensus seeking, has been one element. However, especially as a result of criticism over the decades, the consensus principle has been redefined (Sackman 1975, Wilenius and Tirkkonen 1997, Tapio 2003). According to Rowe and Wright (2001), Delphi groups can be considered as more accurate than individual experts and somewhat more accurate than statistical groups which are made up of non-interacting individuals whose judgements are aggregated.

In this study, the empirical data was gathered following the principles of a Policy Delphi method and its latter variant Argument Delphi (Turoff 1975, p. 80, Kuusi 1999). The Policy Delphi represented a significant departure from the understanding and application of the Delphi technique as practiced in 1950–70 (Turoff 1975, p. 80). Delphi as it originally was introduced and practiced tended to deal with technical topics and seek a consensus among homogeneous groups of experts. The Policy Delphi, on the other hand, seeks to generate the strongest possible opposing views on the potential resolutions of a major policy issue. A Policy Delphi should be able to serve any one or any combination of the following three objectives: (1) to ensure that all possible options have been put on the table for consideration, (2) to estimate the impact and consequences of any particular option and (3) to examine and estimate the acceptability of any particular option. According to Kuusi (1999), the Argument Delphi is a Policy Delphi variant that is focused more on the production of relevant (factual) arguments which are crucial in generating well-balanced and plausible strategies. It is characteristic of Argument Delphi that in the first round the questionnaire can be substituted for interviews in such a way that the varying views within the panel are gathered for the analysis and for the second round feedback (Kuusi 2003). Both in the Policy and Argument Delphi, consensus-seeking is not the main goal because the divergence in the expert panel brings up relevant issues for discussion. A Delphi technique also emphasises a stakeholder involvement and the opinions of the future are obtained from a widely consulted body of people.

In this study, the future images are defined as mental tools that deal with possible future states and help in the the process of perceiving large and complex wholes. They are composed of a mixture of conceptions, beliefs and desires and they affect human choices and steer decision-making and actions (Rubin and Linturi 2001, p. 269). Images of the future can be seen as the causes of present behaviour, as people either try to adapt to what they see coming or try to act in ways to create the future they want (Inayatullah 1993, Bell 1997a).

A scenario approach can be used to widen the future paths in Delphi studies. Comparing future images, scenarios consider in addition the paths to the future and usually also occurrence points of changes. A scenario approach can benefit achieving deeper and more consistent answers for the construction of the scenarios and therefore for the benefit of strategic planning. According to Kahn and Wiener (1967, p. 6), scenarios are hypothetical sequences of events, built with the intent of attracting attention to causal processes and points of decision. This is done in order to show how they may evolve step by step starting from the present situation. Rotmans and Van Asselt (1997) define scenarios as archetypical descriptions of alternative images of the future, created from mental maps or

models that reflect different perspectives on past, present and future developments. A scenario is thus an internally consistent story about the path from the present to the future. However, scenario is not a forecast of the future. It is also notable that a scenario planning approach does not make a stand on e.g. the most probable scenario (see Meristö 1991, p. 29–36, Van der Heijden et al. 2002).

According to Van der Heijden (1996), at least two scenarios are needed to reflect uncertainty. More than four has proven organisationally impractical. Each of the scenarios must be plausible. That means that they must grow logically (in a cause-effect way) from the past and the present. Furthermore, they must be internally consistent. Events within a scenario must be related through cause-effect lines of argument which can not be flawed. Scenarios must also be relevant to the issues under scrutiny. In other words they must provide useful and comprehensive idea generators and test conditions, against which the plans and strategies can be considered. In order to be challenging, scenarios must take under consideration potential surprises that may cause discontinuities in future. According to Van Notten et al. (2005) the exploration of potential discontinuities has been an important function of scenario development.

Godet (2000) makes a distinction between normative and explorative scenarios. An explorative scenario uses history specific information and present trends to build up a scenario for the future. A normative scenario is based on a future image or on a vision of desirable or dreaded future state. These scenarios are written beginning from the future state and coming to the present day. In this study, both the normative perspective as visions taken from the official strategies and the explorative perspective based on the Delphi process (especially the second round) are emphasised.

The sustainability of agriculture is an announced target of agricultural policy both internationally and nationally. Within the sustainability concept, three basic elements – ecological, economic and socio-cultural – are embedded in order to provide a useful framework within which the overall impact of the resource use in the agricultural sector can be described (Yli-Viikari et al. 2002, see also Bruinsma 2003, p. 331–356). In futures studies, a similar, broadly used approach to produce a holistic view on the future is to study topics connected to the changes in a Social, Technological, Economic, Ecological, Political and in Value environment (STEEPV). It is also suitable for the purpose of examining future views from the sustainability point of view. It is possible to gain a deeper insight into the studied factors with the STEEPV set, as the dimensions in a policy point of view are particularly influential and relevant (see Meristö 1991, Loveridge 1999, Van der Heijden et al. 2002). This approach was considered suitable in this study although the themes were constructed somewhat differently in the survey phase. To improve readability and structure of the survey the questions that concerned social and value topics were added on the other themes (TEEP). Hence, the questionnaire was constructed from four themes, namely (1) environmental changes, (2) technology and future competencies, (3) changes in institutions and policy, and (4) agricultural market changes.

The design of the applied Delphi and scenario processes

The next 8-step scenario planning process describes how the Delphi process and the construction of the future scenarios proceeded: (1) discussion and agreement on the task approach in the research group, (2) identifying of trends and important variables according to official agricultural strategies, (3) the selection of experts whose opinions are to be studied (actor analysis, establishment of the panel), (4) the construction of a first round questionnaire as an instrument of data collection based on analysed strategies and the first Delphi round, (5) constructing of future images and preparative scenarios based on the first round results, (6) the communication of the results as feedback to all the respondents (second Delphi round), (7) testing, analysing and interpretation of

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the results and (8) presentation of the data (writing and finalising of the scenarios).

Kuusi (1999) argues that the method for selecting the Delphi panel is one of the most critical phases of a Delphi study. The Delphi facilitator should consider in his/her actor analysis the most important stakeholders, most important substance (the competence of experts) as well as the terms of delivering information in a Delphi process (information policy). The selection process of an expert panel should be done as explicit as possible. An objective actor analysis should deliver besides all the key informants in the focus group of the agrifood sector also the most significant stakeholders in the active agricultural field. In this study, the goal of the iterative rounds was to create a wide interaction between the experts in the field of agriculture in such a way that economical, ecological and social development could be emphasised and the experts would add to well-grounded arguments to the policy discussion in future-oriented manner.

The key issues to recognise in using expert panels or views are the competencies and information policies of experts (Kuusi 1999). The information policies depend on three kinds of interacting factors: the personal competencies of the expert, the norms of the respondent's organisation and the organisers of foresight studies. The reason to establish an expert panel is to get the best possible information as bases for strategy preparation and subsequently strategic decisions (see also Loveridge 2002).

The expert was chosen with the snow ball technique (see Meriö 2000, Loveridge 2002). First, the criteria and classification for choosing expert were discussed and confirmed within the research group implementing the study and the preliminary panellists were listed. Secondly, the name list was discussed at research group meetings on several occasions. Thirdly, the respondent Delphi manager (coordinator of the Delphi process) personally called to chosen experts that were selected to be interviewed and they were also asked for further experts in their own field to take part in the postal enquiry. The list was complemented until there was a sufficient amount of expertise in the sustainability point of view in the panel. The final decision for each expert's selection was made by the responsible researcher. Generally, the Delphi method process can involve from 10 to several hundreds or even thousands of respondents in the panel (see e.g. Bell 1997a, Kuusi 1999, Angus et al. 2003, Kuusi 2003). The participating stakeholders in this study are categorised in Table 1. The boundaries between groups are indicative.

The expert panel was assumed to have expertise in different dimensions of sustainable agriculture (an expert should have an economical, ecological or social perspective in their profession). Thereby, a panel consists of experts who have either specific depth or wider range of expertise in dimensions and scales of sustainable agriculture. Furthermore, their substance knowledge had to be related to some or all of the four key categories (the STEEPV set-up) in which the experts gave their opinions of the future. For the evaluation of experts, comprehensive background information questions were asked during the Delphi process to ensure and revaluate afterward that the relevant substance and the stakeholders were involved in the study.

The study was conducted in a two-round Delphi process. The aim of the first round was to examine future images of Finnish agriculture within the next 20 years. The background material of the study was the official national strategies concerning the agricultural sector and also natural resources (see e.g. MAF 1999, 2001a, b, 2002). This official agricultural strategy approach was chosen as a starting point because these strategies reflect common visions and general goals of both local and national level of future agriculture in Finland. Several agricultural stakeholders have been participating in these strategy processes with their organisational contribution.

The first round of the Delphi study data gathering was organised by a postal survey and by semi-structural interviews. A first round questionnaire was developed and pre-tested by the research group that implemented the study and with five experts in the agricultural field. First, 18 experts were interviewed. Based on the pre-testing results, one measuring dimension (subjective certainty of

Table 1.The participants on the expert panel.

Agri-food sector stakeholders	Total respondents (n)	Total respondents (%)	The group response rates (%)
Research and development	40	39.6	80
Education and consultancy	12	11.9	60
Administration	25	24.8	40
Food industry and trade	7	6.9	47
Agricultural media	8	7.9	53
Agricultural unions and non-governmental organisations	9	8.9	39
Total	101	100	55

probable future) in the questionnaire was only included in the interviews to avoid too laborious answering in the mail survey part. Subsequently, the questionnaire was sent to 167 specialists representing different target groups as presented in Table 1. The response rate to the first round questionnaire was 54.6% overall. The structure of the first round questionnaire allowed experts to express novel questions or statements of their own, through open and free phrasing of questions. By these means, it was supposed to assure that the principle of an iterative specification of answers could take place.

In the following round, the first round results were interpreted as futures images and then returned to the expert panel as median futures images describing the development of the agricultural sector to get feed-back and revaluation of the results (see Fig. 1). Then the revised answers were stored. Moreover, further explanation of some specific issues that emerged from the first round results was also needed. Therefore a focused questionnaire was added to the feed-back one. The issues that needed special focus were chosen based on the rated importance and differences in both desirable and probable future images among the panellists. This focused part of the second round was organised in two separate sections – namely, (1) subjective future path analysis and (2) occurrence points in time. In the second round, the response rate was somewhat lower at 32.4%, and 16 out of the 18 interviewed experts in the first round were able to participate to the second round.

A Delphi data can also be printed out as scenarios. There are several techniques to develop the final scenarios of the Delphi data pertaining to the future. In this study, the structures around the data were created in such a way that desirable and probable dimensions were decisive. In the following round of the Delphi study the experts were asked to answer to three separate issues that were constructed as a second round questionnaire: a feedback report to opinion exchange among panellists, a future path analysis drawing paths up to 2025 by each panellist and questions where an estimation of a proposed statement's occurrence point in the time period 2003–2025 took place (see Fig. 1).

The future path analysis was done by giving a panellist a question of a certain topic where only the starting point of a specific issue was given. These included questions where the statistical information was available[1] to put into a numeric form. The panellists were asked to estimate and draw a line on the presented figure based on each one's experience and also, on the first round answers, how a specific change could occur in the future. A panellist was asked to take under consideration whether the change of a specific question was linear, expansive, declining or included discontinuities. The answers were interpreted in such a way that the margins in a question's scales were determined and, then, the answers were revised and stored. The answers were asked both as absolute and relative values. In this section also, hypothetical changes were introduced and the experts were asked to consider their occurrence points in the time period 2003–2025. In the proposed

[1] The statistical information sources were Statistics of Finland (years 1980–2002), Yearbook of Farm Statistics (years 1983–2001), Farm Register (years 1980–2001), Agricultural Census (1990 and 2000)

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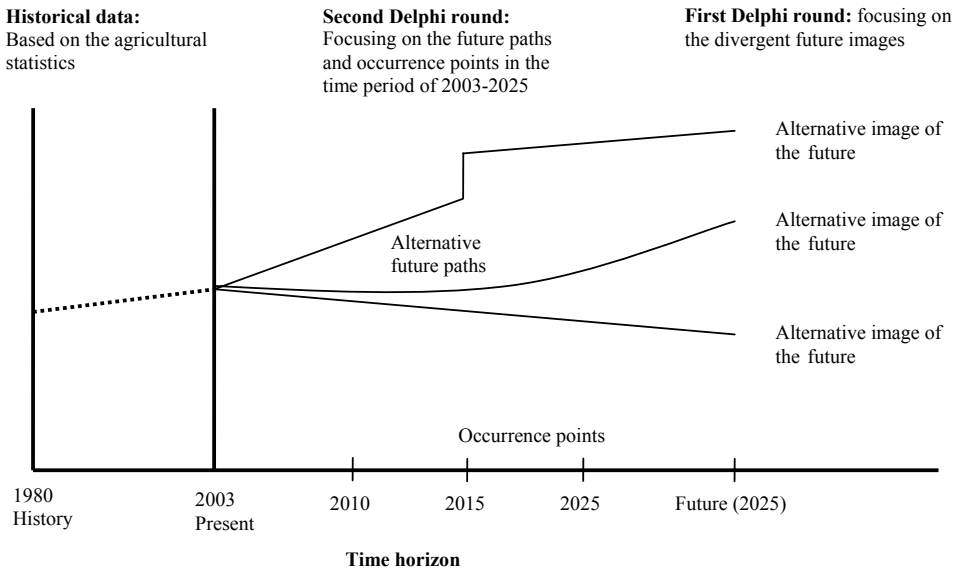

Fig. 1. The time horizon and elements in the scenario process of the study.

change, one was asked to estimate a desirable or probable year for this statement to occur. The panellist was also able to deny the change and give an extreme value to it according to one's viewpoint.

Results

The next step to be made is to decide how to create the necessary structures in the scenarios according to the collected data. This will determine which data will be put in which story and how these data will be connected up. The construction of scenarios in this article is based on the structure on which the Delphi process was organised. The results of the different future images, the future path analysis and the occurrence points are first concentrated upon. Secondly, the analysis of the divergent views as fleshing out the scenarios and also the key premises (important unanimous views) as the basic structure for scenarios is made. Thirdly, writing of the narrative scenarios is done on the basis of these analyses.

The rationale behind the construction of the scenarios is based on the utopia and dystopia kind of thinking that in this study represents two extremes: desirable representing the opportunities in the agricultural sector and undesirable future representing the threats in the operational environment. According to Malaska (2003), utopia is generally understood as an impossible future state, but in futures studies utopia emphasises the positive elements and opportunities in society in such a way that the desired future can be achieved if we know and make the right decisions starting from today. Dystopia, on the other hand, is the opposite and includes a problematic view of the future with possibilities of several drawbacks in societal development such as environmental problems or social distortions. In this study, the probable scenario lies between these two extremes and represents a business-as-usual kind of a scenario. The analogy and discontinuity thinking has been widely used method also within the future studies and especially in scenario planning (see e.g. Malaska 2003, Van Notten et al. 2005). In this study, the meaning of an analogy event represents a situation that a once happened crisis may emerge again in one

form or another. The presentation of a discontinuity event is one which should raise the discussion of possible surprises which can have serious consequences for agricultural development.

From the above mentioned perspectives three scenarios and two mini-scenarios were elaborated through future images and through the importance analysis. Scenarios represent a technology optimistic "day-dream agriculture", a probable future as "industrialised agriculture" and an undesirable future path as "drifting agriculture". Mini-scenarios are based on a discontinuity event such as an unexpected impact of climate change and an analogy event such as an ecological breakdown due to expansive animal disease epidemics from where the directions of storylines are dramatically changed. The mini-scenarios emphasise the possibilities of surprises in such a way that lessons from history and emerging future challenges can be highlighted. It is notable that a multiple amount of scenarios can be constructed from the future images. What is important is that the scenarios are lying in the universe of extremities i.e. are representing the boundaries of desirable, undesirable, feasible and probable outcomes. Therefore they can describe alternatives for strategic planning in policy formulation point of view.

The future images

Through the analysis of futures images, the general guidelines facing the Finnish agriculture were obtained (see also Rikkonen 2003). In this article, future images are constructed in such a way that different dimensions of sustainable agriculture could be considered in a balanced manner. In order to achieve this, the STEEPV set-up is used to cover the ecological, economical and social dimensions of sustainability. The gathered factors in the STEEPV set-up can be understood as a wide range of sustainable agricultural variables (ecological, economical and social dimensions of agriculture), many of which are not easy to quantify. It is notable that there were only few statements in the questionnaire directly concerning values evaluation but otherwise the gap between desirable and probable future image also reflects the state of set of values. In Table 2, the top 40 important topics out of 78 are presented according to the STEEPV framework. After the verbal statement, the mean value and standard deviation of the future images are presented according to the scenarios. In the "drifting agriculture" the mean values are inverted from the state A and interpreted mainly as opposite extreme changes +++ or – – – respectively. It is entirely constructed by the researcher and has no other connections to the empirical data. The answers were asked for on the Likert-scale of –2 to 2 (–2 refers to substantial decrease from present level, 0 refers to no changes to present level and 2 refers to substantial increase from present level).

The future path analysis and the occurrence points in time

In Tables 3 and 4, the minimum, maximum and median future paths and occurrence points of the focused topics in the second round of the Delphi are presented. The results indicate that the regional concentration of agricultural production continues. In southern and western parts of Finland there is just a slight decrease in total cultivated area. In eastern and northern parts the change is more dramatic. Even the median alternative indicates that the cultivated area can drop to half in these areas. Organic farming is supposed to have a 20% share from the total cultivated area in the median future path until 2025. The total amount of agricultural production (arable crops and livestock production) seems to decrease, but only fractionally. Also, fewer farms will exist as the panel expects that the amount of farms will halve by 2016. It seems rather certain that the genetically modified (GMO) varieties will enter the commercial farming in Finland 2010 up to 2012 at the latest. The median alternative indicates that 20% of commercially farmed varieties will be genetically modified by 2025. In general, the expert panel had a strong faith in technological development and in technological innovations. It is supposed to help largely in both production practices and also for the ben-

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Table 2. The alternative outcomes of the Finnish agricultural sector.

State / Dimension	The topic of future statement	Daydream agriculture Mean [SD]	Industrialised agriculture Mean [SD]	Drifting agriculture
Social	– The managerial competence	+1.52 [0.56]	+1.11 [0.43]	– – –
	– Depopulation of rural areas	–1.28 [0.87]	+1.12 [1.02]	+++
	– Agricultural labour force	+0.81 [0.82]	–0.60 [1.08]	– – –
	– Importance of agriculture in rural areas	+0.62 [0.94]	–0.50 [0.88]	– – –
	– Business networks of local agri-production	+1.27 [0.55]	+1.09 [0.44]	– – –
	– Regionally concentrated agri-production	–0.41 [1.20]	+0.97 [0.92]	+++
Technology	– Investments	+0.46 [0.70]	+0.30 [0.80]	– – –
	– Utilisation of new production technologies	+1.18 [0.66]	+1.16 [0.47]	– – –
	– Environmental technology innovations	+1.55 [0.63]	+1.07 [0.46]	– – –
	– Automation technology in animal husbandry	+0.84 [0.94]	+1.33 [0.52]	– – –
	– Biotechnological processes and products	+0.86 [0.91]	+1.24 [0.59]	– – –
	– Genetically modified plant varieties	–0.01 [0.93]	+0.96 [0.66]	+++
	– Information and communication technology during the growing period	+1.21 [0.65]	+1.19 [0.49]	– – –
	– Self-reliant energy production on farms	+1.40 [0.68]	+0.93 [0.56]	– – –
Economics	– Profitability of farm enterprises	+1.37 [0.69]	–0.11 [0.84]	– – –
	– Demand for domestic products	+1.27 [0.71]	+0.15 [0.70]	– – –
	– Demand for imported products	–0.66 [0.89]	+0.74 [0.76]	+++
	– Amount of national support	+0.48 [0.76]	+0.30 [0.85]	– – –
	– Amount of European Union based support	+0.04 [0.80]	–0.96 [0.71]	– – –
	– The share of subsidies in farm income	–0.86 [0.89]	+0.21 [0.89]	– – –
Ecology	– Environmental loading of phosphorus	–1.41 [0.70]	–0.77 [0.66]	+++
	– Environmental loading of nitrogen	–1.33 [0.67]	–0.64 [0.67]	+++
	– Food related epidemics	–1.24 [0.77]	+0.35 [0.74]	+++
	– Animal diseases in agri-production	–0.81 [0.82]	+0.38 [0.82]	+++
	– Average amount of cattle	+0.73 [0.81]	+1.49 [0.67]	+++
	– Cultivated area in a farm	+0.84 [0.74]	+1.49 [0.65]	+++
	– Fertilizers use	–0.76 [0.89]	–0.39 [0.78]	+++
Politics	– Political guidance of European Union	–0.61 [1.00]	+0.49 [1.01]	+++
	– Rural policy goals in CAP (Common Agricultural Policy)	+1.04 [0.96]	+0.89 [0.73]	– – –
	– Limitations of agricultural production (quotas)	+0.02 [0.98]	+0.04 [1.03]	– – –
	– Re-nationalisation of CAP	+0.79 [0.90]	+0.07 [0.85]	+++
	– Industrialised agricultural production structure	–0.83 [0.87]	+0.82 [0.82]	+++
	– Environmental policy goals in CAP	+1.13 [0.75]	+0.95 [0.60]	– – –
	– Risk evaluation of genetically modified products	+1.19 [0.74]	+0.76 [0.63]	– – –
	– Environmental legislation	+0.20 [0.97]	+0.98 [0.57]	– – –
Values	– Ethical consciousness	+1.33 [0.70]	+0.66 [0.64]	– – –
	– Environmental hazards due to production practises	–1.44 [0.59]	–0.80 [0.70]	+++
	– Voluntary measures preventing loading on watershed	+1.25 [0.78]	+0.45 [0.79]	– – –

efit of environmental quality. For the scenario narratives, these results are interpreted in such a way that the median future views describe the "industrialised agriculture" scenario and the maximum and minimum future views complement the other two scenarios.

Table 3. The future paths of Finnish agriculture up to the year 2025.

Year	1980	1985	1990	1995	2000	2005	2010	2015	2020	2025
The total cultivated area (1000 hectares)										
Minimum	2304	2267	2270	2175	2180	1650	1300	900	750	700
Maximum	2304	2267	2270	2175	2180	2350	2550	2500	2500	2600
Median	2304	2267	2270	2175	2180	2100	2015	1950	1900	1800
The total cultivated area in southern and western Finland (1000 hectares)										
Minimum	1475	1456	1491	1435	1420	1200	950	800	700	650
Maximum	1475	1456	1491	1435	1420	1500	1550	1600	1700	1800
Median	1475	1456	1491	1435	1420	1400	1400	1400	1400	1400
The total cultivated area in eastern and northern Finland (1000 hectares)										
Minimum	794	800	786	726	760	450	350	100	50	50
Maximum	794	800	786	726	760	850	1000	900	800	800
Median	794	800	786	726	760	700	615	550	500	400
The development of milk production (million litres)										
Minimum	2920	2800	2600	2296	2378	2100	2100	2000	1900	1800
Maximum	2920	2800	2600	2296	2378	2500	2500	2500	2500	2600
Median	2920	2800	2600	2296	2378	2400	2374	2300	2300	2200
The share of genetically modified plant varieties in commercial farming (%)										
Minimum	0	0	0	0	0	0	0	0	0	0
Maximum	0	0	0	0	0	20	40	85	90	100
Median	0	0	0	0	0	0	5	10	15	20
The share of organic farming (%)										
Minimum	0	0.07	0.3	2.1	6.7	5	5	5	3	0
Maximum	0	0.07	0.3	2.1	6.7	25	30	45	65	65
Median	0	0.07	0.3	2.1	6.7	10	12	15	20	20
The share of renewable energy sources of the total energy used in farms (%)[1]										
Minimum	7	7	7	8	9	5	5	9	9	9
Maximum	7	7	7	8	9	25	40	60	65	70
Median	7	7	7	8	9	10	20	25	30	35
The share of off-farm employment of farmers (%)										
Minimum	-	-	40	-	43	35	35	30	20	15
Maximum	-	-	40	-	43	50	60	70	75	80
Median	-	-	40	-	43	45	50	55	55	60
Imports of agricultural products (€ million)										
Minimum	773	906	942	1345	2005	1600	1500	1400	1400	1100
Maximum	773	906	942	1345	2005	2400	2800	3200	3600	3900
Median	773	906	942	1345	2005	2100	2250	2300	2400	2500
Exports of agricultural products (€ million)										
Minimum	281	484	422	714	995	800	700	500	300	200
Maximum	281	484	422	714	995	1300	1700	2000	2300	2400
Median	281	484	422	714	995	1000	1100	1200	1200	1250

[1] An estimation based on the total energy consumption in Finland taken from Statistics Finland, 1980–2002

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Table 4. The desirable and probable occurrence points in time of proposed statements.

Statement[1]	Desirable year [SD] [2]	Share of panel denying proposed change (%)	Probable year [SD]	Share of panel with opposing probable view [> 25%]
The national support will be 70% (in 2001, 59.5%)	2011 [6.27]	40	2012 [3.42]	National support can be 61.40% by 2025 [26%]
The production of bread and fodder cereals decreases 25% (in 2001, 3,626 billion kilos)	2016 [4.94]	61	2014 [5.50]	Decreases only 5.00% by 2025 [42%]
The combined beef and pigmeat production decreases 25% (in 2001, 265 million kilos)	2018 [6.02]	70	2015 [5.07]	Decreases only 3.86% by 2025 [53%]
The number of farms halves (in 2000, approx 78,000)	2019 [5.07]	49	2016 [4.43]	–
The food industry owns over one third of the total agricultural land	2017 [2.52]	79	2019 [4.92]	Food industry owns 7.27% of the land by 2025 [84%]
Nutrient load (phosphorus and nitrogen) on waters halves from the present level	2011 [5.21]	12	2018 [5.56]	No change to present load by 2025 [25%]
The first genetically modified plant variety in commercial farming	2012 [6.51]	46	2010 [4.35]	–
Agricultural production quotas are withdrawn	2017 [7.03]	75	2019 [5.66]	Quotas are not withdrawn by 2025 [53%]

[1] One statement was disqualified because of the misinterpretation of the question among the panellists
[2] The value in the estimation of both desirable and probable year can vary from 2003 to 2025

The importance analysis

When moving towards scenario building, it is important to consider carefully two main sources of key factors for writing the storyline. These sources include first and foremost key uncertainties that can be found by observing those topics where experts have divergent future views. Secondly, basic premises are also needed to ensure that the bases for each scenario are solid. Both of these sources are rated important by the panel.

In order to focus on the relevant topics when considering the scenario narratives, a reduction in future images can be made according to the importance and divergence of the scrutinised topics. This is done in order to narrow the input data for scenario storylines in such a way that the scenarios are tractable. In the following Figure 2, four categories are organised based on the standard deviation of importance (y-axis) and the importance rating (x-axis) by the panel (see e.g. Mohorjy and Aburizaiza 1997). The categories presents issues that (A) indicates less important but divergent topics, (B) indicates key uncertainties and "the flesh and bones" for scenarios, (C) indicates non-significant questions and (D) refers to basic premises according to the panel. The deviation within answers signals divergent visions among panellists and those topics can be considered also as potential policy conflict issues (see Rikkonen et al.

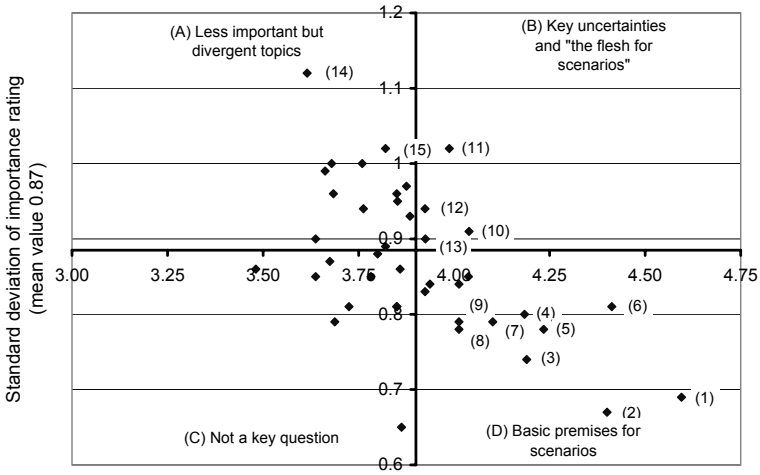

Fig. 2. The importance analysis. The areas (B) and (D) represent the most important agricultural topics according to the panel. The areas (A) and (C) represent those topics which the panel evaluates less important respectively.

2005). In a way, these topics describe uncertainty in the future path from a policy point of view.

The scale by which the topics in each dimension are categorised is relative. Answers were asked on the Likerts scale of one to five (one reflecting 'not important at all' and five reflecting 'very important'). It is notable that 15 out of 40 topics (see Fig. 2) are selected for the scenario construction use in order to keep the scenarios tractable. As a result of the importance analysis, the basic premises for the scenario construction are (1) depopulation, (2) the demand for domestic products, (3) the amount of national support, (4) the amount of EU based support, (5) political guidance of EU, (6) profitability, (7) the share of subsidies, (8) rural policy goals in the CAP and (9) managerial competence. The key uncertainties are (10) phosphorus emissions, (11) animal diseases, (12) the re-nationalisation of the CAP and (13) the average amount of cultivated area on a farm. Less important, but highly divergent, topics are (14) GMO plant varieties and (15) the importance of agriculture in rural areas.

The above mentioned topics can be found in the scenario storylines, although between the scenarios the emphasis of topics varies. This is done in order to capture the essential elements in each of the three scenarios and two mini-scenarios.

The scenario paths and storylines

As conclusions of the Delphi process, the storylines are written in the past tense – as if one were standing at a point in the future, looking back towards the historical development, which has taken place within a certain period of time. In this manner, one creates a possible future to which one can adopt a concrete attitude. By setting up several scenarios or several historical accounts, one creates the possibility of adopting an attitude towards several specified future developments.

"Daydream agriculture"

This scenario puts us in a world where a desired vision within agriculture takes place. The driving force of this scenario is innovative technology. The negative environmental consequences are fully under control with available high-technology. There is a strong belief that technology will help solve any existing and emerging challenges in the agricultural sector. In this scenario, environmental concerns are minimal and technological solutions are fully available in the event of unexpected negative environmental and health concerns. Farmers have taken voluntary measures to prevent environmental emissions. Profitability has increased and the domestic products are dominant in the market.

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Regional policy measures have contributed to rural viability in such a way that there are a balanced population in rural areas. The concentration of regional production was just a threat in the beginning of the millennium and it turned out to be a rather false analysis. Even the total cultivated area in Finland increased up to 2025 to 2,600,000 hectares due to the strong increase mainly in organic farming. The increase in cultivated area came mainly from the southern and western parts of Finland. The number of farms has not decreased much from the 2005 level. In livestock production, milk is the driver and production has increased some 10% in 20 years. The importance of agriculture in rural areas and local economy increased due to the consumer willingness to favour domestic products. Although there were a slight increase in the average amount of cattle and cultivated area on a farm, the outcome was balanced also favouring smaller farm to succeed in agri-business. The off-farm employment is nowadays marginal.

The demand for domestic products has increased substantially which means an expected added value to the refining food industry and to the national economy. Exports were doubled in 20 years due to the increase in organic products, particularly in beef. Several strategies and measures were targeted towards organic farming and such was also the case in other less favourable areas in the EU. These strategies stated that the competitiveness of the areas is based on the development of organic products and the genetically modified plant varieties would remain in a minor role. Otherwise, biotechnology is strongly utilised in agricultural sector. In Finland, organic farming covers now over half of all the total cultivated area. Profitability turned out to increase strongly as new production technology came along and the product prices increased. Also the efforts that the food chain made for improving the managerial competence through e.g. quality and environmental management systems paid the price; environmental stress caused by phosphorus emissions halved in 10 years which was remarkable. Also, animal diseases have been fully in control. The new innovative renewal energy sources have the major share of 70% in the energy use in farms.

EU based support is not any more the key driver for profitable production. Therefore, the role of EU in agricultural issues has changed. The re-nationalisation of the CAP took clearly place in order to take under consideration the varying regions and their circumstances in the EU area. The share of subsidies in farm income has decreased due to the price increase and consumer effect. Rural policy goals in the CAP and concrete measures have made the difference in the development of regression and have made rural areas bloom anew.

"Industrialised agriculture"

Depopulation and also decrease in agricultural labour force took place in rural areas during the first decade even if the CAP emphasised strongly the rural and environmental goals. Some 60% of farmers are employed off-farm. In the southern and western parts of Finland, there has been just a slight decrease in total cultivated area, but in eastern and northern parts, the change is more dramatic. The cultivated area has halved in 20 years to 400,000 hectares. Also, the amount of farms halved by 2016 and the farm size increased through the decade. The total amount of agricultural production (arable crops and livestock production) has decreased but only fractionally. Agricultural production is regionally concentrated because of a seeking for the efficiency. Therefore, the remaining farms utilise high-technology. The utilisation is also done for the benefit of the environment. For example, renewable energy now supplies 33% of total energy used in farms. The remaining farms have been able to keep up with the reasonable profitability level, even if the total amount of support has decreased. This is because the farm size has still increased.

The demand for domestic products remains still strong in spite of the pressure of the imported products; consumers prefer to buy domestic food products. Imports have increased by one fourth but so also exports. There has been a stable increase in commercially farmed GM varieties (20% share in 2025) in agriculture. The first genetically modified plant variety entered commercial farming in 2010. Product prices are still low. The efforts that the authorities made for improving managerial compe-

tence through e.g. quality and environmental management systems paid the price. The environmental stress has been and still is under control. For instance, environmental stress caused by phosphorus emissions decreased during the two decades. In year 2018, some studies indicated that it was halved. Also, animal diseases have been under control thanks to the accuracy protection program which the authorities organised.

Since the Central European countries (CEC) joined the EU there has not been possibilities to broaden the national support system. After the first joined CEC countries the amount of EU based support has decreased substantially. Also, the political control of EU in agricultural issues has tightened after every Agenda period. Rural policy goals in the CAP have increased but the measures fail to influence properly and they did not prevent the depopulation of rural areas. The contribution of regional policy measures has not increased rural viability. The importance of agriculture in rural areas and local economy has therefore reduced.

"Drifting agriculture"

This scenario puts us in a world where agriculture represents a marginal role in the national economy. Environmental impacts of agriculture are extensive and technology fails to solve these problems. There are several major sources of environmental load, and unexpected negative environmental and health problems have taken place due to unsuccessful experiments in biotechnological processes and products. The utilisation of these new productive possibilities was uncontrolled. No attention was really drawn properly to risk assessment. The food industry owns nowadays over one third of the total agricultural land and the share seems to be increasing. The unstable circumstances in society reflect to agriculture and the remaining farmers disregard to follow good farming practices. Therefore, production based environmental hazards have existed through the years.

The population has concentrated around the Metropolitan area and around other centred cities. Rural areas are practically wild nature. In eastern and northern parts of Finland, farming is marginal with only 50,000 hectares under cultivation. The few and the biggest remaining farms are located near the Metropolitan area in south Finland. The livestock and crop production has decreased by 25% and the natural economy has taken place locally.

The demand for domestic products collapsed because of unexpected food related epidemics and the food market is now ruled by imported food products. Also, the situation on world markets is unstable. Import of food products has doubled in 20 years. The level of exports is now lower than any time in the past 45 years. The national production is unable to keep up with competition and, therefore, it is unprofitable. Environmental stress caused by nutrient emissions has been causing unexpected and heavy stress on water systems and although the farming has decreased in total, the recovery seems to take lot of time. Animal diseases and food-related epidemics have become common and, therefore, health problems are severe.

The tightened political control of EU in agricultural and rural issues has caused severe conflicts between member states. Consumer faith as to food security is gone. A support system was first renewed and then withdrawn as the expenses were uncontrolled and no consensus about principles was reached. As the whole CAP was withdrawn, the agricultural market was in disorder for some time. The rural policy goals in the CAP did not have time to really bring about rural viability during the first decade. As the rural areas depopulated, their importance collapsed although agriculture was not the last frontier there.

The Mini-Scenarios

"Return of mad cow chaos"

At the end of 2001, Finland had the first case of mad cow disease. As expected, it remained as single event and the control program of the animal diseases was able to respond to it and calm convincingly the consumer concerns. From the beginning of the 1990s Great Britain was suffering from mad cow disease (178,000 cases, first identified in 1986) and the EU took an active role to face and solve the problems. As the agricultural markets

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were heading strongly towards free trade after the EU agreement in the World Trade Organisation negotiations the traceability of meat products and cattle became very challenging. As a consequence of the muddled commercial activity in the new free trade situation, market rules were unclear some disease-bearing cattles were being shipped uncontrolled from country to country at times. Then the mad cow disease appeared strongly again in Finland in 2016. The consequences were similarly disastrous as in 1990s in Great Britain and, even greater, because the disease was transformed infecting also other livestock species. Because the structure of Finnish livestock production is small scaled in comparison with the EU area or world market actors, the impact of the disease was huge. Livestock production collapsed, cattle were eliminated, and meat and milk products were forced to be imported. As the disease has been identified as infecting also people, health problems to society are yet to be fully unrecognised.

"Unsuspected climate"

The year 2020 was an exceptional year and a turning point in weather conditions. It was very warm at night all summer. The increase in average temperature was 3°C higher compared to the long range average. Precipitation increased also some 30% over the average even if it continued somewhat more moderate in the following years. It was supposed by researchers that the environmental capacity of green house gases had found its limits and therefore sudden responses in eco-system took place. Although some adaptation policy measures had been prepared through the decade, the consequences of the dramatic change in weather conditions were unexpected. In agriculture, a widespread increase in flooding took place due to the strong increase in precipitation and the rise of sea-levels. This was extremely disastrous for the cultivated area in southern and western parts of Finland. There were a couple of straight losses in crop yields and, therefore, livestock production also suffered. Also in the eastern areas, new invasive species ruined the 2020 crop yield although some preparations were made in advance on plant protection. It was not enough. It took years to recover from the disastrous year and to benefit from the increased potential crop yields. Nevertheless, the strong floods and heavy rainstorms are now annual and due to this, there has been some reorientation of the cultivated field area to eastern and northern parts of Finland. There the cultivated area is not so vulnerable to floods. There were also some irreversible damages and biodiversity losses to the ecosystems after 2020.

Discussion

As set out, alternative scenarios for future agriculture in Finland are presented through a Delphi study. From the dimensions of the study, three scenarios and two mini-scenarios were elaborated through future images and importance analysis. The scenario approach makes the future concrete as it describes alternative paths towards it. From the strategic planning point of view, the significance of scenarios is how they are utilised in strategy processes. That demands a lot from the scenarios. They must be plausible, logical, internally consistent and relevant for planning purposes as mentioned earlier. In this article, these criteria were followed.

Methodically, the chosen tripartite design of constructing scenarios through the Delphi technique bring into the discussion a more comprehensive way of foreseeing the future. First and foremost, it introduces a wide range of sustainable agricultural variables as future images. Even from this point it is possible to construct scenarios by backcasting them. Furthermore, in this study also the relative importance of the variables was rated by the panel. This dimension was considered necessary to make a strategic importance map which represented the variables in four categories according to their importance. The importance analysis gave an opportunity to point out first those topics that can be considered as basic premises and also those topics that represented key uncertainties according to the views of the expert panel. These results were then utilised in the scenarios. It has to

be noted that the importance analysis is a descriptive way of categorising the examined variables but it can point out and simplify (1) what is seen important and (2) in which questions the future view is commonly shared, and in which questions there are tensions between the respondents within the topics. Subsequently, as a third step towards the construction of scenario narratives, together with the first round feedback questionnaire a more detailed section was constructed for the second round to make the scenarios more profound. This was done through the occurrence points in time and the future path analysis. All in all, it is beneficial to gather data extensively from several dimensions, because it gives several options to utilise it in the scenario narratives. Naturally the strategy for the required data has to be determined carefully beforehand.

To organise this size of a Delphi panel is quite laborious and also the interaction and feedback are more challenging. This was realised in the beginning and therefore 18 of the experts constituted a group that was also interviewed before the postal part in both of the rounds. This gave value-added to the rest of the panel in such a way that the communication based on these personal interviews increased, and the feedback concerning the Delphi process, the relevant questions and future statements, and the structure of the Delphi was also immediately registered and improved for the benefit of the whole panel.

A considerable additional value of this kind of Delphi process is that a respondent can reflect his/her opinions as an iterative, learning process and, in that sense, it may contribute to achieving a more common vision within the actors in the food chain. At the very least, it increases the consciousness of differing views and their arguments on future among the participative panellists. This is also the matter of a question as to how the results are introduced when they have been finalised. In this study after the Delphi rounds the results were presented in a future workshop together with several other future oriented studies in the field. This future workshop, which was called a policy dialogue phase, was organised to make conclusions as to how Finnish agriculture should prepare itself for national and EU-level agricultural decision making. This policy dialogue was also organised so as to outline the roles of research among the actors in their policy preparation. In this kind of policy dialogue phase, it is also possible that individual actors may find themselves having similar future views and in that sense help them to establish shared strategic goals for the future.

In this study, the overall purpose of the constructed scenarios was the well tested mode to express future threats and possibilities. Therefore, the visionary element is strongly connected to the construction of the scenarios. Delphi can contribute to strategic thinking in such a way that it can create the basic elements for the visionary process. It can systematically represent the paths that are seen as desirable, probable and possible, and also bring into the discussion problematic future views. The gap between desirable and probable futures is decisive because through a critical thinking of how the gap can be decreased, one can find measures and guidelines to achieve a shared future direction. In the best case, these three scenarios can raise discussion and address measures as to what strategy the agricultural sector can adopt so as to achieve the desired vision.

When assessing scenarios, it is important to retrace the basic premises and key uncertainties in them. Rethinking is crucial because the assumptions of premises may change. This also concerns the importance analysis. Some topics may be taken into account in a different manner if its' fundamental relevancy changes. However, once written scenarios are solid bases for further use both as results and as a process learned. Because of a turbulent operational environment, it is useful to repeat the scenario process or update the assumptions and outcomes when the context changes. Also, the exercise of discontinuity or analogy event is beneficial to evaluate change extremes.

Characteristic of Delphi studies is their long-term orientation. It is notable that the presented scenarios are not forecasts, but alternative future developments. The decisive factor for future development is the decision-making of today. Delphi can only provide potential solutions to the problems as an eye-opener of issues that can be identi-

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fied and foreseen today. Delphi can contribute to the discussions of agricultural policy formation. It has to be kept in mind that these results represent only the chosen panel's view on future. The results tell us how the Finnish expert community sees the future of agriculture in the Finnish national context. In its entirety, it brings to discussion a strong expert view of the key issues that are the most relevant in decision-making point of view. Therefore, it contributes strongly on strategic thinking in the process of policy formation.

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References

Aakkula, J., Jokinen, P., Lankoski, L. & Nokkala, M. 2002. Maatalous, tietoyhteiskunta ja kestävä kehitys. Pilottitutkimus tieto- ja viestintäteknologisen muutoksen vaikutuksista maatalouden kestävyyteen. *Agrifood Research Finland, Publications* 19. 80 p.

Angus, A.J., Hodge, I.D., McNally, S. & Sutton, M.A. 2003. The setting of standards for agricultural nitrogen emissions: a case study of the Delphi technique. *Journal of Environmental Management* 4: 323–337.

Armstrong, J.S. 2001. *Principles of forecasting. A Handbook for researchers and practitioners.* Kluwer Academic Publishers: Boston/Dordrecht/London. 849 p.

Bell, W. 1997a. *Foundations of future studies – Human science for a new era. Volume I.* New Brunswick: Transaction publishers. 365 p.

Bell, W. 1997b. *Foundations of future studies – Human science for a new era. Volume II.* New Brunswick: Transaction publishers. 379 p.

Bruinsma, J. (ed.). 2003. *World agriculture: towards 2015/2030 An FAO perspective.* London: Earthscan Publications. 432 p.

Council of the European Union 2003. *CAP Reform – Precidency compromise (in agreement with the Commission).* Cited 24 February 2005. Updated 30 June 2003. Available on the Internet: http://register.consilium.eu.int/pdf/en/03/st10/st10961en03.pdf.

Godet, M. 2000. The art of scenarios and strategic planning: tools and pitfalls. *Technological Forecasting and Social Change* 65: 3–22.

Inayatullah, S. 1993. From "Who am I?" to "When am I?" Framing the shape and time of the future. *Futures* 25: 235–253.

Kahn, H. & Wiener, A.J. 1967. *The year 2000: A framework for speculation on the next thirty-three years*. New York: The MacMillan. 431 p.

Kaljonen, M. & Rikkonen, P. 2004. Divergent images of multifunctional agriculture – A comparative study of the future images between farmers and agri-food experts in Finland. *International Journal of Agricultural Sustainability* 2, 3: 190–204.

Kamppinen, M., Kuusi, O. & Söderlund, S. (ed.). 2002. Tulevaisuuden tutkimus – perusteet ja sovellukset. *Suomalaisen Kirjallisuuden Seuran Toimituksia* 896. 928 p.

Kola, J. 1998. Reforms of the Common Agricultural Policy and agriculture in Finland. *Agricultural and Food Science in Finland* 7: 181–196.

Kröger, L. 2001. Luomutuotanto Suomessa 2010 – Luomuviljelijöiden tulevaisuuden näkemyksiä. *MTT Economic Research, Working papers* 13/2001. 55 p.

Kuusi, O. 1999. *Expertise in the future use of generic technologies. Epistemic and methodological considerations concerning Delphi studies.* 268 p.

Kuusi, O. 2003. Delfoi-menetelmä. In: Vapaavuori, M. & Von Bruun, S. (ed.). *Miten tutkimme tulevaisuutta.* Second edition. p. 134–144.

Lehtonen, H., Aakkula, J. & Rikkonen, P. 2005. Alternative agricultural policy scenarios, sector modelling and indicators: A sustainability assessment. *Journal of Sustainable Agriculture* 26, 4: 63–93.

Linstone, H.A. & Turoff, M. 1975. *The Delphi method: Techniques and applications.* Cited 15 March 2005. Available on the Internet: http://www.is.njit.edu/pubs/delphibook/.

Loveridge, D. 1999. Foresight and Delphi processes as information sources for scenario planning. *Ideas in progress*, Paper number 11. PREST. Cited 15 March 2005. Updated Sebtember 1999. Available on the Internet: http://les.man.ac.uk/PREST/People/Staff/Denis_Loveridge.html#Ideas.

Loveridge, D. 2002. Experts and foresight: review and experience. *Discussion paper series*, Paper 02-09. PREST. Cited 15 March 2005. Updated Sebtember 1999. Available on the Internet: http://les.man.ac.uk/PREST/People/Staff/Denis_Loveridge.html#Ideas.

MAF 1999. *Foodstuffs production in Finland: Quality strategies and goals*. The Ministry of Agriculture and Forestry, Foodstuff quality management group. Cited 15 March 2005. Updated 19 January 2005. Available on the Internet: http://www.mmm.fi/maatalous_maaseudun_kehittaminen/alkupera_nimisuoja_laatu/strategia/Strenlo.PDF.

MAF 2001a. Strategy for Finnish agriculture. Final report of the steering Group. *Working Group Report MAF* 2001: 16. Ministry of Agriculture and Forestry. Cited 15 March 2005. Updated 19 January 2005. Available on the Internet: http://www.mmm.fi/maatalous_maaseudun_kehittaminen/maatalous_ja_maaseutupolitiikka/maatalouspolitiikka/tulevaisuus/strategy.pdf.

MAF 2001b. *Ehdotus luonnonmukaisen elintarviketuotannon kehittämisestä*. Ministry of Agriculture and Forestry. Cited 15 March 2005. Updated 19 January 2005. Available on the Internet: http://www.mmm.fi/maatalous_maaseudun_kehittaminen/luomutuotanto/ajankohtaista/Luomustrategia.PDF.

MAF 2002. Strategy for the renewable natural resources in Finland. *MAF Publications* 8b/2001. Ministry of Agriculture and Forestry. Cited 15 March 2005. Updated 19 January 2005. Available on the Internet: http://www.mmm.fi/english/landwater/natural_resources/Luonnonvara_Englanti.pdf.

Malaska, P. 2003. Tulevaisuustietoisuus ja tulevaisuuteen tunkeutuminen. In: Vapaavuori, M. & Von Bruun, S. (ed.). *Miten tutkimme tulevaisuutta*. Second edition. p. 9–16.

Meriö, H. 2000. Metsäsertifiointiin liittyvät asiantuntijapalveluiden tulevaisuuskuvat. *ESF-publications, Ministry of Labour.* 94 p.

Meristö, T. 1991. *Skenaariotyöskentely yrityksen johtamisessa*. Helsinki: Valtion painatuskeskus. 188 p.

Mohorjy, A.M. & Aburizaiza, O.S. 1997. Impact assessment of an improper effluent control system: a Delphi approach. *Environmental Impact Assessment Review* 17: 205–217.

Puolanne, E. & Wilenius M. (ed.). 2002. Elintarviketalouden reunaehdot vuoteen 2030 mennessä. ETU 2030. *MMM:n julkaisuja* 9/2002. 127 p.

Rikkonen, P. 2003. Maatalouden tulevaisuus vuoteen 2025: elintarvikeketjun asiantuntijoiden tulevaisuudenkuvia Suomen maataloudesta. *MTT Working papers* 32. 51 p.

Rikkonen, P., Aakkula, J. & Kaivo-oja, J. 2006. How can future long-term changes in Finnish agriculture and agricultural policy be faced? Defining strategic agenda on the basis of a Delphi study. *European Planning Studies* (in press).

Rotmans, J. & Van Asselt, M.B.A. 1997. From scenarios to visions. A long way to go. Lessons learned from two decades scenario development. In: *Open meeting of the human dimensions of global environmental change research community*. Laxenburg: Austria.

Rowe, G. & Wright, G. 2001. Expert opinions in forecasting: the role of the Delphi technique. In: Armstrong, J.S. (ed.). *A Handbook for researchers and practitioners*. Boston/Dordrecht/London: Kluwer Academic Publishers. p. 125–146.

Rubin, A. & Linturi, H. 2001. Transition in the making. The images of the future in education and decision-making. *Futures* 33: 267–305.

Sackman, H. 1975. *Delphi critique. Expert opinion, forecasting and group process.* Toronto: Lexington books. 142 p.

Tapio, P. 2002. Climate and traffic: prospects for Finland. *Global Environmental Change* 12: 53–68.

Tapio, P. 2003. Disaggregative Policy Delphi. Using cluster analysis as a tool for systematic scenario formation. *Technological Forecasting and Social Change* 70: 83–101.

Turoff, M. 1975. The policy Delphi. In: Linstone, H.A. & Turoff, M. (eds.). *The Delphi method: techniques and applications*. Cited 15 March 2005. Updated 15 October 2002. Available on the Internet: http://www.is.njit.edu/pubs/delphibook/.

Van der Heijden, K. 1996. *Scenarios – the art of strategic conversation.* Chichester: John Wiley & Sons. 305 p.

Van der Heijden, K., Bradfield, R., Burt, G., Cairns, G. & Wright, G. 2002. *The sixth sense. Accelerating organisational learning with scenarios.* Chichester: JohnWiley & Sons. 307 p.

Van Notten, P.W.F., Sleegers, A.M. & Van Asselt, M.B.A. 2005. The future shocks: On discontinuity and scenario development. *Technological Forecasting and Social Change* 72: 175–194.

Wilenius, M. & Tirkkonen, J. 1997. Climate in the making. Using Delphi for Finnish climate policy. *Futures* 29: 845–862.

Yli-Viikari, A., Risku-Norja, H., Nuutinen, V., Heinonen, E., Hietala-Koivu, R., Huusela-Veistola, E., Hyvönen, T., Kantanen, J., Raussi, S., Rikkonen, P., Seppälä, A. & Vehmasto, E. 2002. Agri-environmental and rural development indicators: a proposal. *Agrifood Research Reports* 5. p. 11–25.

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SELOSTUS

Elintarvikealan asiantuntijoiden skenaarioita tulevaisuuden maataloudesta Suomessa

Pasi Rikkonen

MTT (Maa- ja elintarviketalouden tutkimuskeskus)

Suomen maatalouteen vaikuttavat lähitulevaisuudessa mm. ruokamarkkinoiden samanaikainen globalisoituminen ja lokalisoituminen, Euroopan unionin laajeneminen, maataloustuotteiden maailmankaupan vapauttaminen, maatalouspolitiikan kuluttaja-, ympäristö- ja maaseutulähtöisyyden vahvistuminen sekä bio- ja informaatioteknologian kasvava rooli tuotannossa ja markkinoinnissa. Artikkelissa esitetään asiantuntijoiden vaihtoehtoisia skenaarioita Suomen maatalouden tulevaisuudesta maatalous- ja muun yhteiskuntapoliittisen päätöksenteon tueksi.

Tässä tutkimuksessa maatalouden toimintaympäristön muutoksia ja niiden vaikutuksia tunnistettiin ja koostettiin tulevaisuudentutkimuksessa paljon käytetyllä Delfoi-menetelmällä. Tutkimuksessa on sovellettu kaksikierroksista Delfoita. Ensimmäisellä kierroksella tuotettiin asiantuntijoiden tulevaisuudenkuvia perusteluineen Suomen maataloudesta. Toisella kierroksella tarkennettiin ensimmäisen kierroksen vastauksia ja kysyttiin asiantuntijoilta tarkentavia tapahtuma-aika-arvioita sekä muutoksen suuntia skenaarioiden rakentamista varten.

Vaihtoehtoiset skenaariot ovat Mahdollisuuksien maatalous, Teollistuva maatalous ja Maatalous tuuliajolla. Lisäksi esitetään kaksi mini-skenaariota, joissa tuodaan esille potentiaalisten yllätysten mahdollisuus muokata maataloutta radikaalistikin. Miniskenaariot perustuvat epäjatkuvuustapahtumaan ja analogiatapahtumaan. Epäjatkuvuutena esitetään Odottamaton ilmasto -miniskenaario, jossa äkillinen ilmastonmuutos vaikuttaa dramaattisesti maatalouteen. Analogiatapahtumana esitetään Hullun lehmän paluu, jossa kotieläimiin ja ihmisiin helpommin tarttuva eläintauti vaikuttaa radikaalisti kotieläin- ja maatalouteen.