Directorate for Collective Scientific Assessment, Foresight and Advanced studies (DEPE)

Finnish Safety and Chemicals Agency

CASE STUDY REPORT

South FINLAND
Cereal and oilseed production

Building transition pathways towards chemical pesticide-free agriculture in 2050

Case study conducted as part of the foresight European Chemical Pesticide-Free Agriculture in 2050

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I. Objectives of the case study

The South Finland case study is one of the four regional case studies conducted as part of the foresight European Chemical Pesticide-Free Agriculture 2050. The European foresight study was run within the French Priority Research Program (PRP) 'Growing and Protecting crops Differently'[1], and in connection with the European Research Alliance 'Towards a Chemical Pesticide-Free Agriculture'. It produced three European scenarios, with their transition pathways and quantitative impact assessment. The full report of the European foresight is available here: https://hal.inrae.fr/hal-04231124.

From one of the European scenarios, the South Finland case study aims at building a scenario of chemical pesticide-free cereal and oilseed sector in South Finland in 2050, and at working with local actors on a transition pathway to achieve this desirable scenario. The South Finland scenario is therefore based on one of the European scenarios of chemical pesticide-free agriculture, and illustrates it in a specific region, on a specific crop and cropping system & for a specific and a specific sector and value chain. It is a way to check the plausibility, coherence, and clarity of the generic hypotheses identified at European level, to translate them into a specific context and case study and to identify potential missing elements. Finally, it allows to check with local experts, the feasibility of the Europeans generic hypotheses for a specific cropping system, territory and value chain.

In this report we cover three topics:
- An analysis of the major trends of the agricultural system in South Finland.
- A definition of a common vision of a desirable future, that is the scenario of a chemical pesticide-free cereal and oilseed production in South Finland.
- The building of the transition pathways to get to this desirable future. Our primary objective is to elaborate transition pathways crafted and adopted by the group, that is a timeline from 2020 to 2050 of actions organized to reach milestones which altogether will make us achieve this desirable future.

II. Brief overview of cereal and oilseeds production in South Finland

After a call for interest within the Experts' Committee of the foresight, launched in December 2021, Sari Autio volunteered to participate in the case study. The case study on South Finland was prepared with Sari Autio, Emilia Laitala, who are both Senior Officers at the Finnish Safety and Chemicals Agency Tukes (https://tukes.fi/etusivu), and Marja Jalli, Special Researcher at the Natural Resources Institute Finland Luke.

Region chosen

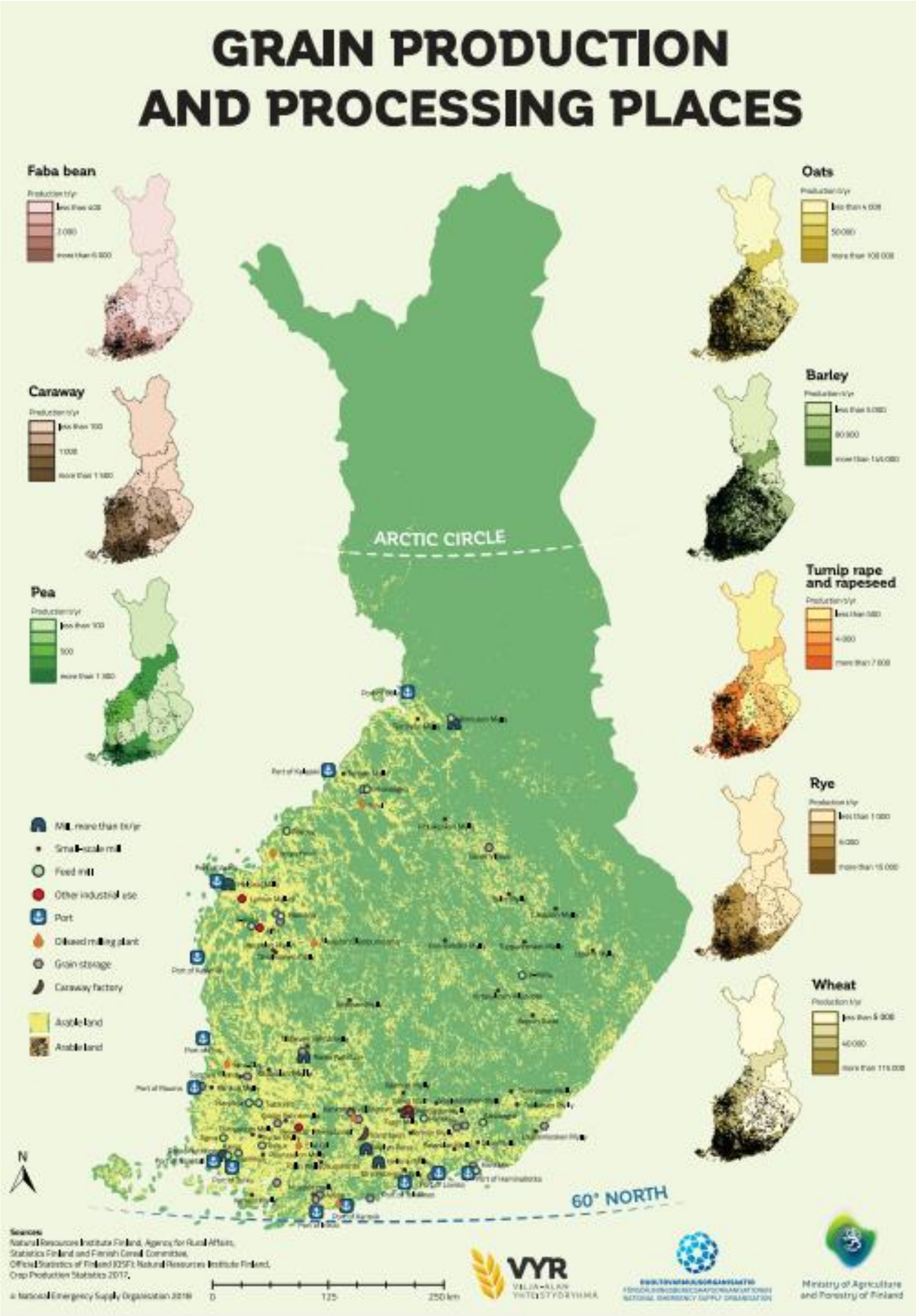
Finland is located in Northern Europe, mainly between the 60th and 70th latitudes, and is a part of the European Union. The northern location sets some limits, for example with regard to what plants can be cultivated. On the other hand, the cold winter reduces the occurrence of plant diseases and pests. The utilized agricultural area in Finland totals 2.3 million hectares, mainly in the Southern and Western parts of the country. Agricultural land accounts for around eight percent of the country's surface area (VYR, 2014).

Sector chosen

The regional coordinators chose to study cereal and oilseed crops. They are cultivated annually, in an area of approximately one million hectares. Cereals represent around 14% of Finland agricultural output (EC, 2021; 2018-2020 average). Finland is the world's northernmost grain-producing country. In Finland, four cereal crops are produced on a larger scale: barley, oats, wheat and rye (VYR, 2014).

[1] https://cultiver-proteger-autrement.hub.inrae.fr/

Figure 1: Grain production and processing places in Finland



Source: Finnish cereal committee. Available at : https://www.vyr.fi/document/1/804/f800e82/huonee_29ec443_Grain_production_and_processing_places_in_Fin.pdf

III. Method and process

III.1- Backcasting definition and application to the foresight study

In order to build the transition pathways, we choose the backcasting methodology. This backcasting method is combined with the exploratory scenarios.

Backcasting approach is a method that consists of analyzing, backward from a desirable future that is considered as an end-point, the actions (innovations, public policies…) that need to be taken to reach that future. It is a normative method, first described by Robinson in the 80's to work on energy transitions: *"working backwards from a particular future endpoint to the present, to determine what measures would be required to reach that future"* (Robinson, 1982).

The backcasting method is particularly appropriate to our study since it allows addressing long term and complex issues, where the dominant trends are part of the problem, involving many aspects of society as well as technological or organizational innovations, public policies and change. By breaking down the future into small steps, it contributes to making scenarios plausible and feasible, and to listing the various steps necessary to achieve them (Dreborg*, 1996*).

The backcasting exercise methodology we propose is inspired from previous foresight studies that have used this approach (Kok *et al., 2011;* Hines *et al., 2019*), that we have adapted to our study and purpose.

III.2- Organization of the work - Calendar of activities

The work on the regional case studies started end of January 2022 (21st), with a kick-off meeting organized with all the regional coordinators. It aimed to introduce the project to the coordinators, to present the methodology, the aim of the case studies and their contribution to the overall foresight, and to agree on the work timing and process. Then, a second meeting was organized with all the coordinators to present the foresight scenarios developed with the European experts' Committee (February 21nd). This second meeting provided detailed information about the three European chemical pesticide-free agriculture scenarios, and micro-scenarios for each component of the system. This information was discussed and used by the regional coordinators to select the desirable scenario.

Concerning Finland, a "regionalization" meeting was organized on March 18th. Its aims were to (1) select the "desirable scenario" and (2) to translate its European hypotheses into hypotheses adapted to the local situation and crop studied.

Then, a narrative of regionalization of the scenario for Finland was built through email exchanges in April.

Finally, the participatory workshop to elaborate transition pathways for cereals and oilseed production happened on April 26th, in Helsinki. It gathered 16 participants.

III.3- Methodology followed in the case study: overview of the different steps

Figure 2 summarizes the process we followed in each of the case study, also valid for the Finland case study. The five steps are further detailed below. Steps 1 and 2 happened in March 2022. The process and template were prepared by Olivier Mora and Claire Meunier. The preparatory work and the retrospective analysis were done by Sari Autio, Emilia Laitala, Marja Jalli (from LUKE, Natural Resources Institute Finland) and Kallio-Kaija Mannila (from Tukes). The "regionalization meeting" gathered all six contributors together. Steps 3, 4 and 5 happened during a one-day workshop organized by the regional coordinator Sari Autio, and co-animated by Sari Autio, Emilia Laitala and Claire Meunier.

Step 1: definition of the desired endpoint in 2050: selection of the desirable scenario

For each of the regional workshop, the experts selected one of the three exploratory scenarios developed with the foresight expert committee.

The regional coordinators, with the support of the foresight team, chose the most relevant scenario. To select the scenario, the regional coordinators, supported by the foresight team, looked for the most relevant scenario for the region, crop and value chain studied. Several criteria could be used, such as the adaptability of the scenario, its plausibility in the specific context of the region and the crop, and its attractiveness for the regional stakeholders.

Step 2: definition of the desired endpoint in 2050: « regionalisation » of the scenario

The selected desirable scenario was adapted to the cropping systems, the farms structures, the value chain and the region considered, in order to make it more tangible and to define a specific endpoint for the region considered. The regionalized scenario translates the generic hypotheses of each component of the system into specific hypotheses fitting with the region considered.

In order to regionalize the selected scenario, we first identified the past and current regional dynamics of cropping systems, food value chains and local area, as described in the example in the table 1. Scientific literature, grey literature, outreach to researchers or stakeholders were used to inform this step.

- In this **retrospective analysis**, we identified trends, weak signals, and ruptures for each of the components: local cropping systems, local food chains and local area.

Table 1: Example of « component value chain table » summarizing past and current dynamics

Definition of the food value chain and its main indicators
How does the food value chain look like for the crop considered? What are its main characteristics: main actors, organisation, main products, economic data, consumer's attitudes
Retrospective analysis of the food value chain
What have been the past evolutions (10 last years)? Who are the key actors involved in these changes?
Prospective
Which factors could influence the future evolution of the value chain? What are the trends? What are the weak signals? What are the possible ruptures?
References (scientific articles, grey literature, experts interviews…)

- We then **translated** and specified the generic hypotheses in 2050 from the **desirable scenario into regional hypotheses** linked to regional dynamics.

This was done by referring to the morphological table for the desirable scenario chosen, and asking, for each hypothesis for each component: What does this hypothesis mean for the region and crop considered?

The regionalization of the scenario was done during a dedicated meeting gathering the regional coordinators of each region and the foresight team.

Its outcome was a regionalized scenario, in the form of a morphological table and a narrative.

One-day workshop in Helsinki, Finland, on April 26th, addressing steps 3, 4 and 5

Step 3: listing obstacles, opportunities and milestones

During the workshop, we began by listing obstacles, opportunities and milestones.

The objective of this part was to identify the key intermediate steps needed to be achieved, in order to reach the desired objectives, and issues and opportunities arising from them. Milestones, obstacles and opportunities were discussed for each of the components of the system and their hypothesis, linking to the desirable scenario and its morphological table.

Milestones are defined as the main steps from the desirable future to the present, or a future event that signals the progression towards our desirable future (Van Vliet and Kok, 2013; Bengston et al., 2020; Hines 2019). Milestones can for example be a 50% reduction in the use of chemical pesticide by farmers in the region in 10 years.

Obstacles are for example: lack of resources, or organization of crop protection services, alternative biocontrol solutions not known to all, lack of financial incentives for transitioning, perceived risks of transition ….

Opportunities are favorable changes that are in favour of a transition towards pesticide-free agriculture (for example, consumers willing to buy pesticide-free products).

Obstacles, opportunities and milestones are identified out of the regionalized scenario. They are discussed for each of its components: agricultural equipments and digital technologies, crop systems, farm structures, food value chain, diet.

Step 4: Defining actions needed

In this step the group discussed which initiatives are needed to reach these milestones, overcome obstacles, and/or make use of opportunities.

An action is defined as a concrete initiative that take advantage of an opportunity, or reduce the likelihood of or prevent from an obstacle. (Bengston et al., 2020).

Actions can be a regulation, a policy instrument, a research program, an education program, a communication campaign, a monitoring, a technological solution, capacity building …

Actions could be, for example, a decision by a mayor to only buy pesticide-free products in the school canteens, a new combination of living microorganisms introduced in the market as a biocontrol solution, increasing the plants resistance to pests; a local NGO campaign to sensitize the population on biodiversity preservation.

The actions must be as specific as possible, and answer the typical questions:

*Why: obstacle overcome, opportunity seized.

*What: type of actions.

*When, and How long.

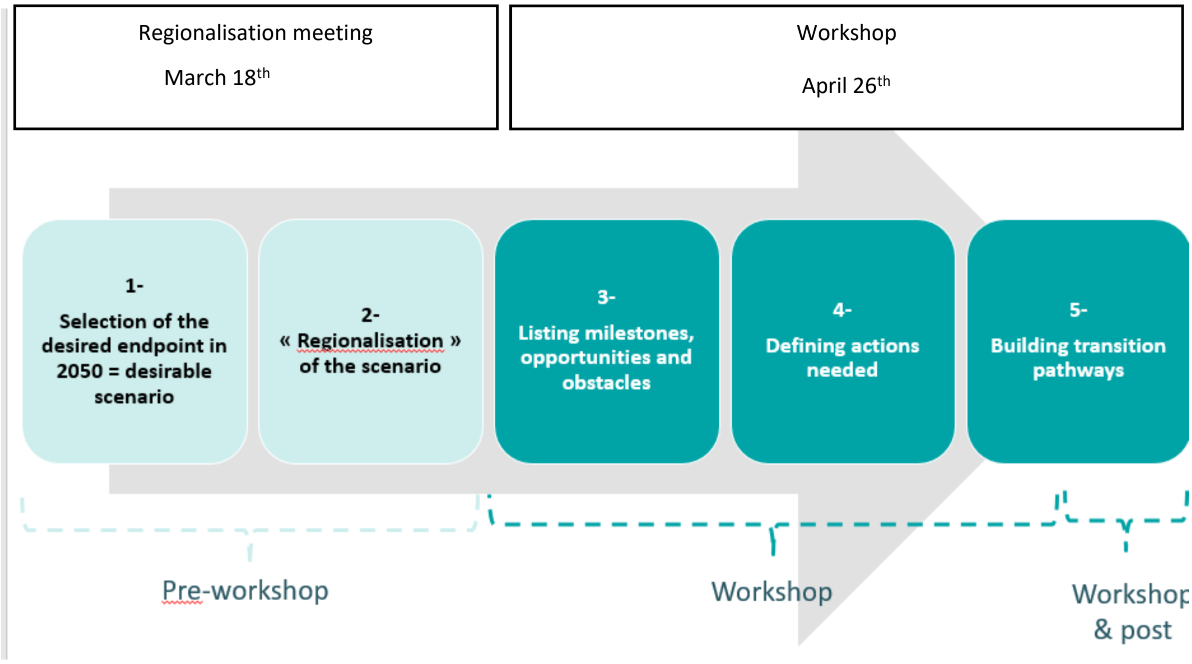
*by Who: actors involved and their roles.

Step 5: Building transition pathways

Milestones and actions were articulated in the backcasting timeline, in order to build transition pathways. We showed how each action on a component of the system will interact with other actions on other component of the system.

The various actions and milestones were organized in order to identify strands of connected actions and milestones that could ultimately form the transition pathway.

Figure 2: Process followed in the case study



IV. Retrospective analysis – cereals and oilseed production in South Finland

In order to conduct the retrospective analysis, a template table was provided to the regional coordinators, listing the different *components* of the foresight and their *variables*. The retrospective analysis aimed at identifying past, current trends and possible future evolutions.

For each component, the following questions were asked:
- What have been the past evolutions (during the last 10 years)?
- Who are the key actors involved in these changes?
- Which factors could influence the future evolution of the component?
- What are the main trends?
- What are the weak signals?
- What are the possible ruptures?

The Finland case study coordinators completed the retrospective analysis template ahead of the regionalization meeting, based on their knowledge and experience. In parallel the foresight team conducted a short literature review (non exhaustive) using WOS[2], documents from the European Commission (EC, 2020) and foresight operations conducted in Finland.

The table was then shared and discussed during the regionalization meeting. The detailed outcome of this discussion is presented in the next pages (tables 2 to 5) and a summary of the main trends identified is presented below.

IV.1- Major trends identified on cereal and oilseed cropping systems

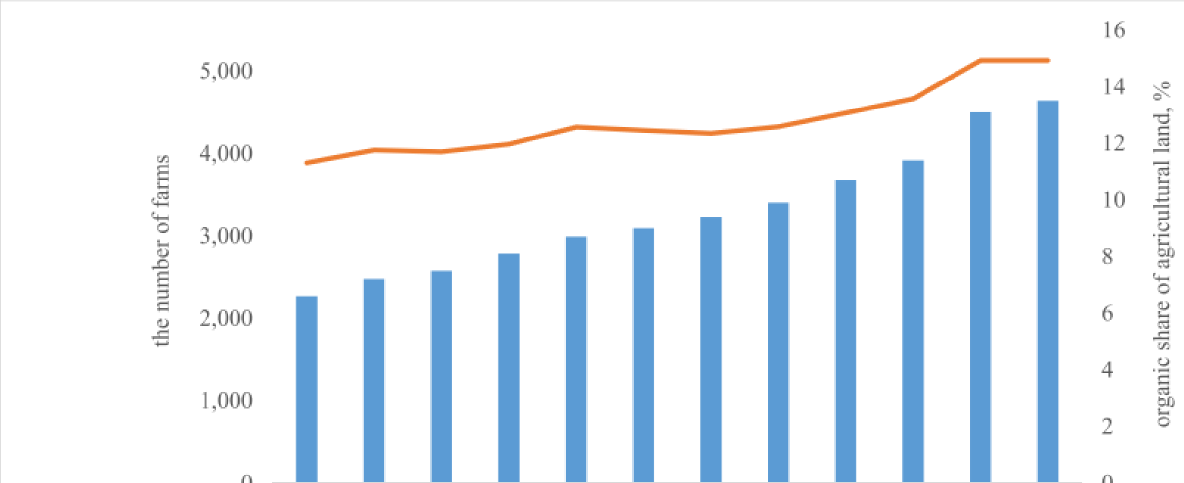
The main cereals and oilseeds produced in Finland currently are wheat, rye, barley, oats, and protein crops (oilseed, pea, faba bean). The share of organic farming has increased over the past 10 years to reach in 2019 around 13.5% share of agricultural land as shown in figure 3 (Kujala et al., 2022). Seeds used are varieties adapted to the specific Nordic climate conditions (short growth season with cool climate and long daily hours). There is a growing interest in reduced tillage: ca. 10% of the field area is now on direct sowing. The main pests to manage are weeds (Salonen et Hyvonen, 2002), leaf diseases insects such as flea beetles. Crop protection measures include the use of chemical pesticides and alternatives such as cultivar resistance, diversified crop rotation (Peltonen-Sainio and Jauhiainen, 2019), catch crops, mechanical control (Vanhala, 2006). Also, crop protection decisions are based on field observations, following threshold values of occurrence of pests and weeds (for example with the web-based monitoring application LukeKasKas for observing weed, plant disease and pest situation and planning for control measures, that is freely available for the farmers: Maatalousinfo (luke.fi)). The choice of plant protection products available and adapted to Finnish conditions decreases, potentially causing an increased risk of resistance. This is due to the small market of pesticides in Finland for chemical companies, and to the European risk assessment and approvals process. In future, there should be an increase in transition to organic farming[3], profitability of organic products being higher than conventional production, and being supported by CAP payments. Finland has launched in 2021 a national program for organic production development by 2030 (Ministry of agriculture and forestry, 2021). An important factor for the future evolution of cereal and oilseed production in Finland is

[2] WOS query « finland AND cereal » and "finland AND oilseed" conducted in February 2022, limited to « topics », generated 176 results, 25 of which were selected based on titles and abstracts.

[3] Organic 2.0 – Finland's National Programme for Organic Production 2030. Publications of the Ministry of Agriculture and Forestry 2021:21. Organic 2.0 – Finland's National Programme for Organic Production 2030 (valtioneuvosto.fi)

climate change. There are already observed increased temperatures during the growing seasons of cereals, with reduced yield variability (Peltonen-Sainio *et al.*, 2009), and evolutions in pests and diseases (Hakala *et al.*, 2011). More generally, maintaining the economy and profitability of Finnish agriculture is an important challenge for the future (Huan-Niemi *et al.*, 2017).

Figure 3: Evolution of the share of organic in agricultural land in Finland from 2008 to 2019 (from Kujala et al., 2022)



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
share of agricultural land	6.6	7.2	7.5	8.1	8.7	9	9.4	9.9	10.7	11.4	13.1	13.5
number of farms	3890	4043	4022	4114	4322	4284	4247	4328	4493	4665	5129	5129

IV.2- Major trends identified on cereal and oilseed value chains

Cereals are mainly processed into bread and milling products for food consumption, and oilseeds to vegetable oils. Roughly, half of annual grain production is used as feed for livestock to support the domestic animal production (cereals and squeezing cakes).

Bread and milling products are basic food products in the diet of Finnish people. Especially rye and oats are important contributors to traditional finish diets. Over the past years, there has been an increased demand for plant-based foods, like oat "milk", vegetable oils, and for organic products. This change in people's diet expectations is triggered by healthy and environmentally friendly choices (Saba *et al*., 2008; Dean *et al*., 2007). The value chain is organized at regional level (see figure 1). The milling industry represents 9 big companies, and 100 small and medium enterprises. There are more bakeries (78 big companies and 871 small and medium enterprises). Retailers are more concentrated with 3 main chains of groceries (EC, 2020). Local direct selling is an increasing trend with local direct selling events such as REKO[4].

Labels are developed on cereal and oilseed products, to inform consumers about their nutritional and environmental benefits: EU organic label, healthy choice (for heart health), domestic production (delicious from Finland[5]). In future, there should an even higher demand for diversified products (for health reasons and diversified diets, but also curiosity testing of new choices). The importance of local production should also increase as a driver of consumers choices, and community supported agriculture.

[4] All Finnish REKO circles: What is REKO? - (aitojamakuja.fi)

[5] The Hyvää Suomesta (Produced in Finland) label | Hyvää Suomesta (hyvaasuomesta.fi)

IV.3- Major trends identified on agricultural equipments and digital technologies

Finland is an innovative and knowledge-oriented society with a strong emphasis on digitalisation and research (EC, 2020). New technologies are available and accessible to farmers. They include remote sensing, drones, IoT (connected tools), mobile applications for agricultural services, virtual trainings of the inspectors of spraying equipment, soil scouting and other techniques to analyze local conditions. Among farmers, young generations are more eager to apply these new technologies[6]. Also, wide application of these technologies depends on their prizes and digital knowledge among farmers. Active research and long-term funding for the development of technologies applicable to Finnish conditions are important. There should be an increasing interest in these IT solutions, driven by environmental concerns among farmers, and increasing interest in analyzing and interpreting the local cultivation conditions (soil health, microbiome…).

IV.4- Major trends identified in Finnish farm structures

In Finland there are typically family farms, 86% are owned by private individuals. There is a past trend towards reduction in the number of farms and increased size (Peltonen-Sainio and Jauhiainen, 2019), even if average field area remains rather modest (49 ha average, 63 ha in organic farming). Finnish agriculture is highly dependent on PAC payments (Huan-Niemi, 2017): agricultural policy and targeted subsidies are a key driver to the general structure of agriculture (EC, 2020). Forestry income is another source of capital for farmers. Cereal farms usually do not employ significant external employees, labor force being primarily farmers and family members. Farms are specializing (32% of farms are specialized in grain production in 2020). We can notice an increasing interest among farmers, consumers and the society in general in environmental protection. Climate change and its consequences in terms of instability could make it difficult for new generation of farmers, at least full time.

[6] See for example Flexigrobots: Flexible heterogenous multi-robot solutions for intelligent automation of precision agriculture operations | Natural Resources Institute Finland (luke.fi)

Table 2: Retrospective of cropping systems for cereals and oilseed production in Finland

<table>
<tr><th>CROPPING SYSTEMS</th><th>CURRENT SITUATION</th><th>PAST TRENDS</th><th>FUTURE TRENDS</th></tr>
<tr><td>System characteristics: orientation, choice of crops and crop sequences</td><td>Cereals (wheat, rye, barley, oats), protein crops (oilseeds, pea, faba bean)</td><td rowspan="7">What have been the past evolutions (10 last years)?

Field area in organic production is increasing (ca. 14 % in 2020). Choice of chemical plant protection products is decreasing, potentially causing increased risk of resistance.

Who are the key actors involved in these changes?

Interest in CAP support on organic farming among the farmers, EU risk assessments and approvals of PPPs, small market of PPPs in Finland (for chemical companies not competitive to apply for authorisations in Finland)</td><td rowspan="7">Which factors could influence the future evolution of the cropping system?

Competitiveness of farming in general, CAP support systems, producer prices of cereals and oilseeds and input prices.

What are the trends?

Transition to certified organic farming, profitability of organics is higher than in conventional production in general. Young farmers more knowledgeable and interested in developing their production than previous generations.

What are the weak signals? Part-time farming?

What are the possible ruptures?

Challenges caused by the climate change to farming and the economy and profitability of agriculture in general.</td></tr>
<tr><td>Varietal choice</td><td>Varieties adapted to the short Northern short growth season with cool climate and long daylight hours</td></tr>
<tr><td>Pest management : Main pests, weeds, pathogens
Main plant protection products used
Alternative solutions to replace PPP</td><td>Careful preparation of the seed bed, including the post-emergence spraying of fenoxy acids or sulfonyl ureas against common annual dicotyledon weeds such as mayweeds. Direct sowing and post-harvest spraying of glyphosate against permanent weeds, mainly cough grass. Control of leaf diseases with fungicides (triazoles, SDHIs, azoxystrobin), and/or sowing of treated seed. Only occasional need for controlling aphids from cereals with pyrethroids. Control of flea beetles from cruciferous oilseed cultivations using treated seed (emergence authorisations of flupyradifuron). Post-emergence treatment against pollen beetle with pyrethroids. Alternatives to chemical control, e.g. cultivar resistance, diversified crop rotation including undersown and catch crops to prevent and suppress weeds, diseases and pests, mechanical control of cough grass after harvest.</td></tr>
<tr><td>Fertilisation</td><td>In conventional farming mineral fertilizers, in animal farms also manure if available. In organic farming green manure and animal manure according to the crop rotation planning.</td></tr>
<tr><td>Management of water resources and irrigation</td><td>No irrigation</td></tr>
<tr><td>Tillage and soil management</td><td>Interest in reduced tillage is increasing. Ca. 10 % of field area in direct sowing.</td></tr>
<tr><td>Monitoring</td><td>Crop protection decisions based on the field observations, e.g. following the threshold values of the occurrence of weeds or pests.</td></tr>
</table>

Table 3: Retrospective analysis of food value chain and diet in Finland

<table>
<tr><th>FOOD VALUE CHAIN</th><th>CURRENT SITUATION</th><th>PAST TRENDS</th><th>FUTURE TRENDS</th></tr>
<tr><td>Type of food products</td><td>Bread and milling products, vegetable oils. Significant part of the lower grade production of cereals and the squeezing cakes of oilseeds go to animal feed to support the domestic animal production.</td><td rowspan="7">What have been the past evolutions (10 last years)?

Increasing consumer demand on organic products. Increasing interest in plant-based foods, e.g. oats milk. Local direct selling events such as REKO.

Who are the key actors involved in these changes?

Young, urban consumers, people interested in healthy and environmentally friendly food choices.</td><td rowspan="7">Which factors could influence the future evolution of the value chain?

Diversification and specialization of producers, e.g. gluten free varieties (oats), diversified diets, curious testing of new choices, local production and community supported agriculture.

What are the trends?

Free from, traceability to the farm, diversified diets.

What are the weak signals?

Information sharing between the consumers, e.g. recommendations in social media, vegan diets, climate concern.

What are the possible ruptures?

Consumers' willingness to pay, stability and diverging of the society.</td></tr>
<tr><td>Food consumption patterns - place of the product in people diet</td><td>Cereals and bread are basic food products in the diet. Especially rye and oats are important in traditional Finnish diets. Diversified bread choices in different parts of Finland. Increased demand of vegetable oils in healthy diets.</td></tr>
<tr><td>Consumers attitudes and expectations towards the products</td><td>Wholegrain products and vegetable oils in healthy diets, trust in low levels of PPP residues in domestic produce.</td></tr>
<tr><td>Main actors in the value chain (storage, primary processors, food and drink manufacturer, retailer, food services…), organisation and governance</td><td>Milling industry: 9 big and 100 SMEs. Bakeries: 78 big and 871 SMEs. One big and several small oil squeezers around Finland. Three main chains of grocery retailers.</td></tr>
<tr><td>Information to consumers (labels, certifications, traceability, …)</td><td>EU Organic label, healthy choice labels such as Sydänmerkki (Healthy heart label) available for cereals and oils, domestic product label Hyvää Suomesta (Delicious from Finland). Traceability to the farm is possible e.g. in contracts of milling industry.</td></tr>
<tr><td>Technologies used to sort, store, process and/or preserve food products</td><td>Modern milling, bakery and oilseed squeezing technologies available. Effective production and supply chains.</td></tr>
<tr><td>Spatial scale: activities at local, national, european, outside Europe</td><td>Variable, depending on the size of the enterprises. Increasing worldwide demand and export of oats.</td></tr>
</table>

Table 4: Retrospective analysis of agricultural equipments and digital technologies in Finland

AGRICULTURAL EQUIPMENTS AND DIGITAL TECHNOLOGIES	CURRENT SITUATION	PAST TRENDS	FUTURE TRENDS
Observation and modelling systems	Active research in developing digital observation and monitoring systems is ongoing. Wide application of digital systems is depending on their prizes and the level of knowledge among farmers.	What have been the past evolutions (10 last years)? More specialized farms and young farmers apply most eagerly new methodologies. Depends on the profitability of the farm. Who are the key actors involved in these changes? Advisers. Economy. Interest in knowledge sharing and collective learning. Retailers of agricultural equipment.	Which factors could influence the future evolutions? Profitability of agriculture in general, possibilities for investments. Environmental concern among the farmers and in the society in general. What are the trends? Increasing interest in IT driven solutions in general. What are the weak signals? Increasing interest in analysing and interpreting the local cultivation conditions, e.g. understanding the impact of the soil microbiome in yield production. What are the possible ruptures? Knowledge gaps, economy, willingness to pay of the consumers.
Specific equipments	E.g. remote sensing, IoT, drones, mobile applications of agricultural services, virtual training of the inspectors of spraying equipment, soil scouting and other methodologies for analyzing local conditions.		
Innovation dynamics	Long-term funding on the research and development of technologies and equipment applicable in Finnish conditions is important. Virtual education of farmers, advisers, trainers and inspectors, using VR methodologies.		

Table 5: Retrospective analysis of farm structures in Finland

FARM STRUCTURES	CURRENT SITUATION	PAST TRENDS	FUTURE TRENDS
Governance of farm structures	Typically family farms, 86 % of farms owned by private individuals	What have been the past evolutions (10 last years)? Reduction of the number of farms and increasing farm size. Less profitable farms are finishing and the most profitable farms stay in business, with most professional leadership. Who are the key actors involved in these changes? Agricultural policy and targeted subsidies affect the general structure of agriculture. Decreasing interest among the young generations to continue running their inherited farms, at least full time.	Which factors could influence the future evolution of the farm structures? Agricultural and rural policies of the society, profitability expectations of agriculture in general, self-sufficiency of food supply in the society, consumer demand of domestic food with no residues of pesticides. What are the trends? Number of farms is decreasing while the average size is increasing, more specialization and knowledge-intensive production methods adapted to local conditions. What are the weak signals? Increasing environmental concern among the farmers and consumers, and in the society in general. What are the possible ruptures? Climate change and instability of the society would make it difficult to engage in the farming in the long term.
Size of farms	Mean field area 49 ha, in organic farming 63 ha. Along the decreasing number of farms, the field area per farm is increasing.		
Labour force (family, sole holder, external to family, …)	In average 76 % of labor force in Finnish farms are farmers and family members, 24 % external employees in 2020. Cereal farms usually do not employ significantly external employees.		
Source of capital	Ownership of the production sites, forestry income, bank loans, CAP subsidies		
Type of farms (specialized, mixed, livestock, permanent crop, …)	14700 farms = 32 % of all farms are specialized in grain production in 2020		
Access to new technologies (digitalisation, machinery, breeding, consultants, …)	New technologies are accessible, but intake varies depending on the education level, interest and age of farmers. Most profitable farms are highly interested in testing and applying new technologies.		

V. “Regionalized” scenario in 2050 in South Finland for cereal and oilseed production

The regionalization of the scenario started during the “regionalization meeting”, based on the retrospective analysis presented in the previous section.

As second step, the regional coordinators chose the desirable scenario out of the three European scenarios. They chose the scenario number 3 “**Territorial and regional coordination, complex and diversified landscapes for a one health food system”.** The reasons for this choice are based on the trends identified in the retrospective analysis, mainly consumers’ trends: increasing interest for diversified healthy products, local production, community supported agriculture. Also, the increasing interest from farmers in analyzing and interpreting the local cultivation conditions and adapt their practices thereof, and the value chain, mainly oriented towards local and regional distribution channels, justify this choice. Another option could have been to study the scenario number 2 “European and regional food systems, soil and food microbiomes for healthy food and healthy diets”, since consumers trends are oriented towards healthy diets. The regional coordinators considered that scenario “Territorial and regional coordination, complex and diversified landscapes for a one health food system” was more appropriate, given the importance of environmental concerns among Finnish society.

Finally, a brainstorming session enabled to translate the hypotheses of the European pesticide-free agriculture scenario “Territorial and regional coordination, complex and diversified landscapes for a one health food system” (S3) into hypotheses specific to the Finnish case study. For this last part, we organized a klaxoon session to gather insights on how the European hypotheses would translate in Finland for the cereal and oilseed sector, for each of the four components. The klaxon board was divided into four areas representing the four components: cropping systems, food value chain, agricultural equipments, and farm structures. Generic hypotheses of the components were described on the left hand side of the board, and participants posted suggestions of hypotheses (practices / status / organizations) adapted to the situation in Finland in 2050. On the right hand side we posted a list of questions to help in the idea generation. Figure 2 shows an example for cropping systems. The ideas proposed are in the yellow sticky notes (Appendix II presents the klaxon board delivered during this session, and table 6 lists the ideas generated during this session).

Figure 3: Example of the idea generation process used for gathering hypotheses adapted to Finland and cereal and oilseed production in 2050.

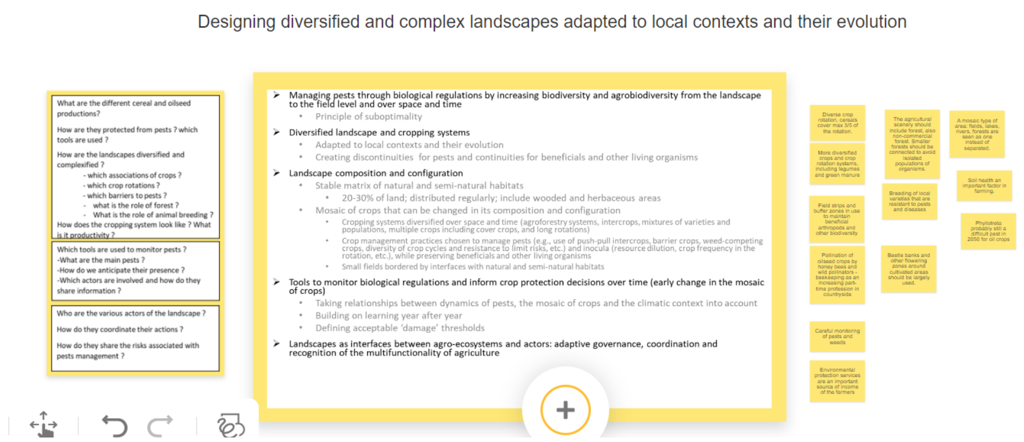


Table 6: List of ideas generated during the brainstorming session:

Cropping systems	**Food value chain and diets**	**Agricultural equipments and digital tools**	**Farm structures**
Diverse crop rotation, cereals cover max 3/5 of the rotation.	Local food markets and direct selling from farms (including REKO)	IT monitoring systems based on remote sensing will be affordable	Family farms are still the main structure of agriculture
More diversified crops and crop rotation systems, including legumes and green manure	Increase in consumption of whole meal products and healthy vegetable oils (lower consumption of animal fat)	co-operation, including equipment sharing might increase	Sharing equipment with other farms will possibly increase?
Careful monitoring of pests and weeds	Cooperation of knowledge sharing between consumers and farmers about the healthy and environmental properties of food	Advisory organisations provide also IT tools	Selling services (e.g. advisory services) can be part of the income of knowledgeable farmers
Field strips and buffer zones in use to maintain beneficial arthropods and other biodiversity	Community supported agriculture will become more common to link the consumers and farmers	Higher level IPM requires online book keeping of pest and disease control to base the control decisions	Crop rotation must be planned and executed well so farms cannot be too specialized
Beetle banks and other flowering zones around cultivated areas should be largely used.	Finland might be more self sufficient in producing protein rich plant crops for fodder and human food	Universities, universities of applied sciences and vocational schools are already developing equipment and this probably will continue in the future	Farmers' organisations like MTK (national organisation of farmers) continue having important influence in the society and politics
Pollination of oilseed crops by honey bees and wild pollinators - beekeeping as an increasing part-time profession in countryside	Consumers' trust in labels (verification of environmental and health claims)	co-development of innovations between researchers + farmers + machinery companies (already research program on monitoring equipments - drones)	Dependence on input retailers is decreasing along reduced use of chemical fertilizers and plant protection products
The agricultural scenery should include forest, also non-commercial forest. Smaller forests should be connected to avoid isolated populations of organisms.	Free from production increases to fulfill the demand of allergic and other diets (gluten free, fat free, vegan,...)	part time researchers & farmers (farm field tests)	Farm size has been increasing in past years and the number of farms decreasing. This trend might continue.
A mosaic type of area: fields, lakes, rivers, forests are seen as one instead of separated.	Less transport of food from long distances	highly educated farmers	Production contracts give continuity
Breeding of local varieties that are resistant to pests and diseases	The traceability of the whole food chain is important for consumers, so easy-to-use applications are needed and created for that		Further processing of own produce, e.g. home bakeries?
Environmental protection services are an important source of income of the farmers	Dependence on big retailers decreasing?		Part-time farming or low scale farming might increase

Table 6 (continued) :

Cropping systems	**Food value chain and diets**	**Agricultural equipments and digital tools**	**Farm structures**
Phyllotreta probably still a difficult pest in 2050 for oil crops	The possibility to easily recycle the food packaging is even more important than it is today		Small scale collective organisations, territorial level, co owning of machinery
Soil health an important factor in farming.	Healthy and environmentally friendly food affordable to all - these products are subsidized public aids		
	Animal production remains especially in the northern part, maybe reduced and switched to organic dairy + biogas		
	Continued interest from big retailers to sell environmentally and healthy food products		
	Recyclable market developed due to forest resources		

Building the narrative for a pesticide-free cereals and oilseed cultivation-in Finland in 2050

Based on the regional hypotheses generated during the regionalization workshop, the foresight team prepared a first version of the regional scenario: a narrative describing the cereal and oilseed production and sector in 2050, without chemical pesticides. In this first version, we highlighted some missing points to get a coherent and clear narrative, and we shared it with the coordinators of the Finland case study, in order to have their inputs on (1) the coherence of the scenario with the local situation and crop studies, and (2) the missing parts.

Main points of discussion and additional elements brought to the scenario:

Bioeconomy: Finland has a strong national bioeconomy strategy (https://www.bioeconomy.fi/). It was discussed how to include this into the scenario in 2050.

The scenario was therefore completed with elements related to bioeconomy: "the farms aim to closing the cycles of inputs and outputs, e.g. by local production of biogas and return of nutrients into the soil via biogas digestates", and "Finnish bioeconomy industry contributes to the development of biocontrol solutions for plant protection".

Clarifications on the cereals and oilseed food sector, the processing (milling) industry, the type of breads produced in 2050, and other types of food products.

The scenario was completed accordingly with elements describing the food processing industry in 2050:

- "Milling and bakery industries maintain local SMEs to provide diversified cereal products and traditional varieties of bread in different parts of Finland";

- "Responsibility and sustainability certificates such as organic label support the consumers' trust in Finnish products".

Do we need to anticipate an issue with the potential increase of mycotoxins in the cereals?

The scenario was completed accordingly: "heat treatment of seeds is used to prevent seedborne diseases and increasing risk of mycotoxins along the humid weather conditions".

Final scenario of Chemical Pesticide-Free cereals and oilseed production in South Finland in 2050

Generic scenario –

Territorial and regional coordination, complex and diversified landscapes for a one health food system

Finnish cereals and oilseed sector produce sustainably healthy milling and vegetable oil products, and delivers ecosystem services to local consumers & citizens who are concerned about environmental and human health preservation.

In Southern and Western Finland, in 2050, cereals and oilseeds are produced without chemical pesticide, in order to answer Finnish consumers' demand for food preserving human and environmental health. Consumers look for food with a high nutritional value and that are little processed. Finnish people are very concerned about environmental protection, preservation of rural areas, and about food sovereignty. In 2050, Finland is self-sufficient in producing protein rich plant crops for animal feed as livestock production has reduced and mainly switched to organic dairy and for biogas. Finnish society acknowledges the ecosystem services of agriculture, and farmers environmental protection services are explicitly targeted by public subsidies. Healthy and environmental friendly food are affordable to all thanks to targeted public subsidies.

Cereal cropping systems are diversified and represent maximum 3/5 of the crop rotation. Other crops include legumes for plant protein, feed nutrition, but also to contribute to healthy soils. Green manure is used as a source of fertilization and also to strengthen soil microbiome. The seeds selected are local, adapted to the specific climate conditions in Northern Europe, and also to pests and diseases. They are heat-treated to prevent seedborne diseases and increasing risk of mycotoxins along the humid weather conditions. Crop protection is ensured through biological regulations by complexification of landscape including forests, crop diversification, with field strips and buffer zones to maintain beneficial arthropods and other biodiversity, beetle banks and flowering zones around the plots, honey bees and wild pollinators for oilseed crops pollination. In 2050, conservation biological control is favored, the landscape is reconfigured as a mosaic of areas including lakes, rivers, forests, connected together to reinforce populations of beneficial insects and avoid isolated populations of pests. Non-chemical solutions, such as late sowing are used for some specific pests such as Phyllotreta spp. on oil crops. Crop diversification and complex landscape are also very important to strengthen the resilience of cropping systems to extreme climatic events that are now more frequent because of climate change. Circular economy if favored and supported by the bioeconomy Finnish strategy. Farms aim to closing the cycles of inputs and outputs, e.g. by local production of biogas and return of nutrients into the soil via biogas digestates.

Cooperation between farmers, advisory organisations, and other actors at territorial level is in place in order to monitor efficiently the weather but also the state of ecosystem and the dynamics of animal pests, weeds and diseases. IT monitoring systems based on diverse remote sensing data and crowdsourcing of information are available, accessible to farmers, and allow online and collective book keeping to base decisions.

Farms remain family based in terms of ownership, capital and work, but have grown in size. Farmers are concerned about sustainability. They are highly educated and regularly trained on agroecology and the use of digital tools. They are supported by independent advisory organisations. They cooperate at territorial level to share machinery (collective organization, co-owning), knowledge, monitoring. They have reduced their dependence on input retailers and also reduced their level of specialization through diversification of crop. Non-farm activities have developed (part-time farming) such as advisory services, own baking productions, research…. Participatory research and development through Living labs have increased the co-development of innovative solutions by gathering researchers, farmers and machinery companies. Virtual education and continuous trainings are provided to farmers in order to give them access and knowledge to redesign their own cropping systems.

Plant productions are transformed locally into milling products that are very diverse, little processed, of high nutritional value thanks to the use of whole meal cereal flours, legumes flours that are rich in plant proteins, fibre, and micronutrients. Milling and bakery industries remain local small and medium size enterprises (SMEs). They provide diversified cereal products and traditional varieties of bread in different parts of Finland. Pulses are also valorized in animal nutrition, improving Finnish self-sufficiency for feed.

Consumers buy these free-pesticide products from a diversity of food chains: big/national retailers, local food markets, and direct distribution channels allowing them to be in direct contact with farmers through digital platforms. Community supported agriculture, improving the link between consumers and farmers, is very popular. Big retailers have seen an interest in selling healthy food products. Food chains "free from" is very developed on shelves, to fulfill demand regarding diverse diets (gluten free, vegan, fat free…). Responsibility, sustainability claims (such as organic label) and certificates are checked and approved by public authorities before being used on food labels. This public verification of environment and health claims has reinforced consumers trust in Finnish products. All across the value chain, the traceability of the whole food chain is ensured for consumers and data about the nutritional composition, the origin, processing steps, environmental footprint are made available to consumers through easy-to-use digital applications. There is a share of knowledge between consumers and farmers about the healthy and environmental property of food. Food chain have reduced the transport of food from long distance, and food packaging is fully recyclable and leverage the bio-based resources materials from forests.

Table 7: Summary of hypothesis per component

	Hypothesis
Food value chain	Local and diversified cereals and oilseeds products, certified by Finnish authorities as healthy and environmentally friendly.
Farm structures	Larger family farms owned by farmers concerned about the environment, rewarded for their ecosystem services, and involved in other activities (part time farming).
Cropping systems	Diversified cereals, oilseed and legumes crops, protected from pests by preventive farming practices, leveraging biological regulations and arranging a mosaic of areas at landscape scale.
Agricultural equipment and digital technologies	Cooperation between farmers to share equipment and also monitoring of weather, ecosystem dynamics and pest developments

VI Workshop to build the transition pathway towards chemical pesticide-free cereal and oilseed production in South Finland by 2050

Helsinki, April 26th, 2022

The facilitators of the workshop were Sari Autio and Emilia Laitala from TUKES, Finland, supported by Claire Meunier, INRAE Directorate for Expertise, Foresight and Advanced Studies.

VI.1- Participants

Participants were selected and invited by Sari Autio.

Table 8: List of participants (name, first name, organization)

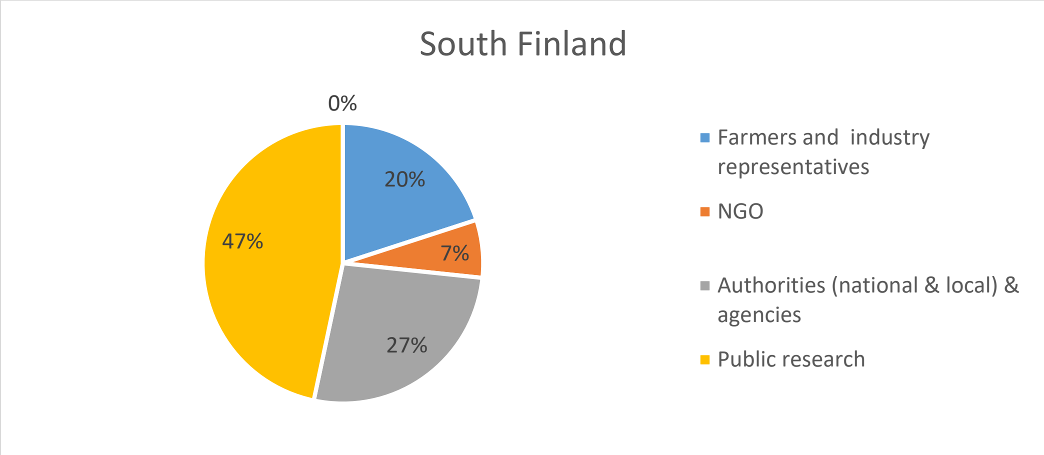
Autio Sari	Tukes (Finnish Safety and Chemicals Agency) – case study coordinator
Laitala Emilia	Tukes – case study coordinator
Jalli Marja	Luke (Natural Resources Institute Finland) – case study coordinator
Anttila Heli	Tukes
Jern Tove	Ministry of Agriculture and Forestry
Kallio-Mannila Kaija	Tukes
Kämäri Tiiti	Häme University of Applied Sciences
Korkman Rikard	Ombudsman, Central Union of Swedish-speaking Farmers and Forest Owners in Finland
Lamminparras Aura	Finnish Organic Food Association Pro Luomu ry
Livonen Sari	Finnish Organic Research Institute
Malin Eliisa	Baltic Sea Action Group
Nevala Noora	Tukes
Pouta Eija	Luke
Roitto Marja	University of Helsinki
Ronkainen Ari	Luke
Ruuttunen Pentti	Luke
Additional participants to the case study, involved in the post-workshop discussions	
Ahlberg Juho	Tukes
Jukkala Jaana	Tukes
Laamanen Tuija	Lukes
Peltonen Sari	Pro agria (rural advisory organisation)

Profile of participants:

The workshop gathered a very diverse group of participants, with almost half participants from public research institutes (Natural Resources Institute Finland Luke and University of Helsinki), public authorities (Finnish Safety and Chemicals Agency Tukes), farmer's representatives and non-governmental organizations (NGO).

Some participants were also private farmers in addition to representing their organizations.

Figure 4: Profile of participants to the workshop



VI.2- Agenda of the day

The day of the workshop was divided into different sessions and activities, following the methodology presented in section III (table 9).

Table 9: Steps followed during the workshop

1-Presentation of the foresight study – context, objectives, method, scenarios
2-Presentation and discussion of the regionalized scenario (cereals and oilseeds in Finland)
3-Identification of milestones, obstacles and opportunities
4-Identification of actions
5-Transition pathways - articulation of actions in a timeline
6-Conclusions, next steps

VI.3- Discussion points during the workshop

Feedback on the scenario

After a presentation of the scenario, each participant got a copy of it and read it in details, taking notes. The scenario was then discussed in two groups, in order to gather participants insights about their understanding of the scenario (*What are the key words from the scenario? For each of the components)*, the challenges they see (*What are the main challenges around the scenario?)*, its clarity (*How clear is the scenario on a scale from 1 to 5? What can be added to make it more explicit?).*

Each group discussed the whole scenario in sub-groups based on these 4 questions. The facilitators captured the various insights on paperboards, and then a participant debriefed in plenary.

Keywords quoted by participants reflecting on the scenario

After reading the scenario, both groups put forward "**cooperation"** as an important keyword. They also mentioned keywords related to cropping systems such as "**profitability**", "**mixed production systems", "diversity", "environmental footprint**", **"self-sufficiency", "keeping up production"**. They quoted key words related to value chain: **"local chains", "transparency".** Some keywords were more transversal, and relate to **"transparency", "shared knowledge", "digitalization", "public subsidies"** (table 10)**.**

Table 10: Keywords quoted after reading the scenario (in green are keywords quoted by both groups)

Group 1	***Group 2***
Profitability	Local chains
Mixed system	Cooperation
Cooperation	Transparency
Diversity	Shared knowledge
Keeping up production	Digitalisation
	Self-sufficiency
	Environmental footprint
	Public subsidies

Main challenges identified by group 1 and group 2 with the scenario

The challenges identified by both groups (table 11) in order to reach the scenario are linked to the **economic situation and sustainability of Finnish farms** and also of small and **medium size enterprises** (SMEs) such as cereal processing companies. Indeed, the Nordic location of Finland brings a lot of constraints for its agricultural production. According to the European Commission, between 2010 and 2018, the income of farm households has decreased, whereas it has increased in households relying on nonagricultural entrepreneurial income or salaried employment (EC, 2020). Ensuring the profitability of Finnish agriculture in 2050, and a fair distribution of value within the value chain is a challenge.

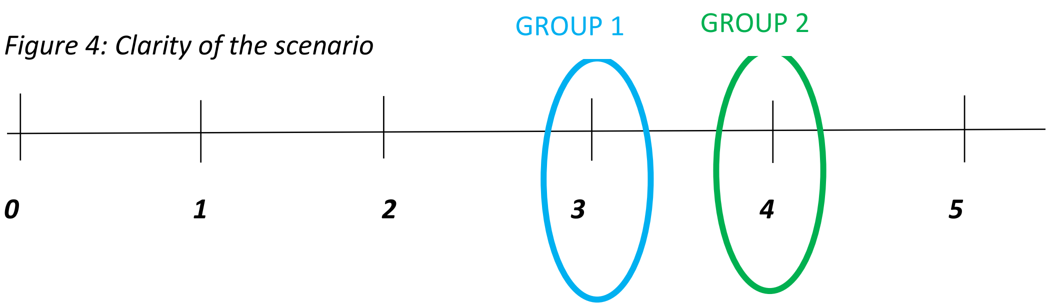
Both groups also highlighted as a challenge – or at least questioned - the co-existence of different production systems in 2050: **conventional without chemical pesticides, and organic**. The share of organic farming has increased over the past 10 years to reach in 2019 ca 13.5% share of agricultural land (Kujala *et al*., 2022). At several occasions in the workshop was discussed the role and place of organic production in 2050. Will the transition go through organic certification for all farms? Will there be a co-existence of various systems: organic, organic with new standards, conventional pesticide free with other criteria (biodiversity, ….)? The consensus within the group seemed to be that there should be no opposition between the various schemes and especially between organic and conventional, and that the transition towards chemical pesticide free agriculture can be achieved through different farming systems.

Participants highlighted the heterogeneity of consumers, not all being concerned nor willing to pay the price for environmental preservation. Similarly, there is also heterogeneity of the farm structures, with different reactions or adaptability to the scenario.

Table 11: Main challenges identified by group 1 and group 1 with the scenario (in green, challenges common or similar to both groups)

Group 1	***Group 2***
Cooperation between farmers and the whole supply chain	Knowledge and time consumption of part-time farmers?
Combining different objectives: production, environment, etc….	Challenge of tillage
Defining the word "chemical pesticide"	Change in energy use towards renewable energy
Economical sustainability of farming is a challenge in Finland and globally	Urbanisation trend is missing from the scenario
Co-existence of different systems (organic, conventional…)	What is the added value of organic in 2050 vs our scenario?
Fair distribution of value across the chain	Heterogeneity of consumers: not all will be concerned about environment, other choice patterns such as price, convenience, …
	Economy of farms require subsidies
	Profitability of SMEs (processors, …)
	Heterogenicity of farms
	Agri-tourism is an opportunity that we should describe in the scenario (linked with ecosystem services)

Figure 4: Clarity of the scenario

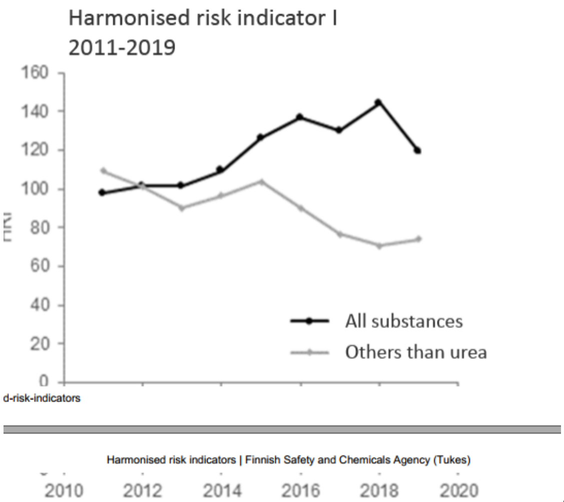


Group 1 considered that the scenario was pretty clearly described in the narrative (rated 3 out of 5 ; figure 4). They suggested several additions in order to make it clearer. First, they recommended to define more clearly in the scenario what we mean by "chemical pesticide free agriculture". This comment also rose within group 2. This generated a general discussion about the scope of the foresight, with the particular case of urea. Urea is used as a repellent against root rot in forests. The Finnish Forest Damages Prevention Act obligates forest owners to carry out pest management in loggings of predominantly coniferous forests during the summer. Urea is also used as a fertilizer in agriculture and forestry. Unlike most plant protection products, urea is not primarily designed with the intent to kill the repelled organisms. In addition, data on pesticide use and risks in Finland show decreasing trends except for urea (figure 5).

It was also commented that 'farm to fork' set targets on the use and risks of **chemical pesticides**, where chemical pesticides are defined as those containing active substances in categories B, D, E, F and G[7].

- low-risk active substances micro-organisms => category A
- Low risk substances chemical => category B
- Other micro-organisms => category C
- Other substances chemical => category D
- More hazardous active substances (CMR) => category E and category F
- active substances that are not approved => category G

Figure 5: evolution of the Harmonized Risk Indicator #1 in Finland



Source: Tukes, 2021

The participants also suggested to add information about the **evolution of the production in 2050**: will there be an increase in production, more export? Several aspects could be added to the scenario:

- Increases in production: due to improved growing conditions especially with climate change (winter crops introduction, longer rain periods, thicker ice)
- Opportunities to export cereals outside of Finland
- Fairer share of value across the chain

They also proposed to describe the **impacts of climate change on Finish cereals and oilseed production** conditions. Indeed, in 2050, due to global warming, there could be the introduction of winter crops, and also the emergence of new pests.

They also discussed the opportunity to add information about the **nutrient cycle issue**, and leaching of nutrients.

Group 2 considered that the scenario was very clearly described in the narrative (average score: as 4 out of 5 ; figure 4). They highlighted some elements that could however be added to the scenario to make it even clearer and complete.

[7] See file for calculating the F2F indicator 1, available at : https://ec.europa.eu/eurostat/web/agriculture/agri-environmental-indicators/information

First, they highlighted an apparent contradiction between consumption of less processed food and vegan diets. For example, oat milk is a plant-based alternative to cow milk, but can be considered as a processed food. They recommended to add information about food prices: how will the food prices evolved in 2050: will they be cheaper, more expensive, still affordable to all? How to manage potential inequalities in access to food? They also suggested to discuss more plant breeding as one of the tools for adaptation to climate change. Finally, they proposed to include retailers as actors who can support the transition – in addition to public subsidies.

VI.4- Building the transition pathway

VI.4.1- List of milestones, opportunities and obstacles, and actions

In the two groups, participants studied the scenario in order to identify first the obstacles and opportunities encountered in relation to achieving the Finland scenario in 2050, and the milestones required to reach the scenario. Group 1 worked on cropping systems and agricultural equipments components, group 2 worked on food value chain and farm structures components.

Then, in a second session, the same groups worked to define the key *actions* that are needed to reach the desirable future. Each group worked from the backcasting timeline, and, for each of the components, think of the actions needed to: (1) Overcome the obstacles; (2) Size the opportunities; (3) Reach the milestones.

The following tables (tables 12 to 15) present the translation of the participants' contribution to the workshop.

Table 12: List of milestones, obstacles and opportunities, and actions, for the food value chain

FOOD VALUE CHAIN	**2045**	**2040**	**2035**	**2032**	**2030**	**2025**	**2023**
Milestones	Community Supported Agriculture is very popular among Finnish people	Plant based diets are major contributors to Finnish diets	Carbon neutral food chain	Strong citizens support for public subsidies to support environmental transition of Agriculture & food system	Food production follows F2F objectives[8]	Consumers' attitude has changed - they are very concerned about environment and biodiversity protection	Quality standards accepted by consumers for food products have changed (less shiny, different shapes, …. Are now acceptable)
Obstacles	Global financial policies					How to change farmers attitude?	
Opportunities	Small scale investments from ordinary people	Mitigation of climate change				Media information regarding biodiversity loss	
Actions	Creation of a "social" label, providing information about the social footprint (share of price among the food chain, ethical values, …) of the food product. ---- Creation of a manual on how to do CSA in Finland. Actor : union of farmers	Plant breeding on pulses to improve their nutritional, taste qualities. Actor: research. ---- New processing technologies are developed by R&D of private companies to manage the digestion issues (digestive tolerance) of pulses	Carbon sequestration in soils. Actor: farmers ----- Research funding. Actor: public policy makers ------ Support from administration (subsidies to farmers), food industry and consumers towards nutrient resource recycling efficiency	Social media influence. Actors: influencers. ------ Labels created for promoting "good food" (environment & health). Actor: government		Selection of criteria and simplified data and information about right food choices - nutritional and environmental. Actors: universities and research institutes. --- Price policies to influence food behaviors changes. Actors: regulators, food chain ---- Creation of a label for "good food" (nutrition and environment). Actors: EU. ---- Prices recommendations allowed for producers. Actors: ministry	

[8] use and risk of chemical pesticides use of fertilisers, sales of antimicrobials for farmed animals, 25% of the EU's agricultural land under organic farming by 2030, food waste, diet

Table 12 (continued): List of milestones, obstacles and opportunities, and actions for the food value chain

FOOD VALUE CHAIN	**2040**	**2035**	**2030**
Milestones	60% share of organic food in food services	Market of food products sold in Finland is renewed - includes more diversified foodstuffs, has evolved to answer changes in consumption habits, open new opportunities for SMEs	25% share of organic in food services
	20% market share of organic food in retail		10% market share of organic food in retail
Obstacles	Will there be enough food available?		Do we have enough know-how to produce so much organic food --- Production costs
Opportunities	Higher incomes for farmers because higher prices	New income flows for farmers -- local & rural development	Consumers demand for environmentally friendly, natural food
Actions	Innovation - R&D developments in food new recipes including organic and plant-based products. Actor: R&D companies. --- Cooking lessons and trainings to consumers and professional kitchens to introduce more organic and plant-based products. Actor: food companies ---- sharing information about the organic food label (communication campaign) ---- Farm to fork: new agri-food policy at EU level. Actors: EU & Member States	Preference shopping service: digital application that recommends + delivers food products according to preferences (nutritional, environmental, social). *Actors: retailers, cooperation with SMEs*	Canteens: Using the EU school scheme to increase the share of sustainable products in schools. Actors: schools canteens owners, local authorities. ---- Dissemination of policy tools to support growing of organic (CAP subsisdies).
Milestones	100% food produced is based on the principles of organic production (or agroecology) even if not all certified organic		
Obstacles			
Actions	Regulation states the new organic standards/ Actor: EU commission		

Table 13: List of milestones, obstacles and opportunities, and actions for the cropping systems

CROPPING SYSTEMS	2048	2046	2042	2040	2037	2035	2030	2028
Milestones	Profitable crop production made possible without the use of chemicals	Gene editing accepted by society and technically possible	Alternative protection methods are available	Varieties healthy and resistant to pests	Crop rotation on 100% farms	Mechanical weeding technologies are available and used by farmers	The use of low risk substances including microbiological solutions) is widespread	50% of fields have multiple crop rotations diversification of crop rotation
Obstacles	insect pests in oilseeds are difficult to control w/o pesticides Crop yields may decrease Research funding is inadequate		Changes in pests occurrence, climate change				Proving efficiency + sufficient range of products available	Attitude of farmers - resistance to change Poor integration of crop production and animal husbandry in southwest Finland
Opportunities	Farmers are well educated Consumers are willing to pay more for chemical free products		Research ongoing			R&D efforts ongoing	Less hazard chemicals when using a low risk substance	straight environmental benefits More diverse cropping systems would increase resilience and offer business opportunities
Actions	Biggest share of food prices go to farmers. Actors: food industries, groceries. ---- Research on non chemical pest management. Actors: government fundings, research bodies public		More research on non chemical pest management (actors: researchers, government funded) ----- R&D development of new plant protection solutions (biocontrol). Actor: biocontrol companies	Breeding program considering lack of herbicides Actors: ministry of agriculture, food sector ----- Benchmark and learn from successes (actor: farmer advisors)	Development of rotation models, option1, option2, … Training of advisers and of farmers Rules, law e-college of regenerative farming. Actors: farmers, advisors, officials and politicians (for subsidies)	Best practices put in action (knowledge transfer) Actors: Natural resources institute Finland LUKE, advisory services	Companies develop new products. ----- Testing for these substances conducted in several countries including Finland, and also in farms. ---- Research conducted (public, private R&D) ----- Authorization of low risk substances facilitated in the regulation. Actor: policy makers.	Establishment of "demonetwork" for crop rotations and facilitation of transfer of organic farmers knowledge to conventional farmers.

Table 13 (continued): List of milestones, obstacles and opportunities, and actions for the cropping systems

CROPPING SYSTEMS	2040	2037	2035	2025
Milestones	Pesticide free control methods for future pests risks are identified	Field usage collaboration models in place	Foresight and scenarios available regarding future pests risks in Finland due to climate change	Cooperation between farmers
Obstacles		tradition - resistance to change ----- sharing benefits & costs		Hatred and lack of respect and trust between neighboring farms
Opportunities		Profit and yield increase		Economic benefits
Actions	Learn from all available and successful control methods already available among farmers (farmers have huge amount of knowledge that can not be found in books). Actors: farmers, advisors, machinery entrepreneurs…	Experimentation between farmers coordinated by local farmers organizations. --------- Dissemination of results and experiences through advisors and farmers organizations	Northern European research project "the most probable pests (insects, diseases, weeds) in Nordic countries and their potential effects on cereals and oilseed crop production. *Actors: Nordic Council of Ministers, H2025, Luke, Nibio, Ahrus, SLU, advisory companies, central & southern EU partners.*	Models of cooperation are promoted through communication campaigns -------- Contracts of collaboration are developed ------ Operational support is provided to accompany the cooperation through starter projects, money (subsidies). *Actors: farmers, advisers, example actors (ambassadors), research*
Milestones		Equipment usage and sharing models	Extension service system that provides best practices to farmers	
Obstacles				
Opportunities			Closer cooperation between farmers	
Actions		Closer cooperation between farmers, research and advisory services.	Closer cooperation and organisation of the research, advisory services and farmers actors: the financers of these sectors	

Table 14: List of milestones, obstacles and opportunities, and actions for agricultural equipments and digital technologies

AGRICULTURAL EQUIPMENTS and DIGITAL TECHNOLOGIES	2050	2042	2040	2037	2030	2028	2023
Milestones	Farming collaboration platform	Multi-purpose robots available to farmers	Farming execution system FES	Holistic farm management DSS	Cooperation on fields to change fields and introduce crop rotation	Specialized equipment and robots to manage diversity of crops	Specialized DSS
Obstacles	Lack of trust	Feasibility Compatibility Interoperability			Lack of collaboration between farmers historically	Profitability (costs of these equipment)	Regional variations Data inputs Trustworthiness Interoperability
Opportunities		Data space standardization			Crop rotation benefits including positive effects on soil health	less costs, less impact on environment, less cost	
Actions	Build trust on technologies and people developing the tools. Actor: research, farmers community ---- Regulate data access and use. Actor: regulators	Research programs to develop reconstruction of generic components, and verify the feasibility of implementing the concepts. Actors: research community	Creation of business need for farmers ----- appearance of highly automated machines and collaboration models. Actors: Agtech companies	Input from cropping system's needs ----- information on future farming systems		Experimentation and demonstration by Ag tech companies and through pilot farms	Standardization - common acceptance of technology as a useful tool for farming. Actors: governance steering regulators and Ag Tech companies ------ Support to farmers to adopt these new tech. Actor : advisory services and research

Table 14 (continued): List of milestones, obstacles and opportunities, and actions for agricultural equipments and digital technologies

AGRICULTURAL EQUIPMENTS and DIGITAL TECHNOLOGIES	**2042**	**2040**	**2037**	**2030**	**2028**	**2022**
Milestones	everyday use of satellites to support farmers	Field based weather forecast in each farmers pocket	Machines available for mechanical weed management	Autoguide in every farm	Growers cooperate to share machinery	Mutual trust between farmers
Obstacles	slow and traditional attitudes in politics and officials	NO other needs for such specific tools. Is it profitable to make such tools only for farmers use?	Attitudes and willingness to change habits and invest in machineries	Lack of money to invest		History
Opportunities	Easy control supporting adaptative farm management	Finnish farmers have a very long history of following weather	We already have research on mechanical weed management	Bettering the soil health, minimizing the leak of nutrients, optimizing the use of PPP		Good examples of collaborations already exits
Actions			Piloting and testing of machines -> demovideos shared with farmers to convince them of efficacy (results in farms visible). Actors: agricultural equipments companies	Research program to develop the autoguides. ---- Discussion on the price /mass purchase ---- Training to help adoption ---- Support for 1st purchase (incentive) Actors: farmers, places who sell the autoguides, advisors, public policy makers	Creation of growers cooperation systems that provide planning platforms, communication methods, information from demo farms. *Actors : advisors, research, farmers.*	

Table 15: list of milestones, obstacles and opportunities, and actions for farm structures

FARM STRUCTURES	**2048**	**2041**	**2040**	**2035**	**2030**	**2025**
Milestones	Agroecological symbioses (farmers + food processors + energy providers)	Higher share of food prices for farmers	larger farms	cooperation platforms among farmers are well established	IT monitoring systems in use	Farmers are highly educated on environment
Obstacles	Urbanization and long distances		high land prices			
Opportunities	share of knowledge and of manpower			individualistic culture among finnish farmers		time constraints
Actions	Development of cooperation and dialogue in the whole value chain. *Actors: farmers, retailers, food processors, energy providers*.	Price recommendations allowed for producers (farmers). Actor: ministry	Financial support to farmers to culture the use of non chemical methods. Actors: policy makers EU, MS ----- Enhancing field markets, removing subsidies from super small farms. Actors: ministries. Financial support to farmers to buy more cultivation areas. Actor: public policy makers.	Pro agria: name of the cooperation platform created by the Finnish government to exchange between farmers		Mandatory courses on agroecology as part of farmers curriculum. Actors: regulators, education institutions
Milestones					Administration services have been renewed in order to be able to measure, value ecosystem services delivered by farmers	
Obstacles					Need new type of supervision, monitoring of activities which will add hierarchy	
Opportunities					new incomes flow for farmers	
Actions						

VI.4.2- Discussion points about the milestones and actions

Future pests development

Group 1 has identified two milestones on cropping systems related to the management of future pests on cereals and oilseed crops: “Foresight and scenarios available regarding future pests risks in Finland due to climate change”, and “Pesticide free control methods for future pests risks are identified”.

Indeed, with climate change, participants anticipate that future pests will emerge in Nordic regions, requiring adaptation in terms of crop protection. For this, they have identified the need to conduct a Northern European research project about "the most probable pests (insects, diseases, weeds) in Nordic countries and their potential effects on cereals and oilseed crop production. Once the future pests are identified, they propose to learn from all available and successful control methods already available among farmers, in Finland and in other countries.

Milestones related to organic food consumption development and to changes in diets

Several milestones in the food value chain relates to the development of organic food consumption, in both food services and in retail: organic food will account for 25% share in food services and 10% market share in retail in 2030, and 60% and 20% in 2040. These milestones build on the current trend of development of organic production and consumption in Finland (see retrospective analysis). It will be supported by CAP subsidies targeted towards organic growth, and by the use of the EU school scheme to promote organic food consumption in canteens.

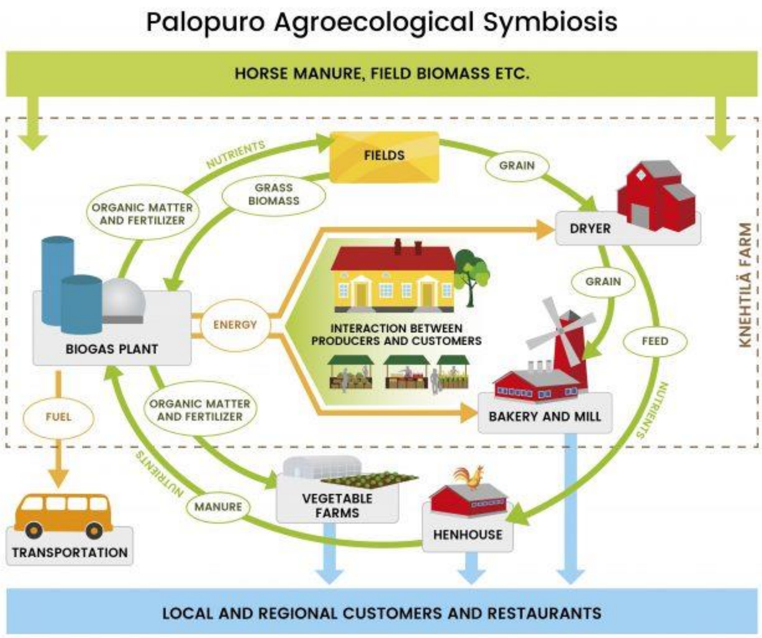
Also, an important milestone in the value chain is the change of Finnish people diet towards Plant based products. This change is triggered by Finnish citizens’ concerns about the environment and biodiversity preservation. It also drives a renewal of the food offer in the Finish market, which has evolved to answer changes in consumption habits and now includes more diversified, plant-based and locally produced foodstuffs. This opens new opportunities for SMEs. Price policies influence food behaviors changes, as well as a label, created at EU level, for "good food" – based on nutrition and environment criteria. This label further evolve in time to include social criteria. As part of this plant-based diet, pulses play an important role. These products are well accepted by Finnish consumers thanks to the use of new varieties, and thanks to new processing technologies developed by the R&D of private companies, to manage the digestion issues (digestive tolerance).

Agroecological Symbiosis

Group 2, discussing farm structures milestones, identified a milestone at the end of the backcasting timeline: agroecological symbiosis in place in the territory.

Agroecological symbiosis (AES) is a food production and processing symbiosis of farms and food processors. In addition, as a localized food system model, AES is expected to have cultural and socio-economic benefits (Koppelmäki et al., 2016; Helenius et al., 2020). There is already one AES system in the village of Palopuro in southern Finland, a cooperative food production system based on energy and nutrient self-sufficiency. This multi-enterprise network, located in Hyvinkää, aims to produce local, organic food using bioenergy and recycled nutrients.

Figure 6: Palopuro Agroecological Symbiosis system



Source : https://blogs.helsinki.fi/palopuronsymbioosi/english/

This model of integration requires very strong cooperation between farmers, processors, and energy producers.

<u>Collaboration between farmers</u>

"Collaboration" is quoted in several milestones in the transition (in 9 milestones across the different components), and has been intensively discussed during the workshop. Indeed, the scenario requires strong collaborations, between farmers, and other actors in the value chain. Cooperation happens at various levels and serves various needs: it starts by creating mutual trust, cooperation to share equipment, field usage collaboration models in place based on experiments results, collaboration platforms for farmers, and ultimately the integrated system of agroecological symbiosis. This aspect is very important in the transition since farmers are used to be working rather isolated, due to the distance and historical practices. For these collaborations to happen, local farmers' organizations play a key role, as well as farmers' advisors, who can encourage and promote exchanges of best practices. Also, communication campaigns can promote models of cooperation, and public subsidies can finance the creation of in projects in cooperation with other farmers.

<u>Demo-farms</u>

A key action identified by the participants in the transition is to rely on demo-farms, which could test innovations, new practices in terms of crop rotation, pest protection, and then share the results with the wider community of farmers.

VI.4.3- Transition pathway

In the last session of the workshop, the two groups worked separately to build one transition pathway each. They were asked to organize chronologically the milestones and actions as identified in the previous sessions, and articulate them logically in the timeline. We did not split the system into components anymore but instead, each sub-group worked on all components. They discussed first the link between the different milestones, and then the link to their related actions. A series of milestones connected together with their actions form a transition pathway.

Working simultaneously on all the components of the system, participants were asked to complete a blank backcasting timeline, starting from the milestone closest to 2050, and to discuss in the group which milestone – or which milestones - it is connected to. They repeated the task with other milestones until they reached year 2020. This provided a series of milestones connected together. Then they picked another milestone close to 2050, and repeated the exercise in order to build a second series.

In practice, a short group of people selected some milestones from the different components, and tried to articulate them on the backcasting timeline. The rest of participants looked at the timeline and were discussing or challenging the order proposed by the small group. They worked first on the general chronology, and then on the logic, i.e. the connection between the different milestones ("this milestones leads to this milestones, to these milestones….). It was an iterative process, as several attempts were necessary to build the connections between the milestones. When an agreement was reached on the connection between two milestones, one participant connected them with masking tape.

At the end of the session each group managed to create a transition pathway. Both groups gathered and each pathway was presented and discussed.

There were several similarities between the two pathways:

- Both started with the same milestones:
  - Attitude changes among consumers
  - Cooperation between farmers / mutual trust
- Both ended with the same milestones:
  - Agro-ecological symbiosis
  - Profitable crop production made possible without the use of chemicals
  - Food is produced on non chemicals and organic standards
- Both groups identified the same milestones related to cropping systems, in a similar order along the pathway, although not exactly happening within the same timeframe: foresight for future pests identification, followed by crop rotation implementation, then availability of alternative crop protection methods, followed by the use of mechanical weeding techniques, and of resistant plant varieties.
- Both groups identified "plant-based products as major contributors to the diet", and "food market renewal" as important milestones in the transition pathway. However "plant-based products as major contributors to the diet" was positioned at different times by the groups (2030 or 2040);
- Similarly, both groups selected the milestone "higher share of food prices for farmers", but they positioned it at different times in the pathway (at the beginning of the transition, or later in 2035).

There are two main differences between both pathways. The first one is the inclusion in the transition of the development of "organic food consumption", which was only selected by one group. The second difference is with regards to milestones on agricultural equipment and digitalization, which were quite different and positioned at different times in the pathway. These points deserve further discussion with the workshop participants.

After the workshop, the transition pathways were transcribed in an excel document (available in appendix 3: version 1 of the transition pathway_ group 1 and version 1 of the transition pathway_ group 2). These versions were studied by the foresight team, who considered their logic and their coherence with the scenario. Since the pathways were mostly similar, they tried to combine them into one transition pathway.

The main adaptations made were:

- A reclassification of the milestones with new colors for the milestones related to public policies, governance, and education & AKIS;
- A re-organisation of the pathway, while keeping the order and year allocated for each milestone (and actions), to make it easier to read;

Also, the foresight team proposed to make some modifications to the milestones, in order to be closer to the scenario:

- Suggested addition of a milestone: "social label", that was already mentioned as an action, to make it more visible;
- Suggested removal of milestone "gene editing accepted", which was only mentioned in one pathway, and does not seem to fit well with the scenario;
- Suggested move of the milestone "profitable crop protection made profitable w/o chemicals" a bit earlier in the pathway.

There remained some questions to be discussed, in addition to those listed above:

- The group of participants had identified a milestone related to carbon neutrality, that indeed seem important in the scenario and also in line with Finland target to achieve carbon neutrality in 2040. Can this milestone be added to the pathway?
- When looking again at the scenario and the transition pathway, it seems that the "landscape management" part of the scenario, and the transition regarding livestock, are not very well reflected in the pathway. Can the pathway be completed by adding some milestones / actions that could address this part of the scenario?
- What will be the share of organic production in Finland in 2050? will it be 100% or will there be a coexistence of organic production (with new criteria) and chemical pesticide free production (but not organic)?

VI.5- Final version and narrative of the transition pathway

The second version of the transition pathway has been discussed with the South Finland case study coordinators, and with interested participants, on September 9th, 2022, in order to get to a 3rd version addressing the missing points. In total, 15 people joined this post-workshop meeting:

-Juho Ahlberg, Tukes

-Aura Lamminparras, ProLuomu

-Eliisa Malin, BSAG

-Sari Iivonen, FORI

-Jaana Jukkala, Tukes

-Kaija Kallio-Mannila, Tukes

-Tuija Laamanen, Tukes

-Ari Ronkainen, LUKE

-Pentti Ruuttunen, LUKE

-Sari Peltonen, ProAgria

-Tiiti Kämäri, HAMK

-Emilia Laitala and Sari Autio, Tukes

-Claire Meunier and Olivier Mora, INRAE

This allowed to discuss the transition pathway and four pending points related to the role of organic consumption, the coordination of actors for the implementation of agro-ecological symbiosis, the landscape planning and complexification, and the carbon neutral food chain.

- **Outcomes of the discussion on the role of organic consumption growth in the transition**

During the workshop, milestones related to the organic consumption growth were selected in one transition pathway, but not in the other. In the September meeting, there was a consensus among the participants on the importance of keeping these milestones related to organic in the transition. Organic development drives the reduction in the use of chemical pesticides in the whole food system. In our transition, organic farmers act as pioneers of agro-ecological methods.

It does not mean though that in 2050 100% of the cereals and oilseed production will be organic for several reasons. First, it may not be possible to implement organic practices everywhere. Also, higher prices of organic food may impact consumers. There will then be a coexistence of organic cropping systems with chemical pesticide-free cropping systems in 2050. According to several participants, the standards for organic production will very likely evolve towards the inclusion of additional criteria related to agro-ecology.

- **Outcomes of the discussion on the landscape planning and complexification**

The scenario describes several actions on the landscape planning, to manage pests, for example : « crop protection is ensured through biological regulations by **complexification of landscape including forests, crop diversification, with field strips and buffer zones "… "**the landscape is reconfigured as a **mosaic of areas including lakes, rivers, forests,** connected together"… "Crop diversification and complex landscape are also very important to strengthen the **resilience of cropping systems to extreme climatic events".**

- **Outcomes of the discussion on cooperation of actors to transition towards agroecological symbiosis**

To achieve agroecological symbiosis there is a need to implement strong cooperation between different actors across the food value chain, connecting farmers, food processors and energy providers. This can happen through local cooperatives, or through the creation of an organization for the development of the territory (region), or through the willingness of a local institution. It can also start from one local actor, willing to activate the local ecosystem and to drive the innovation forward, towards agroecological symbiosis. Given the rather long distance between actors in Finnish regions, digital tools could be sued, such as DIH – Digital Innovation Hub – connecting remotely actors working on the same goal. Then, implementation of agroecological symbiosis requires an important change in the Finnish market, so far rather centralized, and that would evolve to local systems.

- **Outcomes of the discussion on Carbon neutral food chain**

The milestone « carbon neutral food system » is of critical importance and included in Finland's carbon-neutral and fossil-free welfare society by 2035 (https://ym.fi/en/climate-neutral-finland-2035). This milestone needs to be related to "landscape planning and complexification" (proper landscape planning, development of carbon shrinks). On the other hand, carbon neutrality can prove challenging, for example without the use of herbicides for weed control in no-tillage farming. There is a need to find solutions to solve this issue and manage to achieve both objectives of carbon neutrality and chemical pesticide-free cereal production.

A final version of the transition pathway was prepared (figure 8) and shared with the participants of the workshop. A simplified version of the transition pathway, in a gradient form, is also presented (Figure 7), together with a narrative describing the transition pathway, as follows:

The transition starts with consumers' change in attitude: they become even more concerned about the impact of their consumption on the environment. They are better informed about the environmental and nutritional footprint of the food they buy thanks to a sustainability logo appearing on product labels. Also, price policies encourage consumption changes towards products that are better for human and environmental health. This leads to a growth in organic food consumption, which represents in 2030 10% of the share in retail, and 25% in food services. Public policies support this evolution by subsidizing farmers' conversion to organic farming (CAP), ensuring a fairer split of food prices along the food value chain and by leveraging the EU school scheme to increase the share of sustainable procurement in canteens. This also leads to a change in Finnish diets towards a majority consumption of locally produced plant-based food. In 2033, the Finnish food market has been renewed, and proposes a variety of plant-based diversified food products including pulses.

Consumers' increased demand for sustainable, organic, plant-based food stimulates the diversification of the crops produced in Finland. Farmers' crop rotation and diversification successes are promoted through "demonetwork" and facilitation of transfer of organic farmers' knowledge to conventional farmers. Collaboration between farmers, and with researchers, advisors, is encouraged by public subsidies, and allows sharing of best practices, operational support, and dissemination of results from experiments.

Pest management practices evolve towards less use of chemical pesticides through the continued development of organic farming, acceleration of crop diversification and widespread use of mechanical weeding. As of 2024, digital tools – satellite, weather forecast, autoguides – help farmers to anticipate risks and support action by prophylaxis. The Farm to Fork objective of 50% pesticides reduction in 2030 is reached. In parallel, a research program on Northern Europe future pests on cereals and oilseed crops identifies future pests developments linked to climate change, and builds scenarios of future crop *protection. This leads to the development of new biological control solutions, based on farmers' knowledge and R&D efforts from biocontrol companies. In 2036, farmers use in majority low risk substances and microbiological solutions.*

In 2030, the ecosystem services provided by farmers are legally acknowledged. They are monitored and rewarded by the renewed administrative public services. This reinforces the farmers' local cooperation: in 2030, they collaborate to share machinery. They also conduct together field experiments, coordinated by local farmers' organizations, whose results enable the development of field usage collaboration models adapted to the local conditions. By 2037, collaboration platforms are set up to exchange information, to monitor the biological regulations and the biodiversity at the landscape level. All the data gathered through this platform are aggregated and treated by a collective decision support system tool.

In the 2040's, Finnish consumers' expectations in terms of food sustainability enlarge to also include its social dimension. This leads to the creation of a new sustainability logo informing about the social footprint of food. Community Supported Agriculture becomes very popular among the Finnish population.

By the mid-2040's, cooperation goes one step further with the implementation of agroecological symbiosis (AES) in every region in South Finland. AES is the integration, at local level, of farmers with food processors and energy providers, to base farming and cereal production on renewable bioenergy, to close nutrient cycles, be more connected with consumers, and revitalize the rural spaces. They produce produce pesticide free cereals and oilseed products, in addition to their own energy, from local biomass. AES brings together all local actors in the food chain up to consumers, provides environmental benefits, generates a local food culture and enhance local rural livelihoods and economy.

Figure 7: Target diagram summarising the key transition steps in the transition pathway of South Finland towards chemical pesticide-free cereal and oilseed production by 2050

CSA : community supported agriculture ; F2F : farm to fork ; DSS : decision support system

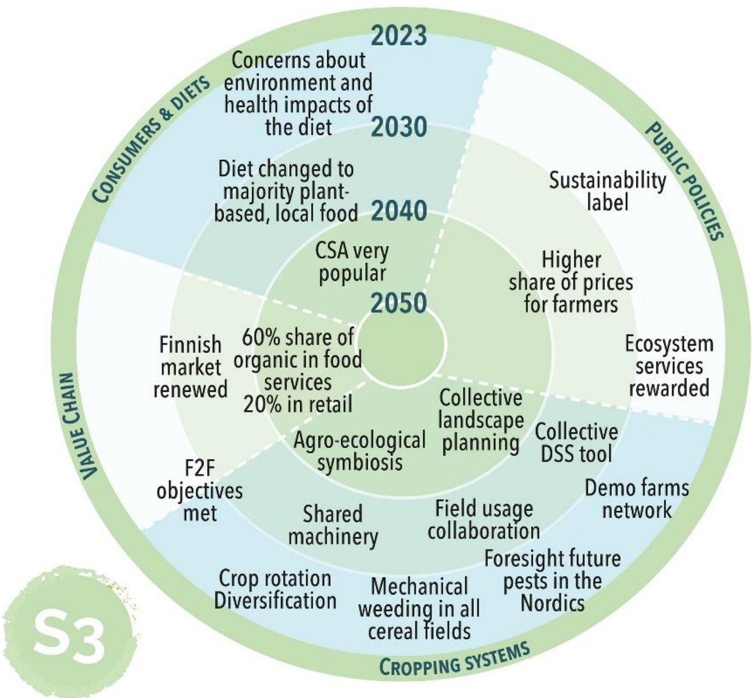
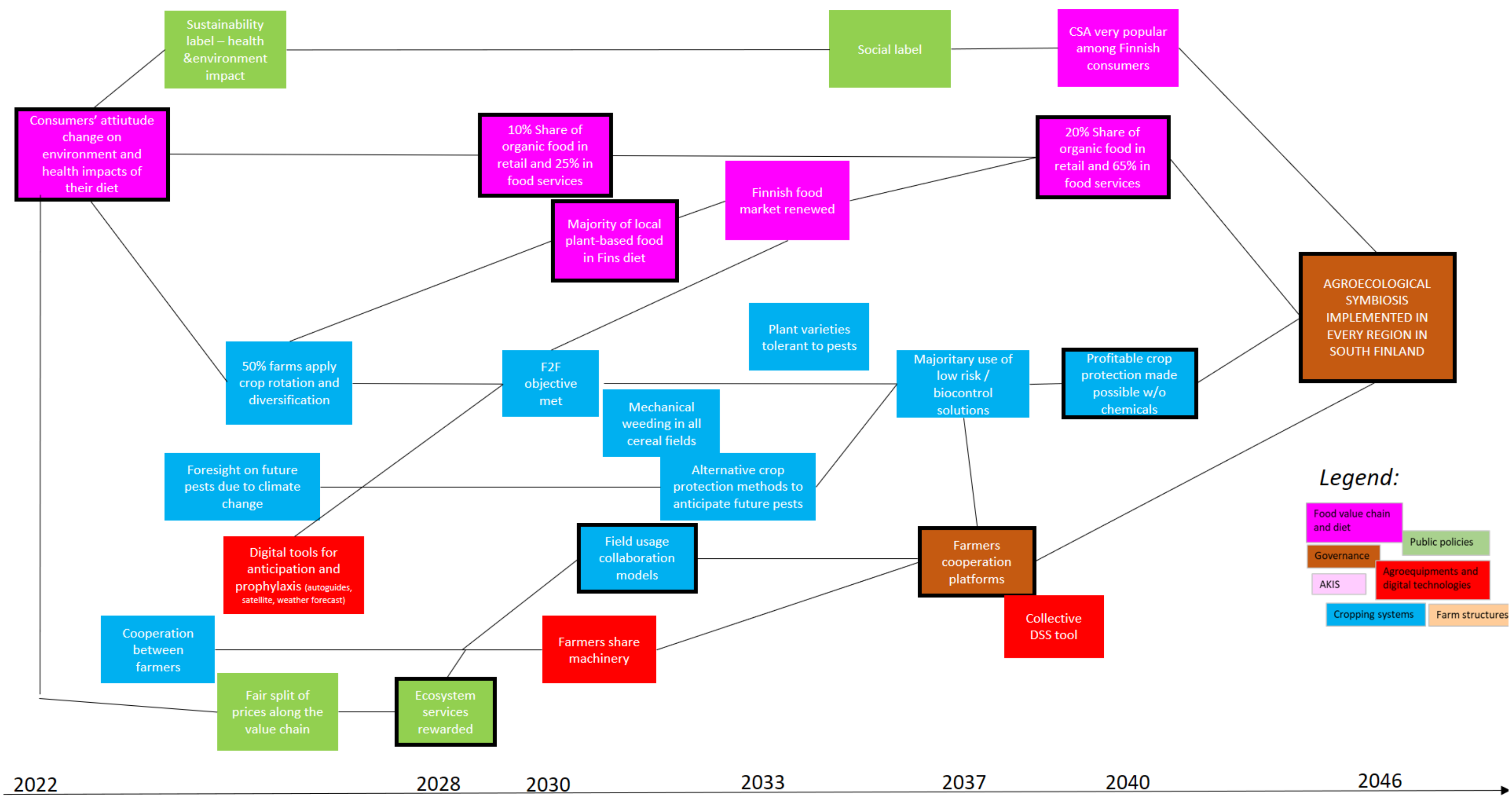


Figure 8: Simplified transition pathway for cereal and oilseed production without chemical pesticides in South Finland



VI.6- Overall feedback from participants

After the workshop, the regional case study coordinators sent a questionnaire to all participants to ask for their more complete feedback on the day.

There were seven questions asked to the participants: 10 participants answered to the questionnaire.

1- **How would you rate your overall satisfaction with the workshop? Please rate on a scale of 1 to 5, 1 being poor and 5 excellent**
2- **What were the most interesting parts of the workshop? Pick 1 or more**
3- **How relevant was the workshop to your work? Please rate from 1 (not at all) to 5 (very much)**
4- **How useful was the workshop for your work? Please rate from 1 (not at all) to 5 (very much)**
5- **Do you think you will use the outcomes of the workshop in your future work? Please rate from 1 (absolutely not) to 5 (for sure)**
6- **Do you agree with the following statements:**
    a. The objective of the workshop was clearly given?
    b. The backcasting methodology helped to build transition pathways?
    c. The participatory process succeeded in taking advantage of the different types of knowledge and expertise of the participants?
    d. We had enough time to discuss among participants?
7- **What are your recommendations to improve the workshop? What should we do more? What should we stop doing? What should we start doing?**

The table in Appendix 4 gives the full details about the questionnaire results.

The overall satisfaction of participants was rated at average 4,5 out of 5.

They identification of milestones, obstacles and opportunities was listed as the most interesting part of the workshop.

The vast majority of the respondents found the workshop relevant and useful to their work, and believe that they will use the outcomes of the workshop in their work.

All respondents found that the objective of the workshop was clearly given, that the backcasting methodology helped to build the transition pathway, and that the participatory process succeeded in taking advantage of the different types of knowledge and expertise of the participants (100% participants answered either “fully agree” or “mainly agree” to the questions).

Finally, 40% of the respondents considered that the time allocated to the discussion among the groups was not enough.

They made some recommendations for improving the organization of the workshop, in particular:

- To work more on the last section of the workshop, the transition pathway, for example by making a couple of “straight” pathways in the group;
- To send the scenario ahead of the workshop;
- To re-discuss the outcome of the workshop at a later stage;
- To allocate more time for discussion.

VI.7- Feedback from the facilitators

What worked well:

- The preparation ahead of the workshop and especially the day before, so that we are all familiar and comfortable with the different activities;
- The participants: their expertise, very complementary, their level of engagement throughout the day;
- The backcasting methodology and step by step approach;
- The workshop setting: rooms close to each other, large rooms;
- The material for the workshop;
- Building the transition pathways;
- The composition of different expertise of the participants was diverse enough to foster good and even a bit provocative discussion, which was highly valuated by the experts

What could be improved:

- The time keeping: unfortunately, the time was limited and some participants wished another day for the workshop to complete the discussions.
- The plenary sessions: give more time for each group to report on their ideas
- The "copy-paste" of the backcasting templates: too time consuming.

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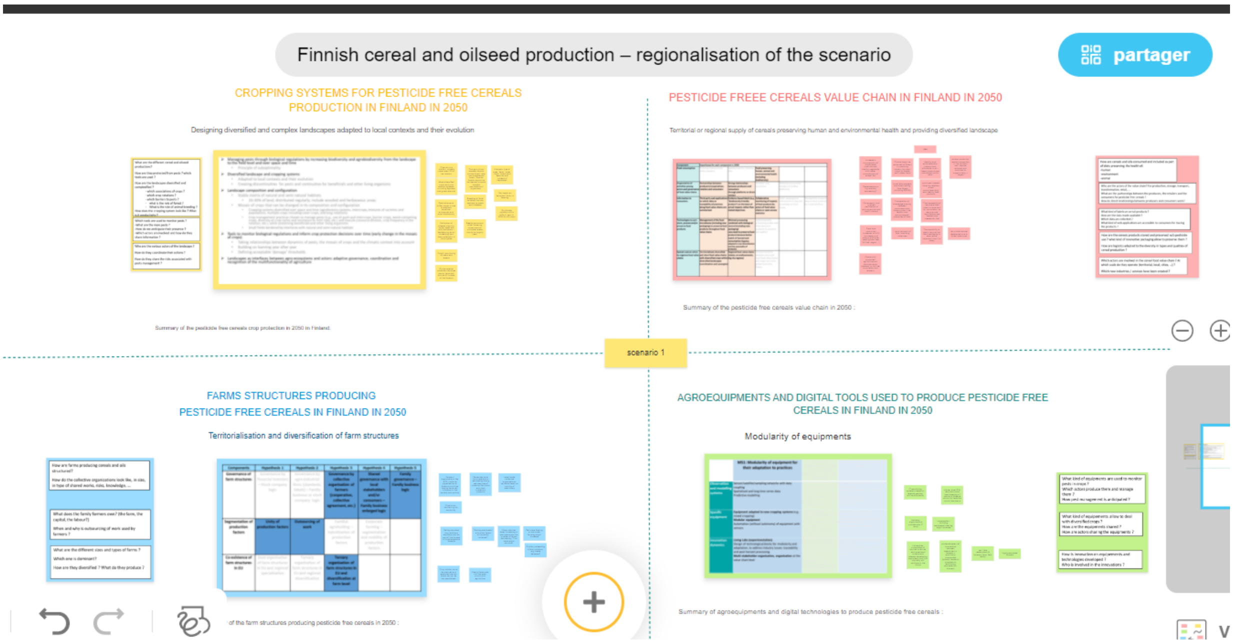
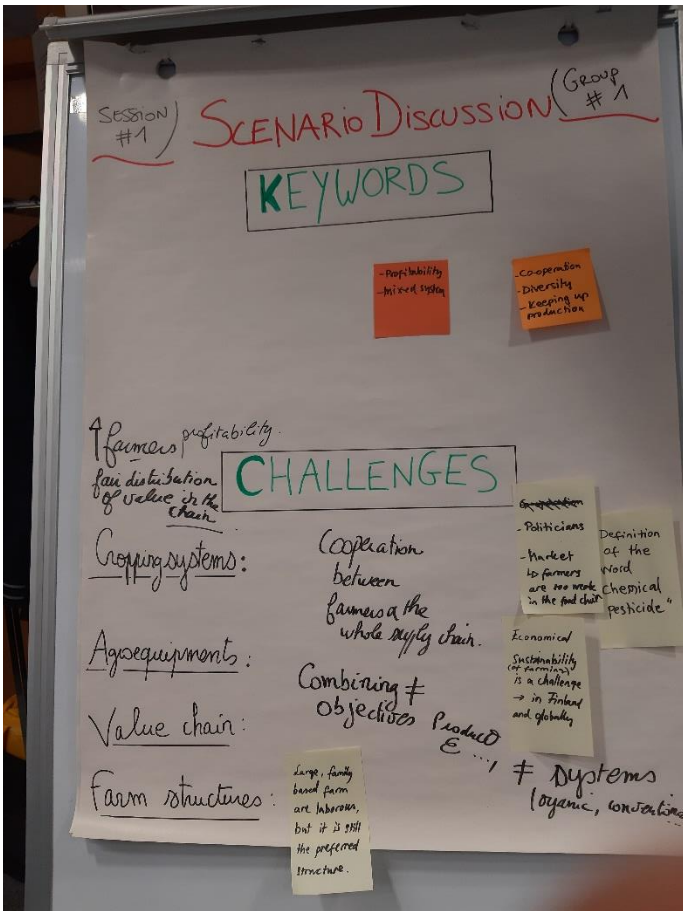
APPENDICES

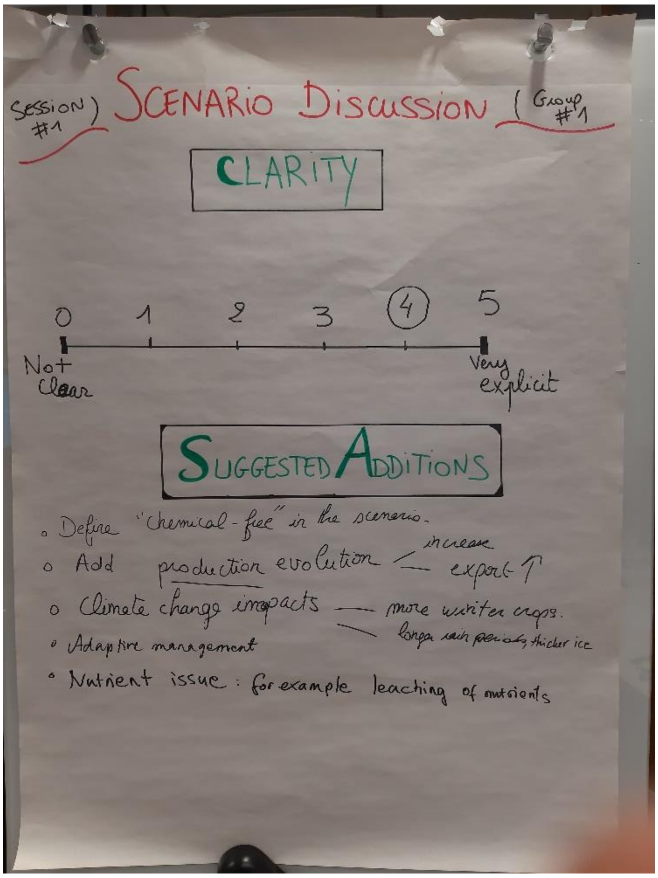
APPENDIX 1 – Overview of the klaxon page generated during the "regionalization meeting"



APPENDIX 2 – Detailed discussion about the scenario

Group 1





KEYWORDS

Profitability

Mixed system

Cooperation

Diversity

Keeping up production

CHALLENGES

Cooperation between farmers and the whole supply chain

Combining different objectives : production, environment, etc….

Defining the word "chemical pesticide"

Economical sustainability of farming is a challenge in Finland and globally

Co-existence of different systems (organic, conventional…)

Fair distribution of value across the chain

CLARITY OF SCENARIO GROUP1

4

SUGGESTED ADDITIONS

Define chemical free in the scenario

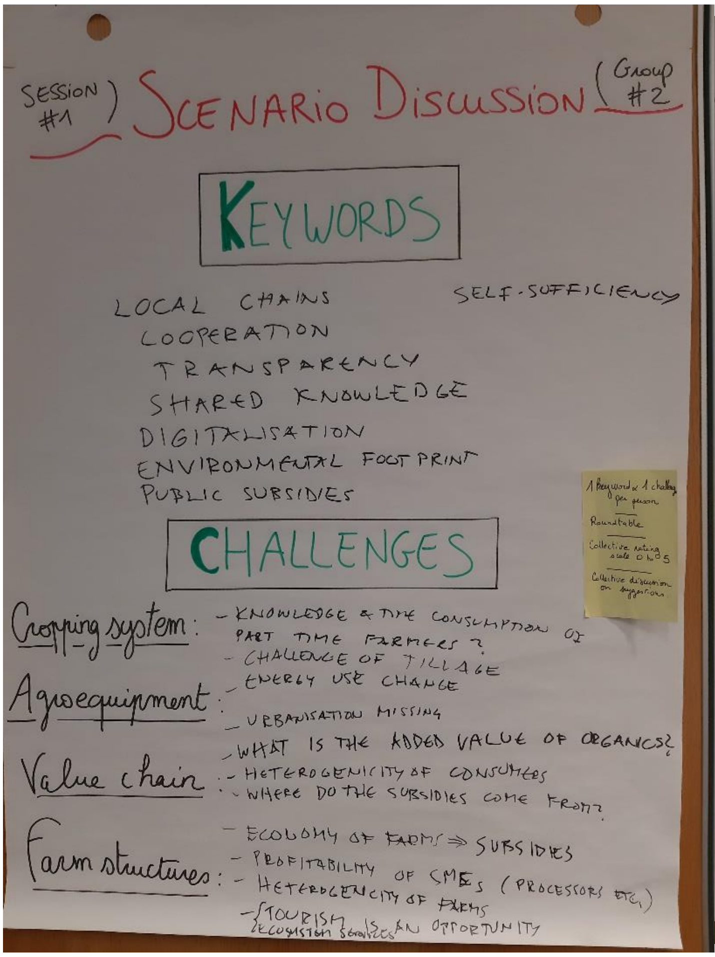
Add production evolution in 2050 : increase in production, export

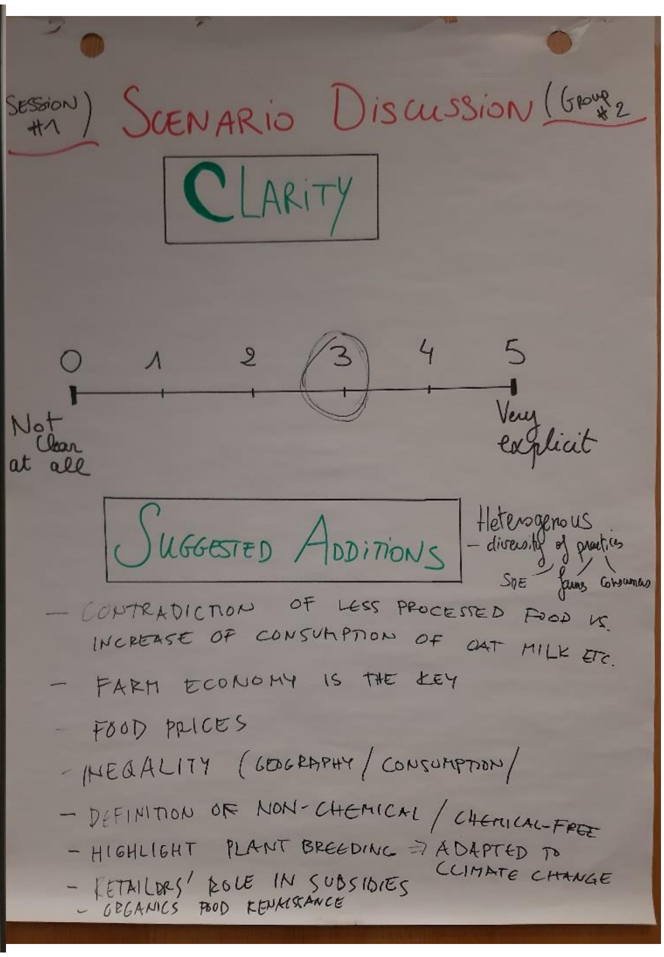
Describe impacts of climate change : winter crops introduction, longer rain periods, thicker ice

Adaptative management

Nutrient cycle issue : leaching of nutrients

Group 2 discussions over the scenario





KEYWORDS

Local chains

Cooperation

Transparency

Shared knowledge

Digitalisation

Self-sufficiency

Environmental footprint

Public subsidies

CHALLENGES

Knowledge and time consumption of part-time farmers ?

Challenge of tillage

Change in energy use towards renewable energy

Urbanisation trend is missing from the scenario

What is the added value of organic in 2050 vs our scenario ?

Heterogenicity of consumers : not all will be concerned about environment, other choice patterns such as price, convenience, …

Economy of farms require subsidies

Profitability of SMEs (processors, …)

Heterogenicity of farms

Agri-tourism is an opportunity that we should describe in the scenario (linked with ecosystem services)

CLARITY

3

ADDITIONS

Contradiction between less processed food and vegan diets (ie. oat milk)

Farm economy is the key to manage the transition

Talk about food prices : will food be cheaper, more expensive, still affordable ?

Inequalities

Highlight plant breeding as one of the tool for adaptation to climate change

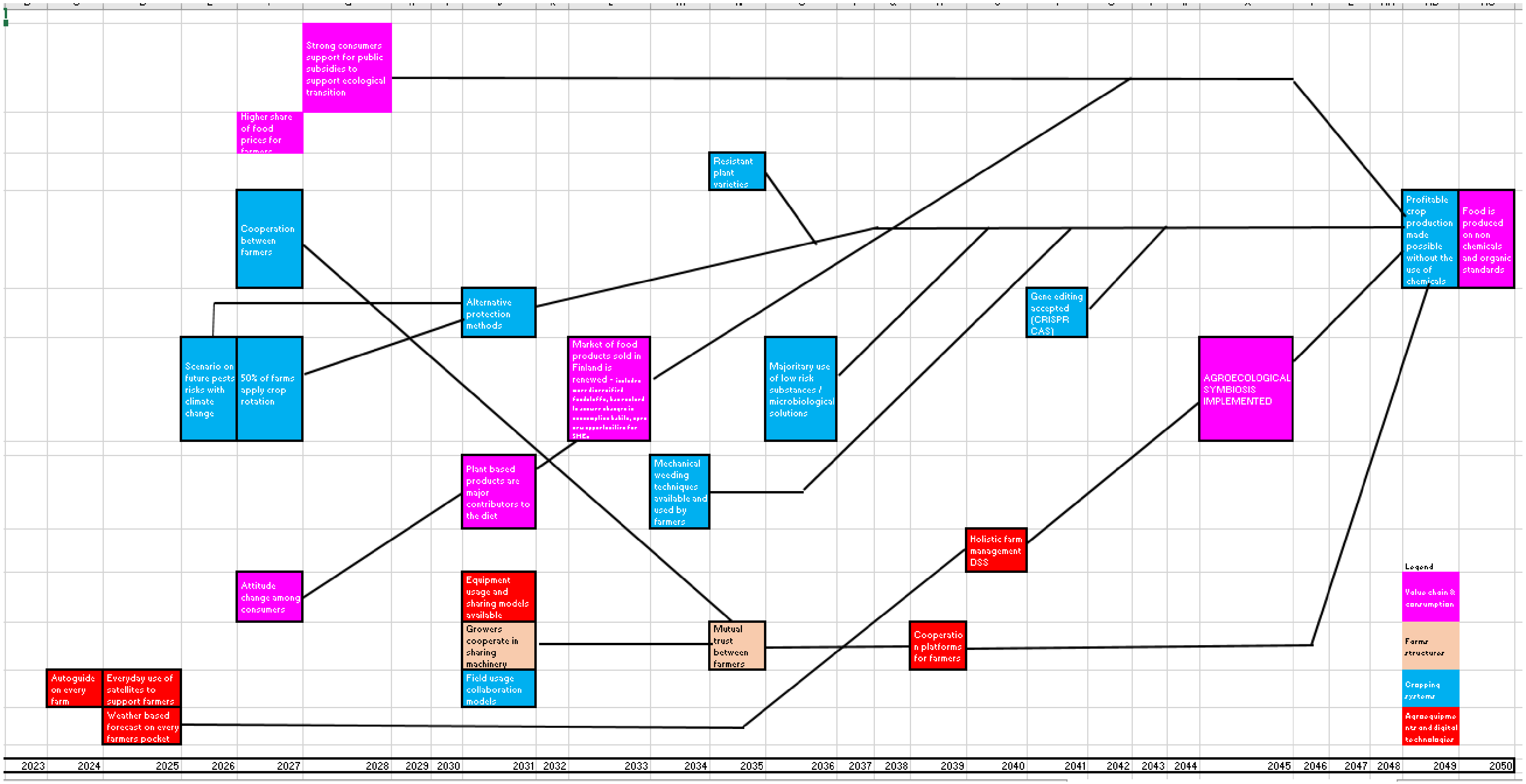
Retailers have a role in subsidies for the transition - not only public subsidies

Renaissance of organic production ?

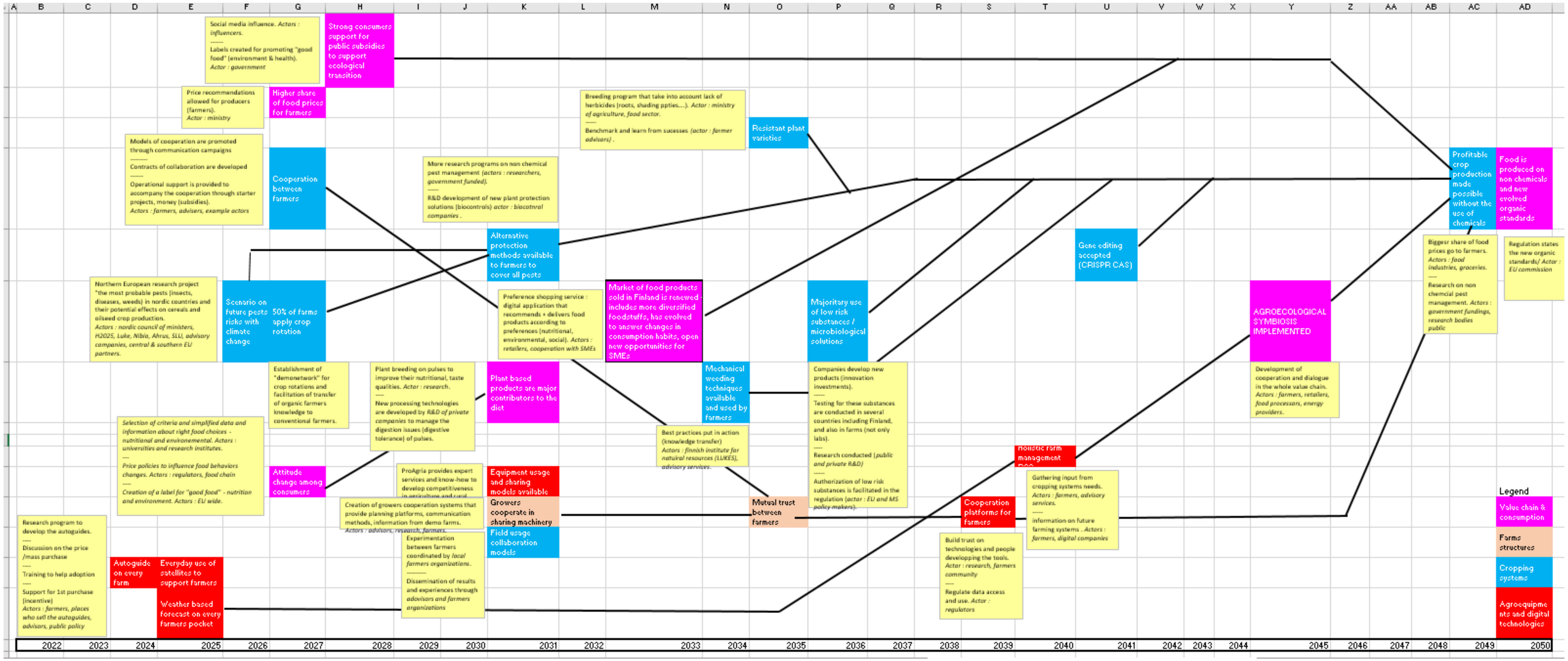
Define chemical pesticide free

APPENDIX 3 - Transition pathways

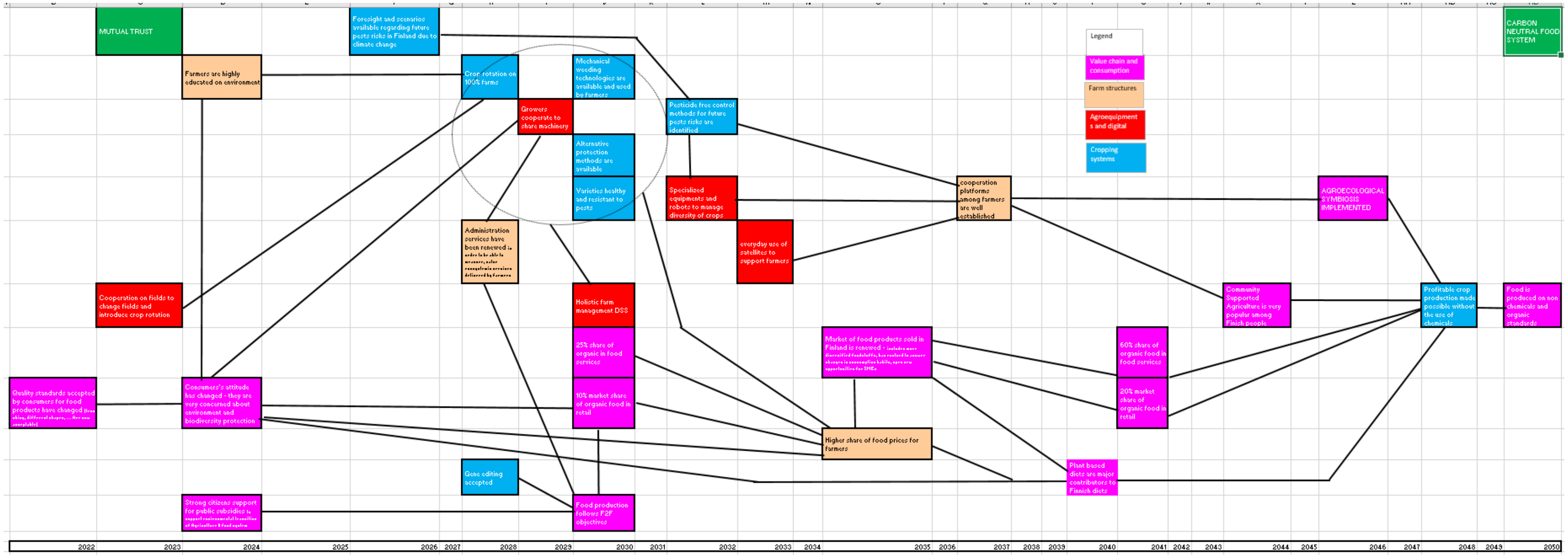
Transition pathway prepared by group 1



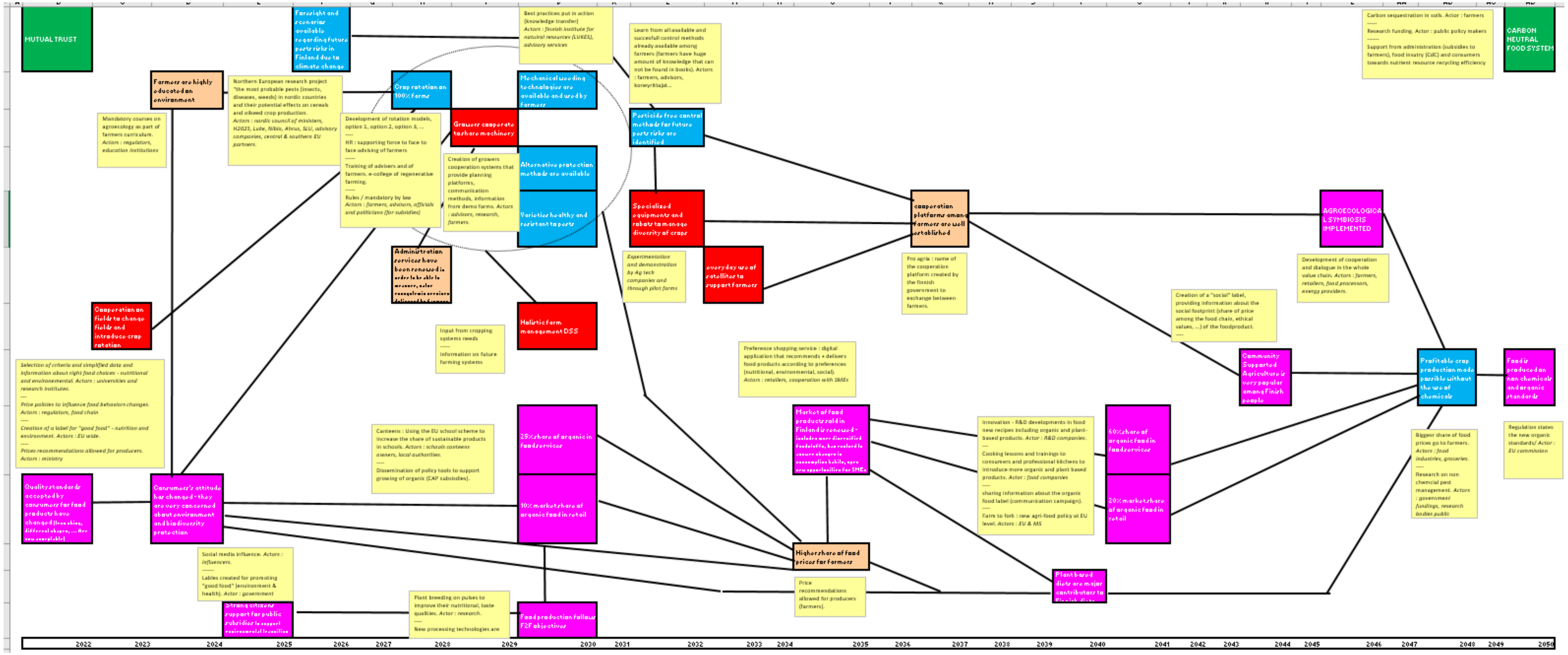
Transition pathway prepared by group 1, with actions



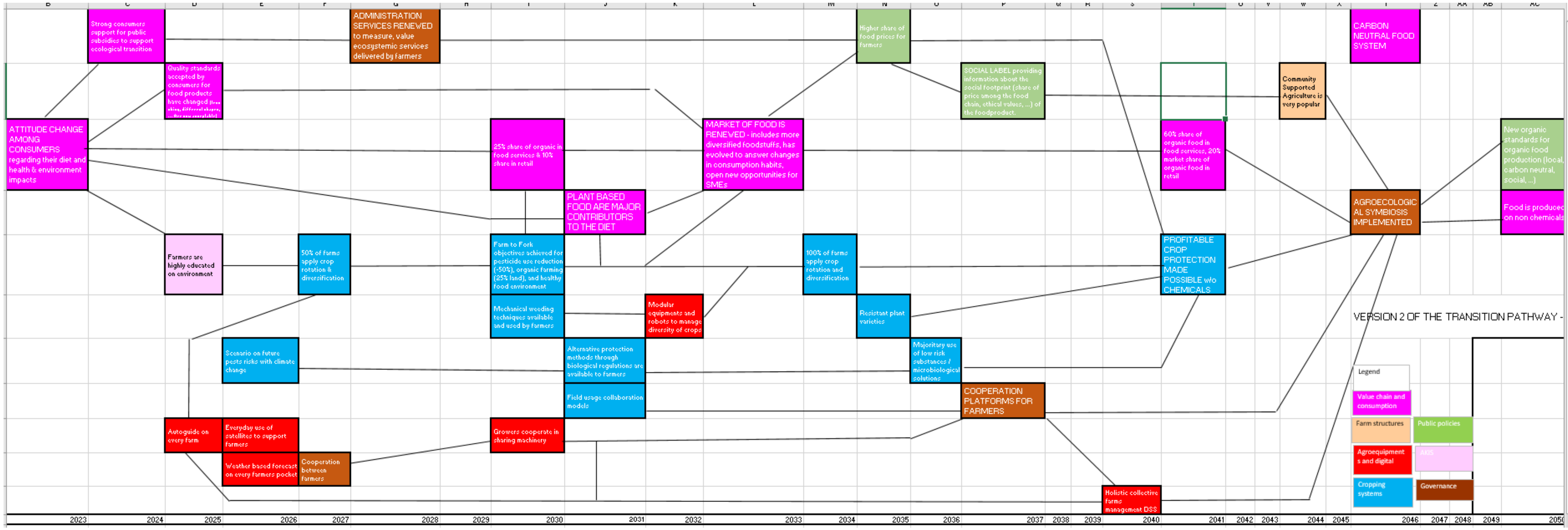
Transition pathway prepared by group 2



Transition pathway prepared by group 2, with actions



Version of the transition pathway, combining proposals from group 1 and group 2



APPENDIX 4 - Detailed feedback from participants

						Do you agree with the following statements:			
How would you rate your overall satisfaction with the workshop ? Please rate on a scale of 1 to 5, 1 being poor and 5 excellent	**What were the most interesting parts of the workshop ? Pick 1 or more**	**How relevant was the workshop to your work ? Please rate from 1 (not at all) to 5 (very much)**	**How useful was the workshop for your work ? Please rate from 1 (not at all) to 5 (very much)**	**Do you think you will use the outcomes of the workshop in your future work ? Please rate from 1 (absolutely not) to 5 (for sure)**	**What are your recommendations to improve the workshop ? What should we do more ? What should we stop doing ? What should we start doing ?**	**the objective of the workshop was clearly given ?**	**the backcasting methodology helped to build transition pathways ?**	**The participatory process succeeded in taking advantage of the different types of knowledge and expertise of the participants ?**	**we had enough time to discuss among participants ?**
4	2-Scenario presentation and discussion	4	4	3	maybe even smaller groups would do better	I mainly agree	I fully agree	I fully agree	I mainly agree
4	1-Overall presentation of the foresight and backcasting method/2-Scenario presentation and discussion/3-Activity on identification of milestones, opportunities and obstacles/4-Activity for identifying actions and actors	5	4	4	The last section of the workshop, the transition pathway work could be developed further. For more clarification I think it would be clearer to make a couple of ? straight? pathways in the group . Now it was a little difficult to get a grip of what kind of actions and goals where relevant for the differennt pathways the group constucted.	I totally agree	I mainly agree	I fully agree	I mainly agree
5	1-Overall presentation of the foresight and backcasting method/3-Activity on identification of milestones,	5	4	4	More time for discussion. Thank You! This was the best workshop ever!	I mainly agree	I fully agree	I fully agree	I disagree

	opportunities and obstacles								
5	1-Overall presentation of the foresight and backcasting method/3-Activity on identification of milestones, opportunities and obstacles/5-Building transition pathways	4	4	5	It would be very fruitful to organise 2 days workshop session in order to offer more time for discussions.	I totally agree	I mainly agree	I fully agree	I agree to some extent
4	3-Activity on identification of milestones, opportunities and obstacles	4	4	4	The given topic is very large and complex and also the methodology has quite many steps, so the task was quite challenging. My worry is that as there is so much in the topic, something may not be identified in the workshop. Although it is difficult to give any advice how to over come this. Maybe some opportunity to return the outcome of the workshop latter.	I mainly agree	I fully agree	I mainly agree	I mainly agree
4	3-Activity on identification of milestones, opportunities and obstacles	4	3	4	Define your objective - what is meant by chemical pesticide? Why do we have to leave all chemical pesticides? What is a hazardous pesticide? Why do you not trust the authorisation system of today (1107/2009)?	I mainly agree	I mainly agree	I fully agree	I disagree

5	3-Activity on identification of milestones, opportunities and obstacles	5	5	4	Nothing to add!	I totally agree	I fully agree	I fully agree	I mainly agree
5	2-Scenario presentation and discussion/3-Activity on identification of milestones, opportunities and obstacles/4-Activity for identifying actions and actors/5-Building transition pathways	5	5	5	The scenario could have been sent to the participants in advance, in order to save time and go straitforward to the backcasting.	I totally agree	I fully agree	I fully agree	I mainly agree
5	5-Building transition pathways	5	5	5	In a talkative group there was too little time to complete tasks, but in more silent group the time might be just enough. Thank you!	I totally agree	I fully agree	I fully agree	I agree to some extent
4	4-Activity for identifying actions and actors/5-Building transition pathways	5	5	3	more pathways	I totally agree	I mainly agree	I fully agree	I mainly agree

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