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

CASE STUDY REPORT

South South-East ROMANIA
Vegetable 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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This report is a supplementary material of the foresight report
Mora O. (coord.), Berne J.-A., Drouet J.-L., Le Mouël C., Meunier C. (with the contribution of Forslund A., Kieffer V., Paresys L.) (2023). European Chemical Pesticide-Free Agriculture in 2050. Foresight Report, INRAE (France), 643p. https://dx.doi.org/10.17180/ca9n-2p17

All publications related to the foresight study are available on INRAE website:
https://www.inrae.fr/en/news/european-pesticide-free-agriculture-2050

This document is the report of the case study Chemical Pesticide-Free Vegetable Production in South South-East Romania by 2050. It has been conducted as part of the foresight European Chemical Pesticide-Free Agriculture in 2050 commissioned and financed by the French Priority Research Program "Growing and Protecting crops Differently". This foresight study was conducted by INRAE's Directorate for Collective Scientific Assessment, Foresight and Advanced Studies (DEPE).

Version 1 filed on 2023, December 20th

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I. Objectives of the case study

The South South East (SSE) Romania case study has been conducted as part of the European foresight study "towards chemical pesticide-free agriculture in Europe in 2050" coordinated by INRAE[1]. The European foresight study was run within the French Priority Research Program (PRP) 'Growing and Protecting crops Differently'[2], 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.

Four case studies have been conducted in four europan regions: Tuscany (Italy), South Finland, Bergerac Duras (France) and South South East Romania. From one of the European scenarios, the South South East Romania case study aims at building a scenario of chemical pesticide-free vegetable sector in South and South East of Romania in 2050, and its transition pathway. It 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.

Through this case study, we covered three topics:

- an analysing major trends of the agricultural system in the region considered;

- the definition of a common vision of a desirable future, that is the scenario of a chemical pesticide-free vegetable production in SSE Romania;

- the building of a transition pathway to get to this desirable future. Our primary objective is to elaborate a transition pathway, crafted and adopted by the group, that is a timeline from 2020 to 2050 of actions organized to reach milestones which altogether will enable this desirable future.

[1] https://www6.inrae.fr/cultiver-proteger-autrement_eng/Studies-tools/2050-Foresight-Study
[2] https://cultiver-proteger-autrement.hub.inrae.fr/

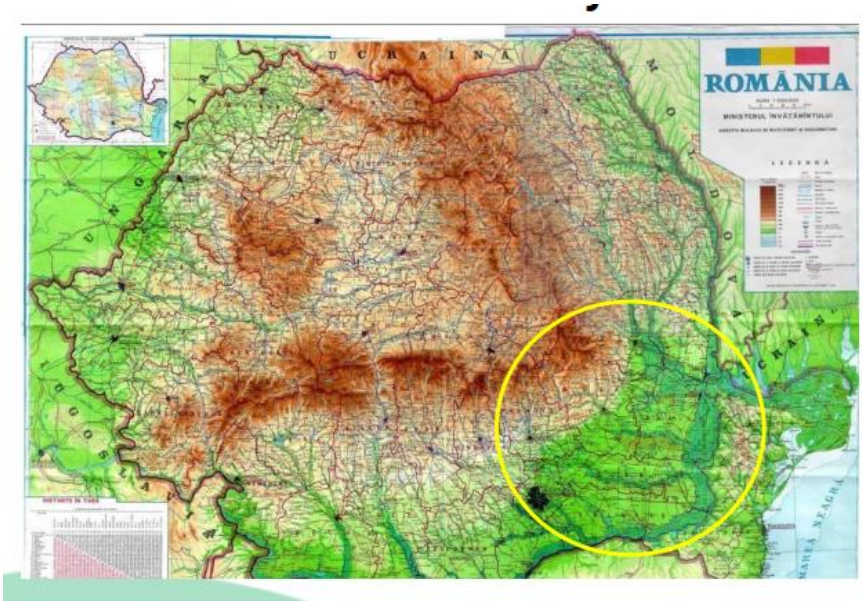
II. Details about the case study

After a call for interest within the Experts's committee of the foresight, launched in December 2021, Prof. Gina Fintineru volunteered to participate in the case study. The case study on SSE Romania was prepared with Prof. Gina Fintineru, Prof. Viorica Lagunovschi and Dr. Ana Butcaru, who are respectively Vice-rector on Research&Innovation, Professor and Researcher at the Research Center for Studies of Food Quality and Agricultural Products in the Bucharest University of Agronomic Sciences and Veterinary Medicine (UASVM, https://www.usamv.ro/index.php/en/home-eng).

Region chosen

Romania is a European country, member of the European Union since 2007. Agriculture in Romania is very important for the country economy and its employment. In 2018 it represented 61% of the added value of the food chain. The most important sectors in terms of production value in Romania are cereals, vegetables, horticultural plants, and industrial crops. Vegetable production accounts for 13.1% of total agricultural input (2018 data, EC 2020).

Figure 1: Map of Romania highlighting the studied area



Sector chosen

The regional coordinators chose to study vegetable production. South South-East of Romania is considered one of the most favorable area for growing vegetables (figure 1). All species can be grown in high yields, including thermophilic ones (melons, oats, cucumbers, tomatoes, eggplants, etc.) both in early, summer-autumn crops or crops for industrialization. Vegetable production is of 3.501.427 tons (2020 data), with a very low share of organic[3].

The most cultivated vegetables are tomatoes, white cabbage, peppers, eggplants, dried onions and dry garlic. Between 2014 and 2018, although the areas cultivated with vegetables have decreased, production has increased (Chiurciu et Fulgeanu, 2019).

[3] Source of the statistics : www.insee.ro

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 cutting down the future into various 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 (for example 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 at introducing the project to the coordinators, presenting the methodology, the objectives of the case studies and their contribution to the overall foresight, and to agreeing 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's 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 Romania, a "regionalization" meeting was organized on March 15th. It gathered the Romania case study coordinators – Prof. Gina Fintineru, Prof. Viorica Lagunovschi and Dr Ana Butcaru – experts invited by the case study coordinators, Dr. Costel Vînătoru, eng. Ghiță Coman, and eng. Tudor Stanciu, and members of the foresight team Olivier and Claire. 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.

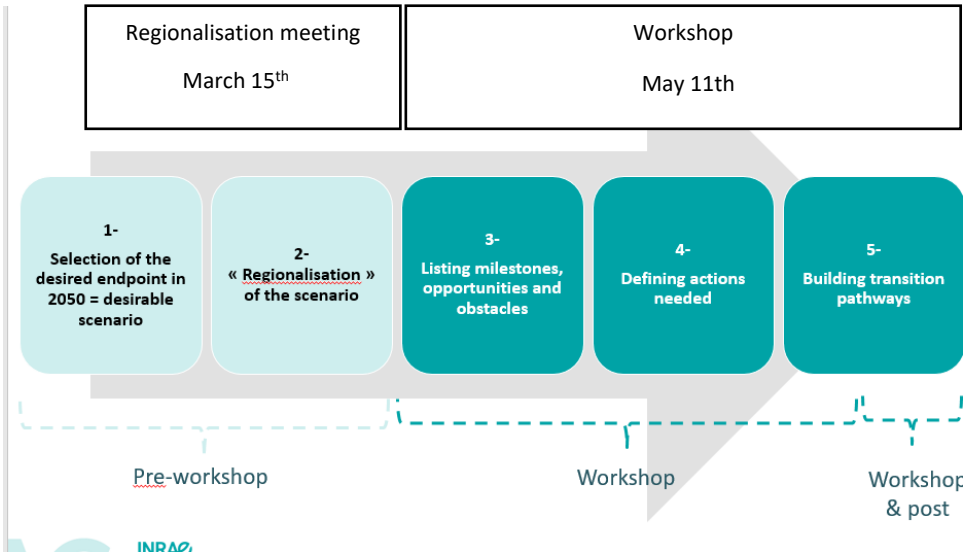
Then, a narrative of regionalization of the scenario for SSE Romania was built through email exchanges in April.

Finally, the participatory workshop to elaborate transition pathways for vegetable production in SSE Romania happened on May 11th, in Bucharest. It gathered around 20 participants.

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

The figure 2 summarizes the process we followed in each of the case study, also valid for the SSE Romania case study. The five steps are further detailed below. Steps 1 and 2 happened in March 2022. The process and template were prepared by the INRAE foresight team members (Olivier Mora and Claire Meunier). The preparatory work and the retrospective analysis were done by Prof. Gina Fintineru, Prof. Viorica Lagunovschi and Dr Ana Butcaru. The "regionalization meeting" gathered five contributors together and three experts invited. Steps 3, 4 and 5 happened during a one-day workshop organized by the regional coordinators and co-animated by Ana Butcaru, Roxana Ciceoi, Prof. Gina Fintineru, Prof. Viorica Lagunovschi and Claire Meunier.

Figure 2: Process followed in the case study



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

For each of the regional workshop, the experts select one of the three scenarios developed with the foresight expert committee. The regional coordinators, with the support of the foresight team, choose 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

In this step, the selected desirable scenario was adapted to the cropping system, the farm structures, the value chain and the region studied. First, the local coordinators ran a retrospective analysis to identify the past and current regional trends for the cropping systems, the food value chain, the agro equipment and the farm structures in the local area, and for the local sector. They used scientific and grey literature, and outreach to researchers or stakeholders to inform this step.

They answeedr to the following questions for each component:

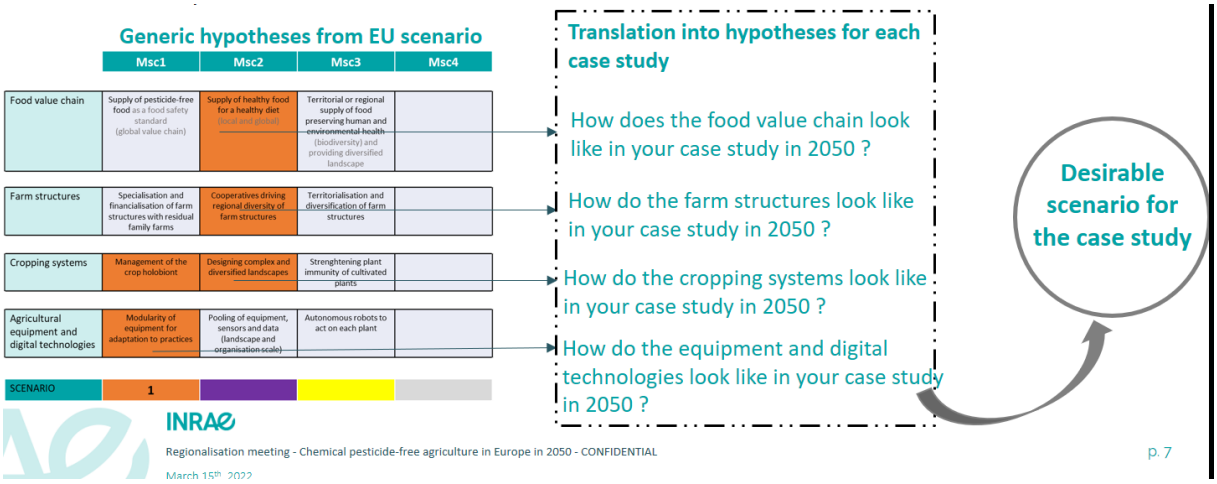
- What have been the past evolutions (during the last 10 to 20 years)?
- Who are the key actors involved in these changes?
- Which factors could influence the future evolution of the component?

- What are the main trends?
- What are the weak signals?
- What are the possible ruptures?

Then, thanks to this retrospective analysis, the European generic hypotheses of evolution (of the desirable scenario) were translated into hypotheses adapted to the specific region and sector. A brainstorming session was animated by the foresight team members, to translate the generic hypotheses of each component of the system into specific hypotheses fitting with the region considered, as shown in the figure 3. This was done by referring to the morphological table for the desirable scenario chosen. For each hypothesis of each component, participants were asked: What does this hypothesis mean for the region and crop considered?

The outcome of this step was a regionalized scenario, in the form of a narrative and summary table of hypotheses.

Figure 3: Translation of the generic hypotheses from the EU scenario into specific hypotheses



One-day workshop in Bucharest, Romania, on May 11th, addressing steps 3,4 and 5

The one-day workshop was dedicated to building the transition pathway towards the scenario of chemical pesticide-free agriculture by 2050, built in the step #2.

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 et Kok, 2013; Bengston et al, 2020; Hines et al, 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 etc….

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 can 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.

IV. Retrospective analysis – vegetable production in South South-East Romania

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 and current trends and was completed by a first survey on possible future changes.

The SSE Romania coordinators completed the retrospective analysis template ahead of the regionalization meeting, based on their knowledge and experience. They also questioned experts within their network. In parallel, the foresight team conducted a short literature review (non exhaustive) using Web of Science (WOS)[4] and documents from the European Commission (EC, 2020).

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

IV.1- Major trends identified on vegetable production in SSE Romania

Farmers choose to cultivate both established varieties and new varieties that have emerged, according to the region and local conditions. More recently they diversify production to answer to processors / traders demand. At the moment 85% of the varieties used come from the seed market (mainly foreign hybrids). There is a consumer trend for traditional taste and old "look and feel" for vegetables, where Romania traditional varieties could be used. The biggest problem in terms of pests in vegetable production are weed; they are managed through manual weeding in most cases. Predatory insects, entomopathogenic nematodes or bacteria/fungi are used to control greenhouse pests. Copper and sulfur are used against phytopathogens, and mechanical traps against rodents. With climate change and the introduction of new varieties, new pests have and will continue to emerge. Also, resistance to insecticides starts to appear. In future, biological control of pests could become the standard protection strategy, with products based on baculoviruses and entomopathogenic fungi and viruses. The integration of new pests monitoring devices (pheromone traps, satellites) will help farmers in their pests management practices. Fertilization methods have developed a lot over the past years, with several new products reaching the market (biostimulants, water soluble fertilizers, foliar fertilizers, ….), but chaotically used because not accompanied with training and advice (Scurtu and Lacatus, 2013). This use has affected soils (EC, 2020) and water qualities. In future, farmers need to be supported by consultants, soil analysis and diagnosis in order to choose the best fertilization strategy. Water use will also become a challenge in future years due to climate change. At the moment drip irrigation covers more than 90% of the vegetable sector.

IV.2- Major trends identified on vegetable value chains

Vegetable production has diversified over the past years, and now comprises of numerous vegetables (beets, carrots, peppers, tomatoes, eggplant, broccoli, celery, potatoes, onions, garlic, beans, cucumbers, zucchini, squash…) (Giurgiu et al, 2019). During the pandemic home cooking has intensified. Vegetables play a central role in Romanian diets (Constantin et al, 2022). Romanian consumers are affected by global nutrition issues (childhood obesity and other diet-related diseases) (EC, 2020), lack of knowledge about food, rising gross domestic products and energy costs. They look

[4] WOS query « Romania AND vegetable AND trend» conducted in February 2022, limited to « topics », generated 13 results.

now for higher quality vegetables, without residues of pesticides, for health reasons. Demand for organic products is also increasing by more than 10% each year, even though Romania is among the European countries with the smallest areas for organic crops (2.9%) (Merca et al, 2021). Organic products; it is perceived by consumers as high-quality products natural, environmentally friendly, without chemicals. In the past there was no supply chain management but progressively connections are beginning between manufacturers, traders, processors (Popescu, 2016). In future, the vegetable value chain should further develop and integrate actors such as cooperatives as groups of manufacturers, processors and storage units, retailers and ultimately consumers. Vegetables are mainly sold fresh, especially local productions. They are mostly manually sorted and are stored either sold directly to consumers or stored in cold storage facilities. In future, and in line with the green deal, organic vegetables should continue to grow. Traceability throughout the product cycle should also develop, enabled by the integration of the value chain, and development of digitalization.

IV.3- Major trends identified on agricultural equipments and digital technologies in SSE Romanian farms

Romanian farmers haven't been encouraged to digitalize vegetable crops in the past 10 years; only in the last 4-5 years has a niche appeared with some digital tools' development. Machinery used in vegetable growing is unevenly distributed and is often old and/or lacking (Constantin et al, 2022). Basic digital and software skills in Romania are among the lowest in the EU (EC, 2020). Currently monitoring schemes are mostly made up of thermometers, traps, UV lamps and weather stations. Some innovations are developing such as 3D video cameras which can measure the volume of the plant, recognize colors, etc…Farms are still in a stage of transition in general and regarding agricultural equipments in particular: large farms have managed to invest and implement modern monitoring systems. In future, grants and consultants should support small and large farmers in their adoption of modern tools. They can come from the state, retailers, IT companies, and EU aid programs.

IV.4- Major trends identified in SSE Romanian farm structures

Farms cultivating vegetables are in the vast majority managed at the family level (EC, 2020; Marinescu et al, 2021). Vegetable farm size varies from 0.1 to 10 ha. The vast majority of employees are members of the family, and for certain works day laborers can be employed. Large farms are starting to seek the help of consultants and to invest in new technologies. Capital comes from family funds and EU-supported projects. Some farmers are also trying to create integrated chains to maximize profits. In future, access to markets could be facilitated through online platforms. Also, consumers increasing requirements for healthy and high-quality vegetable products should provide development opportunities. Challenges lay with the lack of collaboration between small farmers, the lack of qualified staff and competition with import products.

Table 1: Retrospective analysis of cropping systems for vegetable production in SSE Romania

CROPPING SYSTEMS	CURRENT SITUATION	PAST TRENDS	FUTURE TRENDS
System characteristics: orientation, choice of crops and crop sequences	New species introduced after 1990, along with traditional crops many other species and varieties have been introduced.	Strong diversification of the products that operators choose to grow. This trend is due to consumer demands.	Product quality is not coherent due to not having a clear plan, but big farmers are more aiming to the consumer need and they are producing more varietios in one crop (ex. Tomato- from heilroom, excellent taste nice color to varieties with LSL gene destined for long storage on supermarket). The crops will be monitored more closely by specialists in more segments (like fertilisation/pest control/digital monitorring) with a better crop performance overall. The farmer will need more consultants with excellent expertise in order to get the best results. Factors that may influence: -possibility to implement irrigation system; - access to subsidies; - offering support in order to sell the obtained products. In the future, varietal choices could go back to Romanian varieties better adapted to growing conditions.
	In general, farmers try to adapt depending on the region in which they are located, local requirements, and more recently, the connections they manage to establish with different processors / traders. The big problem is the sale of the obtained products.		
	New hybrids are introduced on the market, with specific cultivation needs, growers make choices depending on the place of sale (supermarket or direct to the consumer).		
Varietal choice	We work with many species (mainly foreign hybrids).		
	Farmers choose to cultivate both established varieties and new varieties that have emerged in order to diversify production. In general, the new varieties also go through a "testing" by the farmers, and depending on the results they continue or not to use a new variety.		
	More and more varieties are returning, there is a clear need for taste and "old look and feel", but professional varieties occupy more than 85% of the market, where the description of the variety is clearly highlighted by the owner.		
Fertilisation	Use of biostimulators. Decreased use of synthetic fertilizers (from 14 producers - now only 1), Orientation to organic, compost, bio-fertilizers use of biostimulators, biofertilizers palletized from animal waste, use of certified organic manure.	Use of manure and crop rotation.	Establish a standard fertilization strategy that is based on the use of certified organic manure and the introduction of new biofertilizers / biostimulators to develop the plant multilaterally.
	The market for products intended for use in organic farming has diversified greatly, so at present there are many products that can be administered in crops to increase soil fertility and lead to rich crops.	Not a coherent usage of technology, and that leads to unhealhy products and missusage of natural resources.	
	A clear trend in increasing the production based on fertilisation. All fertilisation methods are chaotically used (base fertilization, water solubile fertilisers, foliar fertilisers and biostimulation). There is a huge need of education of farmers. In the past 10 years a lot of new technologies penetrated the market, with low information and usage experience. New and improved fertilisers are pushing the verieties to grow bigger and better with an excellent quality (for example controlled released fertilisers/ water solubile with sea weed, biostimulants etc.)		

Table 1 (continued)

CROPPING SYSTEMS	CURRENT SITUATION	PAST TRENDS	FUTURE TRENDS
Pest management: Main pests, weeds, pathogens, Main plant protection products used, Alternative solutions to replace plant protection products	Pest control: natural predators (such as predatory insects or entomopathogenic nematodes) in the control of greenhouse pests (thrips, aphids, etc.), biological control is also done with entomopathogenic bacteria / fungi). Products containing already established substances such as copper or sulfur are used to control phytopathogens. Mechanical traps are used to control rodents. In the case of weed control, manual weeding is mostly used.	Past trends in biological control have been non-existent. In the past organic farming meant that a crop did not have any treatment applied (be it with organic insecticides). The growing demand on the market for organic products has led to the professionalization of this sector.	With climate change, pests are becoming more and more difficult to control. Along with these, the development of solutions to combat them is evolving. Future trends are: -Establishing biological control of predators as a standard strategy, the use of products based on baculoviruses and entomopathogenic fungi. -Integration of new solutions such as entomopathogenic viruses to control fungal agents (viruses that destroy fungi). The weak signals are the appearance of resistance to *B. thurinigensis* toxins, the most used insecticide in Romania.
	Currently the market offers a diverse range of methods to control both diseases and pests. With the introduction of new varieties / species into the culture system, other diseases / other new pests appeared, which were not encountered in the past. In addition to the work applied to reduce / reduce the effect of pests / weeds, farmers also resort to the administration of plant protection products.		
	Natural predators: weeds = the biggest problem. The main pests / pathogens depend on the region, on the ecological conditions of the year. New pests appear (*Tuta absoluta*) that are very aggressive; Recognition mechanisms are difficult, especially at the level of small producers using integrated, biological and crop rotation solutions.		
	Better management of foliar products and better understanding of biostimulants will significantly reduce pest pressure. Combined with the new wave of IPM (predators-biofungicides-biostimulators-crop rotation)		
Management of water resources and irrigation	Climate change - acute droughts in recent years, a good year meant in the past 800 l / sqm, now 500 l / sqm.		There will be an increasing interest for water conservation products like Zeba or soil surfactants. Water usage will have to be decreased by 20%.
	In the case of vegetable farms, it is found as the main irrigation system, the drip irrigation system.		
	Drip irrigation is used on a wide range of crops with more than 90% coverage in the entire vegetable sector, due to lack of water from irrigation channels. The need is covered by direct drilling and a semi improvised water filtering system, combined with a Venturi bypass used for applyig water soluble fertilisers.		
Tillage and soil management	Soil is afected by huge quantities of fertilisers used in the last 10-15 years, chaotically, EC level in super intensive areas like Matca/Izbiceni/Dabuleni is huge, water is infiltred with a lot of fertilisers (especially N). There is a huge need that every farmer needs to make a soil analyses and after that to establish a fertilisation strategy (based on water quality, soil type, EC/pH/Cationic exchange/Variety/Location/type of growing system).		
Monitoring	Pheromone traps for pest monitoring	They were not used	
	EC (electrical conductivity), pH, are starting to be understood and monitored by vegetable farmers, but still there is a lot of room to improvement like satelitar monitoring, a service that is still 3-5 years ahead, first crops that will be impacted will be onion and carrot (close to the fiels crops way of management, where these technologies are already penetrating). In the future, there should be the integration of new monitoring devices that can scan / capture pests present in a plantation and with an automatic learning program to make decisions / send alerts.		

Table 2: Retrospective analysis of food value chain and diet in SSE Romania and vegetable production

FOOD VALUE CHAIN	CURRENT SITUATION	PAST TRENDS	FUTURE TRENDS
Type of food products	Common products: beets, carrots, peppers, tomatoes, eggplant, broccoli, celery, potatoes, onions, garlic, beans, cucumbers, zucchini, squash;	potatoes, beans, onions and tomatoes	Diversification of production: introduction of niche crops such as asparagus, artichokes, pack choi…
Food consumption patterns - place of the product in people diet	During the pandemic, home cooking intensified and healthy vegetables played an important, central role. Demand for organic vegetables has grown by more than 10% each year. Vegetables have a special role, being consumed in all possible forms. Consumer preferences have diversified, so there are requirements for more niche vegetables, but the demand is also for the main ones (tomatoes / potatoes / peppers / beans, etc.).	Consumption in households Very little in restaurants	Consumption in households, due to the accelerated pace, consumption in specialized places will increase
Consumers attitudes and expectations towards the products	Products without residues that do not affect their health, with nutrition, gustatory and aesthetic qualities; In general, parents choose these products to use in their children's food, having a higher degree of safety about what they consume; The attitude of consumers is still reluctant, most of them not knowing the whole process behind obtaining an organic product.	Price was more important than quality	Highest quality without harming the environment.
Main actors in the value chain	Manufacturers, retailers, distributors, primary processors.	Farmers Customers. There was no concept of supply chain management.	Cooperatives / manufacturers - processors / storage - retailer-customer
Information to consumers (labels, certifications, traceability, …)	Labeling, distinctive signs for ecologically certified products, global GAP certification that provides traceability. The labeling of organic products is a well-defined thing, which can lead to sanctions for operators if the labels made by them are not in accordance with the rules of organic farming. The label provides a good identification of the product on the shelf and a clear traceability can be established	Reduced	Coherent labeling and traceability - standard
Technologies used to sort, store, process and/or preserve food products	Mostly manual sorting and labeling, short-term cold storage. The vast majority of farmers choose to sell their products fresh, directly from the field, but in the case of processors there are modern storage spaces that can ensure proper storage (cold rooms). Regarding the processors, the technological flow is in the current trends, that is, they manage to put on the market at the end, a finished quality product.	The import being very high, there was no question of sorting and packing. The local producers were left to sell the goods only in fresh condition	Digitization and use of high-performance sorting / packaging machines

Table 2 (continued)

FOOD VALUE CHAIN	CURRENT SITUATION	PAST TRENDS	FUTURE TRENDS
Spatial scale: activities at local, national, european, outside europe	In general, it is preferred to sell local fresh products / vegetables.	Focus on imported products - local products were classified as poor quality	The focus will be on local products.
		The trends are around the location of the food, this being a consequence of three factors: the higher apparent quality of the products and the apparent lower chemicalization of the products, the higher degree of freshness due to the shorter distance needed to reach the consumer products, respectively the community idea, by this understanding that a very high percentage of consumers prefer to pay a higher price, by this understanding that they support the producers / community nearby. The defining actors in this whole mechanism are the educated consumers, with a strong vision on what sustainability and conservation of the environment means.	The main driver of future trends is technology and digitalization, either in agritech (precision agriculture, food traceability, etc.), or in the integration of all actors in the supply chain. From the point of view of products, continuing what the new Green Deal or the new common agricultural policy promotes, the emphasis is on the growth of certified organic products, on ensuring a decentralization of food, as well as ensuring traceability, throughout the product cycle (from production, for marketing). The two trends have the advantage of overlapping, in terms of public policies, but also in terms of market needs. Regarding the ruptures, the most delicate component is represented by the increase degree of knwoledge on digitalization within the producers, as well as regarding their association, in order to respond to market needs.
Other comments	The appearance on the Romanian market of ecological products. Diversification of cultivated products; Acquisition of modern equipment for processing the resulting products; Key players - producers / processors / European Union that has encouraged this sector.		* Access to subsidies; * Ensuring sales markets * The tendency is to expand the organic farms, thus, there is an increase in the number / areas cultivated in the ecological system.
	In addition to economic factors (price and income), there were non-economic factors such as habit, quality / freshness, taste and preferences of family members, reported by consumers as the most important to impact their food choice. The Romanians have undergone substantial changes in their diet and significant annual variation in the level of consumption of individual products.		Consumers increasingly want food to be healthier and more ethical, and to taste good. "Going local" is a movement that promotes local development supported by local consumers. It is a growing trend towards empowering local economies. In general, consumers feel confused because of too much information, mixed or contradictory messages. They need help with viable selection criteria and support from public authorities (through food and nutrition policies) and from the private sector. At the same time, they like to have a choice when it comes to shopping.
	From the perspective of the Romanian consumer, organic products are natural, environmentally friendly products, without GMOs, without chemicals that use natural fertilizers, a special certified production process, in a clean environment, in an ecological farm. In addition, organic foods are perceived as high-quality products at premium prices.		Consumers values, priorities, perceptions and attitudes towards food choice are affected by global changes in terms of: increase level of nutritional malfunction, childhood obesity and other diet-related diseases, lack of time, high level of stress, lack of knowledge and awareness of food, small households, rising gross domestic product (GDP) and energy costs, food safety, and the quest for variety, novelty, premium and ethics.

Table 3: Retrospective analysis of agricultural equipments and digital technologies in SSE Romania

AGRICULTURAL EQUIPMENTS AND DIGITAL TECHS	CURRENT SITUATION	PAST TRENDS	FUTURE TRENDS
Observation and modelling systems	Currently, observation systems are mostly made up of thermometers, adhesive traps, U.V. lamps and very few weather stations.	The Romanian farmer has been stimulated very little in the last 10 years to digitize his vegetable crop, only in the last 4-5 years has a niche appeared that comes to his aid with certain digital tools. The actors involved in these changes are some I.T companies and certain Supermarket chains.	The main factor would be the support and granting of financial aid to the farmer who wants to digitize his farm, help from the state, supermarkets and from I.T companies that are involved in this field. Trends: The new schemes in the European aid programs also involve the digitization of Romanian farms What are the weak signals? The farmer's education in understanding and managing the new equipment is almost nil, and this would lead to his disinterest in the new technology. What are the possible ruptures? Lack of cooperation between state institutions, retailers and farmers.
Specific equipments	Monitoring weather stations, sensorized to perform multiple functions in crops (watering, aeration, fertilizing, shading, etc.) 3D video cameras (which can measure the volume of the plant, recognize the color of the crop, can measure the volume of the solarium / greenhouse, etc.).		
Innovation dynamics	The emergence of monitoring systems, which came to support the farmer from certain activities on the farm.		
	In the case of greenhouses, the possibility to control humidity / temperature and other factors with the help of technology. This reduces the need for work and thus reduces costs.	Farms are still in a stage of transition, in general, large farmers have managed to implement modern management / monitoring systems, with capital to invest.	Co-opting farmers in cooperatives; Calling specialized people / consultants Continue to provide grants to support small and large farmers.

Table 4: Retrospective analysis of farm structures in SSE Romania

FARM STRUCTURES	CURRENT SITUATION	PAST TRENDS	FUTURE TRENDS
Governance of farm structures	In Romania, farms whose agricultural profile is the cultivation of vegetables are managed either at the family level, the vast majority of activities being carried out by family members, or in the form of an SRL / II. This differentiation depends very much on the size of the farm.	In recent years there has been an attempt to diversify farm products. Operators are trying to adapt to market demands in order to market what they produce.	Factors that could positively influence: -access to new technologies; -subsidies offered; -access to new markets with the help of online platforms; - increasingly stringent consumer requirements for healthy, quality products. Factors that could adversely affect: -lack of labor and qualified staff; - difficulties in selling products due to massive imports; -division of farms and lack of collaboration between small farmers. Small farmers will be smaller, big farmers will be bigger, due to lack of association.
Size of farms	The surface of vegetable farms varies from 0.1 ha to 10 ha.		
Labour force (family, sole holder, external to family, ...)	The workforce is hard to find, and the available workforce is not specialized, for this reason, the vast majority of employees are members of the same family. For certain works, which involve a higher volume of work, day laborers are also used.		
Source of capital	Equity, in the case of smaller farms, but also capital from the application of various EU-supported projects.		
Type of farms (specialized, mixed, livestock, permanent crop, ...)	There are both farms specializing strictly in vegetable farming and mixed farms (some farmers are trying to create integrated chains in order to have a better profit and capitalize more efficiently on the land they have).		
Access to new technologies (digitalisation, machinery, breeding, consultants, ...)	It is noticeable that large farmers, as well as small ones, have started to seek the help of consultants. In addition, they have begun to adapt to new technologies (purchasing high-performance equipment, higher quality materials - eg solarium foil, irrigation systems).		

V. "Regionalized" scenario in 2050

The regionalization of the scenario started with a meeting, called "regionalization meeting", divided into three steps. The first step was to discuss the retrospective analysis in order to get a clear understanding of the local context, cropping system, value chain and actors involved, and their trends.

Then, the regional coordinators chose the desirable scenario out of the three European scenarios. They chose the scenario numer two (S2) « **European and regional food systems, soil and food microbiomes for healthy food and healthy diets"**. The reasons for this choice are based on the trends identified in the retrospective analysis, mainly consumers' trends: increasing interest for healthy diets where vegetables play a central role. Also, the agronomic conditions of the area and in particular the very favorable soil conditions. Finally, the crop protection trend towards the development of the use of bacterial, fungi and virus-based solutions.

A brainstorming session enabled to translate the hypotheses of the European pesticide-free agriculture scenario "European and regional food systems, soil and food microbiomes for healthy food and healthy diets" into hypotheses specific to the SSE Romania case study. For this last part, we organized a klaxoon session to gather insights on how the European hypotheses would translate in SSE Romania for the vegetable growing 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 SSE Romania in 2050. On the right hand side we posted a list of questions to help in the idea generation.

Figure 4 gives an example for cropping systems. The ideas proposed are in the green sticky notes (Appendix II presents the klaxon board delivered during this session). Table 5 lists all the ideas generated during this brainstorming session.

Figure 4: Example of the idea generation process used for gathering hypotheses adapted to SSE Romania and vegetable production in 2050

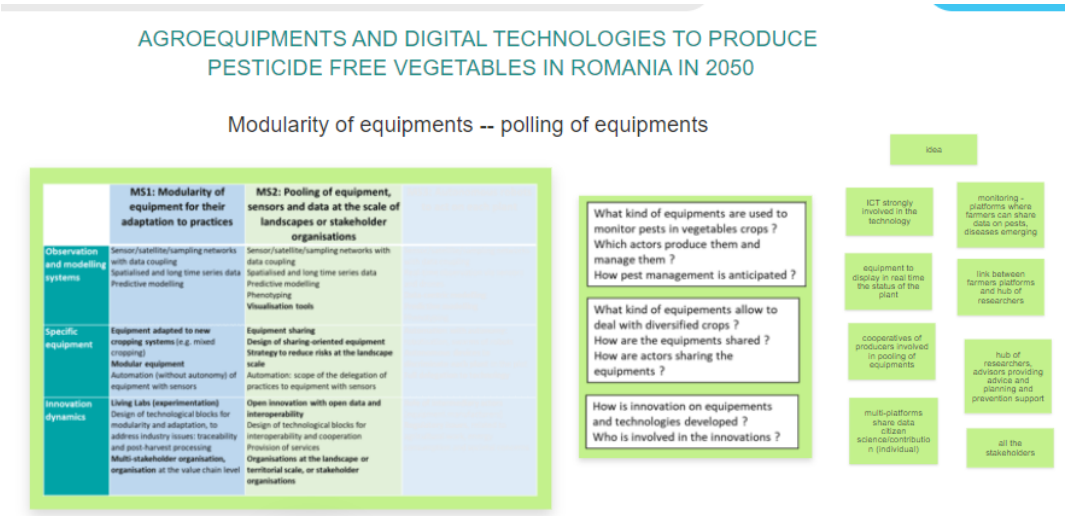


Table 5: List of ideas generated during the brainstorming session, organized by component

Cropping systems in 2050	**Food value chain in 2050**	**Farm structures in 2050**	**Agricultural equipments and digital technologies in 2050**
Inoculation of key microorganisms in order to modulate the crop microbiota (Trichoderma sp., Bacillus sp…)	Regional storage/deposits for diversity+ can help producers to sell fresh vegetables	Small, medium, large	ICT strongly involved in the technology
Crop rotation, association with aromatic plants (basil, mint) + pulses	Storage warehouses for producers at regional level, for each county, owned by the cooperative	Young farmers, educated, innovative	Equipment to display in real time the status of the plant
A strong network between stakeholders	Healthy food is the main concern for consumers (diversified, fresh, organic, frozen / dried)	Increased of average size of family farms	All the stakeholders
Choice of crops and cover crops in order to raise the soil organic matter and boost the plants imune system	Drying technologies	Circular farms	Multi-platforms to share data Citizen science/contribution
Livestock has developped (sheep, goat) in order to provide fertilisation	Dried vegetables as a healthy product for children	Cooperative associations providing bio-fertilising solutions	Cooperatives of producers involved in pooling of equipments
Vegetable production will be protected from pests by other insects	Food processors involved or cooperatives processing vegetables to sell added value vegetables	Labour managed by family and neighbours	Monitoring - platforms where farmers can share data on pests, diseases emerging
Cultivation of perennials, which will better withstand climate change	Every product will be labeled regarding the environment impact and nutrient value	Consumers, volunteers helping in picking operations	Hub of researchers, advisors providing advice and planning and prevention support
Smart/ precise fertilisation and irrigation	Varieties adapted to local agro pedoclimatic conditions and climate change	Local/regional market	Link between farmers platforms and hub of researchers
Open science, participative research inc consumers, producers. Vegetable Producers groups / Communities share technologies, solutions	Consumers involved in the decision process, strong communication between consumers and farmers + transparency	Short value chain	For monitoring plant microbiota: sensors, digital technologies.
Use of herbal traps (tobacco) - push pull	Fresh, freeze, other healthy processing technology		Tools for monitor pests - DSS with phenology, nutrients, pest and disease control
Strong epidemiological services + many innovative digital technologiesț companies	Every product will have the public pedigree, beginning to seedling, soil management, water consumed, pesticide etc		
Local varieties - seeds resources from the newly created genes bank			
Association of crops - corelated to vegetable species			

Building the narrative for a pesticide-free vegetable production in SSE Romania 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 vegetable production in 2050, without chemical pesticides. Based on this first version, some missing points were added and other clarified.

Will there be only open fields in 2050 or also green houses? There will be both Open fields and protective spaces (greenhouses, solars, etc).

Can you give more details about the vegetable value chain in 2050: how are vegetables distributed? where? by whom? Different value chains are used by vegetable producers, ranged from short food supply chains and local food systems to more sophisticated value chains.

- Short chain relies on trust and conveys information directly to the consumers: 1. Face-to-face within farmers markets or cooperative's local outlets; 2. Spatial proximity, in the specific region of production, including regional restaurants, agritourism, and public institutions - schools, nurseries etc; 3. Spatially extended: outside of the region of production, valorising quality and focusing on region identity. Vegetable producers' cooperatives, acting as commercial organizations (including certification, packaging, branding to ensure premium organic prices), are regular suppliers of major retailers, via contracts, and also open premium cooperative's market outlets (ex: cabbage, onions, broccoli, mushrooms)
- Cooperative-oriented approach allowed some of the successful speciality and alternative quality chains to extend into national and international market channels. They focus on blockchain, data integration, data traceability, collective agreements in order to enhance food quality along the value chain.

How are vegetable distributed?

Vegetable distribution takes several forms:
(1) vegetable stock echange
(2) specialized department of cooperatives distribute on a specific map of consumers,
(3) specialized transport companies develop special department for food transport directly to consumer,
(4)" supermarket" (specialized shops) for retail, …

Details about fertilization practices in 2050: Organic fertilisation/ or Pellet-shape organic fertilizer is provided, especially by livestosck sheeps and goats, and smart methods of fermentation compost fertilization are used. /caws…

Can we also elaborate on the link between farmers, rural areas and urban areas (delivery of vegetables to Bucharest region, …)? In 2050, every vegetable will have a pedigree, including social farm aspects. Every consumer, if she/he wish, can be acknowledge about the farmer who produces every piece of vegetable she/he eats.

Examples of association of plants to contribute to pest management: squash (pumpkin) and corn can be associated, for combining respectively soil covering and shade. Carotts are associated with onions, garlic, whose odors repel carrot rust flies. Farmers also use herbal traps such as tobacco to attract pests, and beneficials insects. *Tagetes sp*., *Calendula* and *Centaurea* are used as companion plants with different vegetable species. alfalfa and clover are intercroped.

Final scenario

Generic scenario - European and regional food systems, soil and food microbiomes for healthy food and healthy diets

South east Romanian organizations of farmers leverage good soil conditions and maintain strong microbiome interactions from the soil to the plant, to produce pesticide-free vegetables that are major contributors to healthy Romanian diets.

In 2050 in south east of Romania vegetables are grown without chemical pesticides, and provide the local and national consumers with highly nutritious products, that are major contributors to their healthy diets. Vegetables are produced in family farms that are grouped together at regional level, in order to share storage facilities, develop brand, marketing and selling strategies. Farmers have access to several modes of action in order to avoid the use of chemical pesticides in their cropping system. These are based on 4 main levers : the management of the microbiomes, from soil to the vegetables, the monitoring of the soil and pests, diversification of crops, and fertilisation practices. Vegetables production is diversified and include tomatoes, cucumbers, eggplants, melon, onions, broccoli, etc… Vegetables are grown in open fields and protective spaces (greenhouses, solars, etc). They are mostly sold fresh, directly from farm to consumers, in regional storage facilities that are owned by the regional cooperative. They can also be sold in local and peri-urban markets. There are processing units, owned by the farmers's organizations, where vegetables are dried, or frozen, or canned, and sold to the local, regional and national markets, and even internationally in the case of quality labelled vegetables.

Romanian consumers pay lot of attention to the healthiness of their diets. The impacts of chemical pesticides on human health are well known to consumers and public health authorities, who have decided to ban their uses. Healthy diet means to them consuming a diversity of food products, seasonal, in majority cooked at home, little processed, produced with "like home" recipes. Food products are of high nutritional value, and pesticide free. Vegetables are key parts of their diet as they bring micronutrients (vitamins, minerals) and also polyphenols, dietary fibre that exert prebiotic functions, contributors to healthy gut microbiome. Consumers are well aware of the benefits of well balanced gut microbiome on various functions (gut health, brain health, immunity, etc…) and overall health Diets rich in vegetables are encouraged as a way to balance the gut microbiome and prevent development of non communicable diseases. Vegetables are considered priority products, and therefore are supported and promoted by the health authorities in the Romanian government. Nutritional information of food is provided to consumers, through labels or digital platforms.

Consumers live and feel close to the farms. They contribute to the vegetable production by helping with the picking, buying vegetables directly from the farmers. Different scales of value chains are used by vegetable producers. They range from short food supply chains and local food systems to more sophisticated value chains. Farmers leverage short chain distribution channels to build trust and conveys information directly to the consumers. Vegetables are sold directly to consumers in farmers markets or cooperative's local outlets, to regional restaurants, local schools, local nurseries, … They are also sold outside the production region by valorising the quality and region identity of the vegetables. Vegetable producers' cooperatives, acting as commercial organizations (including certification, packaging, branding to ensure premium organic prices), are regular suppliers of major retailers, via contracts, and also open premium cooperative's market outlets (ex: cabbage, onions, broccoli, mushrooms). Some specialty vegetables and premium quality products are distributed in national and international markets via a cooperative-oriented approach. They focus on blockchain, data integration, data traceability, collective agreements in order to enhance food quality along the value chain. Every vegetable has a pedigree, including social farm aspects, so that consumers get access to information about the farmer producing it. Vegetables distribution channels take several forms : vegetable stock exchange, specialized department of cooperatives distribute on a specific map of consumers, specialized transport companies develop special department for food transport directly to consumer, "supermarket" (specialized shops) for retail, …

Average farms size has increased but there remains diversity of farm sizes in the region. They are mainly owned by families working together with the support of neighbours. Young farmers get access to education and trainings. They are encouraged to adopt innovations on crop protection.

Vegetables crops are protected from pests without the use of chemical pesticide. Beneficial organism are integrated in the farm ecosystem. An important lever for protecting vegetables from pests is the management of the holobiont, from the soil to the plant. By analyzing the soil microbiome composition, farmers better understand reservoirs of microbial diversity (soil, air, weeds and water). Strong epidemiological services, sensors and other digital technologies companies provide tools to measure soil health indicators (DNA profiling, enzymatic activity, …), but also weeds, and plant microbiota composition, and pests dynamics. Technology is strongly applied in farms, with different sensors, imagistics (satelittes, drones, etc), applications for farms with Decision support systems (including all managements tasks). These data are shared within the cooperative among farmers. Farmers can then modulate microbiomes using biocontrol solutions through innoculation of micro-organisms such as *Trichoderma sp, Bacillus sp*. that are applied on farms soils. Also, vegetable varieties are selected in the Romanian genes bank, to be adapted to local agro and pedoclimatic conditions, and soil microbiome. Crops and cover crops are chosen in order to raise the soil organic matter and boost the plants immune system. Precise and non chemical fertilisation is preferred in order to reinforce the recruitment capacities of cultivated plants and reduce pest virulence. Organic fertilisation or Pellet-shape organic fertilizer is provided, especially by livestosck cows, sheeps and goats, and smart methods of fermentation compost fertilization are used. Agroecological solutions for crop protection also include the choice of association of crops to limit the development of pests, by associating together vegetables, cereals, legumes, aromatic plants (basil, mint). Alfalfa and clover are intercroped. For example, squash (pumpkin) and corn can be associated, for combining respectively soil covering and shade. Carrots are associated with onions, garlic, whose odors repel carrot rust flies. *Tagetes sp*., *Calendula* and *Centaurea* are used as companion plants with different vegetable species.

This cropping system requires strong cooperation between actors : farmers within the cooperatives, that provide tools, data on and biofertilizing solutions. There is also a strong network with researchers who provide advice, planning and prevention support, and with ICT (information and communication technologies) companies. All these actors are partners in the entire food chain.

Table 6: Summary of hypotheses in 2050

	Hypothesis
Cropping systems	A diversity of vegetables are grown without using chemical pesticides, leveraging 4 main levers : the management of the microbiomes from soil to the vegetables, the monitoring of the soil and pests, diversification of crops, and fertilisation practices.
Agricultural equipment and digital technologies	Technology is applied in farms, with different sensors, imagistics (satelittes, drones, etc), applications for farms with Decision support systems and epidemiological services to measure soil health indicators and pests dynamics.
Food value chain	Vegetables are key parts of the diets of Romanians, who pay a lot of attention to their health. They eat a diversity of vegetables, mostly from short food supply chains and local food systems, and also through more sophisticated distribution channels. Vegetables are accessible to all since they are considered priority products, and therefore are supported by health authorities.
Farm structures	Family farms are grouped together at regional level, in order to share storage facilities, develop brand, marketing and selling strategies. Young communities of farmers are educated and trained. Farmers, researchers, ICT companies, … are partners in the entire food chain.

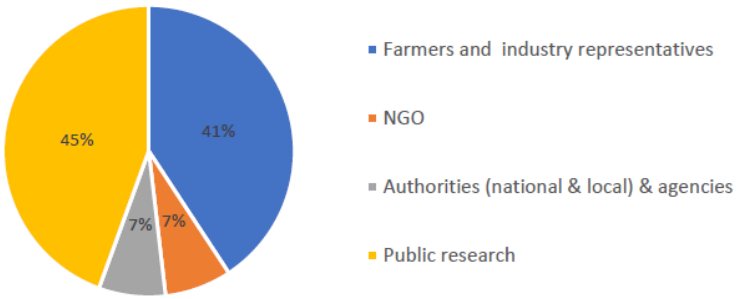
VI. Workshop to build the transition pathway

The workshop happened in Bucharest, on May 11th, 2022. The facilitators of the workshop were Ana Butcaru and Roxana Ciceoi from the University of Agronomic Sciences and Veterinary Medicine in Bucharest. Prof. Gina Fintineru introduced and closed the workshop, and Prof. Viorica Lagunovschi presented the scenario. Claire Meunier, from INRAE Directorate for Expertise, Foresight and Advanced Studies, presented the methodology used in the workshop.

VI.1- Participants

Participants were selected and invited by the case study regional coordinators. In total there were twenty-one participants to the workshop (table 8). Almost half of the participants were farmers and industry representatives, the other half were researchers (figure 5). There were also two representatives of public authorities and two representatives of non-governmental organizations.

Figure 5: Profile of participants to the workshop



Note: some participants combined two activities, for example researcher and farmer.

VI.2- Organisation of the day

The day was split into different sessions according to the methodology described in chapter III, as detailed in table 7 below.

Table 7: Main steps of the day

Presentation of the foresight study
Presentation of the regionalized scenario and discussion
Identification of milestones, obstacles and opportunities
Identification of actions
Building transition pathways
Conclusions, next steps

Table 8: List of participants to the workshop

Nr. crt.	Name	Organizație/ Funcție	Organization/ Position
1	Zamfir Bianca	Genetic Resource Bank/ Researcher	Banca de resurse genetice/ Cercetător
2	Marian Bogoescu	Academia de Stiinte Agricole și Silvice/ Secretar general	Academy of Agricultural and Forestry Sciences / General Secretary
3	Camelia Bratu	Genetic Resource Bank/ Researcher	Banca de resurse genetice/ Cercetător
4	Mihaela Sima	Direcția Agricolă Ilfov – Serviciul de implementarea politiciilor, strategiilor în agricultură și industria alimentară	Ilfov Agricultural Directorate - Service for the implementation of policies, strategies in agriculture and food industry
5	Joițaru Teodor	BioAgriCert – Organism de inspecție și certificare în agricultura ecologică	BioAgriCert - Inspection and certification body in organic farming
6	Roxana Ciceoi	Centrul de cercetare pentru studiul calității produselor agroalimentare/ Cercetător	Research center for quality study of agri-food products/ Researcher
7	Marius Dragoi Corlățan	Andermatt SRL – Firma de cercetare, dezvoltare, marketing produse bio	Andermatt SRL - Company for research, development, marketing of organic products
8	Dan Constantinescu	Nasu Roșu – produse eco, distribuție/ Manager	Nasu Roșu - organic products, distribution/ Manager
9	Oana Bujor	Centrul de cercetare pentru studiul calității produselor agroalimentare/ Cercetător	Research center for quality study of agri-food products/ Researcher
10	Lucian Blaga	Fructavit SRL/ Manager	Fructavit SRL/ Manager
11	Mihai Mihu	Molul Țăranesc/ administrator platformă	Peasant Mall / platform administrator
12	Cristi Tudor	Microgreens/ Administrator	Microgreens/ Administrator
13	Mihaela Stan	Reprezentant Comisia pentru Agricultura din Camera deputaților	Representative of the Committee on Agriculture in the Chamber of Deputies
14	Viorica Udriște	Green Agency –(implementare proiecte pe agromediu)/ Manager	Green Agency - (implementation of agri - environment projects) / Manager
15	Coman Gheorghe	Enten System, senzori și echipamente de monitorizare culturi	Enten System, sensors and crop monitoring equipment
16	Andreea Stan	Centrul de cercetare pentru studiul calității produselor agroalimentare/ Cercetător	Research center for quality study of agri-food products/ Researcher
17	Corbu Gabriel	Gradina corbilor	Gradina corbilor (farm)
18	Tudor Stanciu	Beleza Store Srl	Beleza Store Srl (store)
19	Ciprian Serbuta	Enviro-naturals	Enviro-naturals (store)
20	Elena Ivan	Centrul de cercetare pentru studiul calității produselor agroalimentare/ Cercetător	Research center for quality study of agri-food products/ Researcher
21	Ion Certan	Centrul de cercetare pentru studiul calității produselor agroalimentare/ Cercetător	Research center for quality study of agri-food products/ Researcher

VI.3- Discussion points during the workshop

Feedback on the scenario

After a presentation of the scenario, it was 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. The details of the outcomes of this discussion are in Appendix 3.

After reading the scenario, both groups quoted keywords related to the cropping system in 2050 around **soil fertility**, **soil microbiomes**, **biological control**, **beneficial micro-organisms**. They also listed keywords related to the farm structures and typology evolution towards **association of farms**, **cooperatives**, other forms of farming. The keywords on the vegetable value chain are linked to the products processing, **storage**, **logistics**, **branding and marketing**. "**Health**" is also quoted in both groups, as an important keyword in this scenario around healthy products for healthy diets.

Table 9: Keywords quoted after reading the scenario (in green are keywords quoted by both groups)

Group 1	*Group 2*
Soil – fertility	Health
(Recipes) strategies for farmers to control diseases and pests	Fertile soil – microbiome
Soil monitoring, pests	family farms / association
Sale	short chain of capitalization
Cooperatives, other forms of farming	Education
Education of farmers	information (dissemination of research results)
Biodiversity, species association	social character
Regional warehouses	resistance to change
Use of natural (organic) fertilizers responsibly	products / processing units
Health	Legislation
Biological control, beneficial organisms	Support
Precision agriculture	digitalization and blockchain
Varieties	brand and marketing
Farm typology	Storage
Distribution chain	Logistics
Ecosystem	

Challenges identified on the scenario

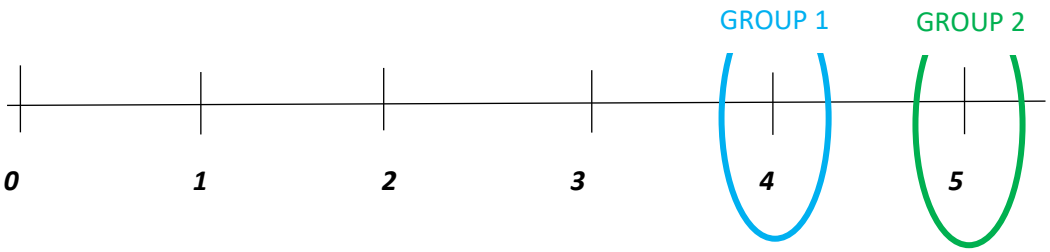
Some challenges of the scenario were identified by both groups. A first challenge is linked to farmers' **reluctance to change**, in particular to create **associations of farms**. Participants also quoted the challenge of **educating farmers but also consumers**. Both groups also referred to **legislation** as a challenge in achieving the scenario of a chemical pesticide free vegetable production in 2050; the legislative framework needs to be revised in order to make the transition happen. They also highlighted the socio-**economic factors as a challenge**, and in particular price / affordability of vegetables (buyers vs consumers behaviors). Other challenges were mentioned related to poor access to technology, climate change, small number of protected areas and retail organization.

Table 10: Main challenges of the scenario identified by the groups (in green are challenges that are common to both groups)

GROUP 1	**GROUP 2**
Farmers' reluctance	Resistance to association
Lack of training of farmers	Educating small producers and consumers
Food education	Legislative framework
Retail	Culinary education
Poor technology	Buyers vs. Consumers
Global warming / climate change	
Socio-economic factors	
Small number of protected areas	
Lack of associations	
Vegetable diversity	
Legislation	

Clarity of the scenario

Figure 4: Clarity of the scenario, as rated by participants from group 1 and group 2, on a scale from 0 to 5



Group 1 considered that the scenario was clearly described in the narrative (average score: as 4 out of 5). They highlighted some elements that could however be added to the scenario to make it even clearer and complete.

They suggested describing more the **diversity of vegetables** and of the varieties adapted to the different value chains. They also suggested revising the scenario to make it more coherent, and provide more clarity to the **way pests will be managed** in 2050 without chemical pesticides. They suggested to describe how the **legislation**, the policies will guide towards the transition to a chemical pesticide free

vegetable production in 2050[5]. Finally, they suggested to better describe the link between vegetable **manufacturers and big cities**: how will the big cities, such as Bucharest, be supplied with fresh regional vegetable productions in 2050?

Group 2 rated the scenario as even clearer (5 out of 5). To further improve it, they suggested, as group 1 did, to detail how the legislation / regulation will create the framework for a pesticide free vegetable production in 2050. They also propose further insisting on the **cooperation** all across the value chain, on the consumers' and producers' information about the advantages of consuming organic vegetables. Consumers could also play a role in the vegetable growing and be directly involved with farmers: going to the farms, picking vegetables, … They also recommend to describe the **role of innovations** in technologies (robots, innovations in the supply chain to replace man labour).

Both groups highlighted the **role of urban horticulture** in 2050: composting stations in cities, small greenhouses in the roofs, urban and community gardens...

VI.4- Outcomes of the workshop

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 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 below table (table 11) presents the translation of the participants' contribution to the workshop. The non-selected milestones are also listed separately (table 12).

[5] Public policies and legislation changes are addressed in the transition pathway.

Table 11: Milestones and actions generated during the workshop (translated from Romanian) - Milestones in bold, connected actions below

Vegetable cropping systems	Vegetable value chain	Farms structures in South South-East Romania	Agro equipment and digital technologies
2040 **New forms of CEA implemented (modern greenhouses, vertical farming, …)**	**2035** **Defining short chain and local farms in legislation (implementation)**	**2045** **Making turnkey microfarms in the vicinity of cities to be used by those who do not own land and want to grow organically**	**2050** **Elimination of chemical pesticides**
Urban farming (Local government, building owners, owners' associations). Resistant varieties, Politics + research (Farmers). Machine learning algorithm (Software companies). Easy to use system.	1. Development of digital platforms with short chains and local markets, dedicated financing (Legislation). 2. Creating a favorable (favorable) legislative framework, providing fiscal and financing facilities (Legislative). 3. Stimulation of functional associations (clusters, producer groups, cooperatives, ...), Provision of fiscal and financing facilities (Legislative)	1. Creating functional models (universities, legislative framework). 2. Land identification (public / private), land conversion, infrastructure construction - roads, fencing, utilities, plots (DAJ, local councils). 3. Identification of applicants (associative organization of applicants) (DAJ, NGO). 4. Organization of operations (funding, inputs) (Applicants' associations)	Legislative regulations - directives (MADR). Replacement of chemical pesticides with organic products (Farmers)
2030 **CEA (Controlled Environmental Agriculture) (greenhouses) Close control environment agriculture, vertical farming.**	**2035** **Legislation of eco-food education in schools (curriculum, food acquisition / purchase)**	**2035** **Specialists in farms and or outsourcing services (the "heavy" ones)**	**2035** **Blockchain technology for traceability of the final products**
1. Interior design (Real estate). 2. New companies in the agricultural sector. 3. Implementation of modular greenhouses (retailers in Romania). 4. HORECA - modular greenhouses. State subsidy.	How to educate children on the production and consumption of eco-food (Ministry of Education, MADR)	Creating and supporting courses for farmers. Creation of programs aimed at knowledge exchange (agricultural directorates, town halls, certification and control bodies, farmers)	Collaboration between key actors (farmers and software developers) to facilitate access to such easily usable and implementable technology. Communicating the benefits of such technology to the end consumer through PR & Marketing companies

Table 11 (continued)

Vegetable cropping systems	Vegetable value chain	Farms structures in South South-East Romania	Agro equipment and digital technologies
2030 **Building up soils**	**2030** **Digital platform. Digitization. Creating informative HUBs (info about who, where, what produces ..)**	**2030** **Sustainable diversification, Smart crops with perennial vegetables and green manures**	**2035** **Crop monitoring in the production areas - field, greenhouses, solariums** **Specialized training for farmers in the use of new equipment.**
Soil: crop rotation - diversification. Inclusion of green crops / protection. List (product catalog). Amendment. Windbreaks. Reforestation (Actors - farms + MADR).	IT team co-op (Ministry Department). Data collection, Organization of farmers' information campaigns, Organization of consumer information campaigns (MADR, DEJ, AFIR, Certification companies, Social media)	Law / Agricultural policy for the obligation to diversify on farms (2025-MADR). Organization of demonstration fields + technology transfer in each region (2027 - Universities, experimental stations, technology). Awareness campaigns (MADR + universities + input companies).	Research. Training. Technical solution. Financing (EU, banks, etc.). Private IT companies - equipment suppliers. Farmers who have already been advised how to use the equipment. Agricultural high schools and universities in the field + researchers from different fields.
2030 **Increasing biodiversity in horticultural crops in order to reduce the incidence of diseases and pests (Plant Association)**	**2028** **National market policy on vegetables***	**2028** **Family farms organized in a cooperative system**	**2030** **Biological control as a standard in plant protection**
1. Carrying out cultivation plans that take into account all specific factors (eg allelopathic effects) by introducing new species that do not have the same specific pests (horticultural engineer). 2. Obtaining a varied assortment and identifying the sales market and consumer education (PR & Marketing). 3. Collaboration with research centers and introduction in the culture plan of acclimatized species inside them (researchers / research centers). 4. Use of repellent species with multiple functions (horticultural engineer).		1. Financial support for the development of production through local programs (European Commission, MADR). 2. Financial support for infrastructure provision (logistics storage facilities, protected cultural areas) (European Commission, MADR, ADR)	Biological control: bringing natural enemies into the culture. Use of beneficial bacteria. Educating / informing farmers.
2033 **Water preserving methods applied in 35% farms***			

Table 11 (continued)

Vegetable cropping systems	Vegetable value chain	Agro equipment and digital technologies
2025 **Farmers education programs are in place**	**2025** **Providing logistics locally**	**2030** **50% reduction in chemical pesticides. Monitoring of the concentration of nutrients and soil microecosystems**
Information by organizing workshops, demo lots (university staff, academics, research, local council, town halls, associations, agricultural agencies). The obligation by legislative means for a majority of the culture to be achieved in an ecological system. Providing free specialist advice for organic crops (researchers, engineers, teachers). Promoting through the media the nutritional benefits due to the consumption of organically grown vegetables (Ministry of Health, MADR, MEC, Media Institutions). Financing.	Association of farmers in various forms, Creation of warehouses (Farmers, local authorities, central authorities)	Carrying out periodic inspections by taking soil and fruit samples (Agencies with specific activity). Cultivation of varieties and hybrids with resistance / tolerance to the attack of pathogens (Farmers, producers, research). Implementation of biofertilization programs (Research). Improving the range of ecological control products (Research, farmers). Cultivation of varieties / hybrids adapted to super-intensive ecological crops (Farmers, research, academia)
2025 **New production spaces with specific monitoring. Construction of renewable energy modules for new equipment**	**2023** **Food education programs in schools run by volunteers with the school teaching staff***	
2022 **National and regional organization to coordinate, monitor the transition and secure fundings**		

*Milestones added post-workshop

List of acronyms:

DAJ = Directia pentru Agricultura Judeteana = Direction for county agriculture

MADR = Ministry of Agriculture and Rural development

ADR = Agentie de Dezvoltare Regionala = Agency of Regional Development

DEJ = Directia economica Judeteana = Direction for County economics

AFIR = Agentia pentru Finantarea Investitiilor Rurale = Agency for Rural investiment financing

MEC = Ministerul Educatiei si Cercetarii = Ministry of Education and Research

Table 12: List of non selected milestones

FOOD VALUE CHAIN
Access to digital technologies and equipment to enable rapid analysis of quality indicators
Organization ... On farms (at harvest time). Introduction of organic vegetables in hospitals and kindergartens.
Simulation of the application of new concepts (permissive legislation, subsidies)
Cold storage
Introduction of organic vegetables in hospitals and kindergartens
Short chains in conjunction with the cooperative's distribution channels
Legislating consumer education
Organizing workshops in organic farms
Education - producer - final consumer
Supporting the association
Involvement of children and depressed people in farm activities
Public policies adapted to the type of family farm
"Production cabinets" of aeroponic production available through funding programs for each community
Increasing digital skills in manufacturers
The obligation to provide food in the public system from local sources
Education - information through: practical applications up to the farmer and consumer level. Objective: close connection
Composting points every km in cities
Consumer education
FARM STRUCTURES
Conservation of useful entomofauna
Biological control
Promoting and applying the "biodynamic farm" principles
Diversified production. Smart crops with perennial legumes and cover crops and green manures. Biological control (fungi, bacteria) + predatory insects. Conservation of useful entomofauna.
Developing a national marketing strategy
Information - education platforms for organic farming
Introduction of technical quality monitoring systems
1000 adopted farms + “pick yourself”
Education - producer - final consumer (direct, without intermediaries). Family farms (development of strategies for capitalizing on production)
CROPPING SYSTEMS
Increasing yield per m2 by managing crop cycles over one year (2030)
Financial support, partial subsidization of cropping systems (2022-2030)

Integrating multi-use species into culture (2030)

Restoration of soil fertility according to the degree of degradation (2022-2050)

Complete green & circular economy in the CEA type of agriculture (2025)

(Creating) support programs for producers and guidance towards the association with various financial incentives. Creation of regional warehouses and communication channels between farmers. (2030)

Diversification of eco products for pathogens control (2030)

Crops with specific directions of use (2040)

Use of robots for harvesting. Integrating self-learning software into technology (2040)

Prioritization & staging of crop systems for varieties, species (2022-2050)

Mechanized / robotic harvesting. Resistant varieties. Blockchain systems for implementing PPP strategies. (2050)

Diversification of cultivation systems according to logistical capacity (2050).

AGRICULTURAL EQUIPMENTS AND DIGITAL TECHNOLOGIES

Artificial intelligence & visual recognition in the monitoring system of the cropps

Financial support for the purchase of equipment (2022-2030)

Accessibility to new information. Current Business Promotion Opportunities (2030)

Defining specific technical means (their choice) (2022-2030)

VI.4.2- Discussion points about the milestones and actions

Vegetable cropping systems

One of the key milestones identified in the transition towards chemical pesticide free vegetable cropping systems is the **increase in the biodiversity in farms**, by building up specific crop schemes (through collaboration with research teams), introducing new species combinations, a varied assortment of crops including repellent species. This will require collaboration between stakeholders, development of technologies easy to use and implement, and policies supporting crop rotations, flower strips, use of innoculants (micro-organisms) …

Another important milestone is "**building Soils**" which requires monitoring through soil samples analysis and controls, crop rotation and diversification, inclusion of green crops for soil protection, windbreaks, reforestation among others.

The pest management evolves progressively with two milestones: a 50% reduction in use of pesticides facilitated by the diversification and association of plants, and then 100% reduction (ie. total suppression). These require the **availability of organic pesticides**, the development of **resistant varieties**, and **state support** for the transition. Support to farmers comes from public subsidisies, free specialist advice, demo lots, strong collaboration between researchers and farmers.

Vegetable supply chain and consumers education on food and nutrition

In the past there was no or little supply chain management for vegetables in the region, but progressively connections are beginning between manufacturers, traders, processors. In order to implement short supply chains by 2050 there is a need to set up a **legal / regulatory framework** that will define and then support its development through subsidies… then, **digital platforms** will be created in order to share information and communicate about these short chains, evolving to IT platforms and blockchains. A series of economical instruments - national, European public subsidies - can support this transition, activated through the future CAP reform starting in 2028.

Also, **consumers education** about the importance of healthy diets is a very important action, through media campaigns, children education curriculum.

Farm structures

Similarly, a **legislative framework for family farms** will enable the support of their development and create an environment favorable to the cooperation: association of farms, small producers joining and working together. This **association of farms** in cooperative systems is supported financially, both for its production and for the infrastructure provision.

The group also proposed a milestone related to **microfarms**, where people produce their own vegetables. People can refer to demonstration models, and they have access to a platform with all the information needed to produce vegetables. These microfarms can be set up in urban areas or in the countryside close to the cities. These microfarms are developed by local associations interested in the program. They form a new business model.

Milestones and actions related to agro equipment used in vegetable production

Milestones and actions on agro-equipment aim at putting in place relevant monitoring tools in the different vegetable production areas, in order to be able to get precise data on soil, plant microbiomes, as well as nutrients. This requires research, innovation and training of farmers for adoption of these tools. There is also a milestone related to use of renewable energy for controlled environment agriculture (CEA) systems.

VI.4.3- Transition pathway towards chemical pesticide-free vegetable production in SSE Romania

In the last session of the workshop, the two groups gathered in order to build the transition pathway. They were asked to organize chronologically the milestones and actions as identified in the previous sessions, and articulate them logically in the timeline. The system is not split into components anymore. The group 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. 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. 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 the group gathered around the pathway and the facilitators asked whether some additional milestones were needed. This allowed to re-organize slightly some milestones, but no other milestone was generated. The transition pathway produced at the end of the workshop is in appendix 1.

After the workshop, the transition pathway was translated and transcripted on an excel document (version 1 of the transition pathway). Then, this version was studied by the foresight team, considering the logic, and coherence with the scenario. This allowed to build a second version of the pathway, where the milestones related to public policies, governance, and education & AKIS were reclassified with new colors. Also, while keeping the order and year allocated for each milestone (and actions), the pathway was re-organized to make it easier to read. Some modifications to the milestones were proposed, in order to be closer to the scenario and to the trends identified in the retrospective analysis. Appendix 4 provides the detailed final version of the transition pathway.

This new version was presented and discussed with the regional coordinators in a meeting on September 14th. During this meeting, several items of the transition pathways were discussed and helped building its final version.

<u>Discussion on the position of some milestones in the transition timeline</u>

The milestone **« National organization to monitor the transition and securing funding”** was moved earlier in the transition since coordination, monitoring and fundings will be necessary from the start of the transition.

Similarly, the milestones related to “**short chain implemented**” and “**microfarms in cities vinicity**” were also moved earlier in the transition.

Role of Controlled Environment Agriculture in the 2050 vegetable production and in the transition

Although open fields will remain the majoritary practice in 2050 in SSE Romania, Controlled Environment Agriculture (CEA) is described in the 2050 scenario (« Vegetables are grown in open fields and protective spaces (greenhouses, solars, etc)". Indeed, in 2050, it is anticipated that CEA such as vertical farming will have a significant share in vegetable growing. This year – in October 2022 – the biggest vertical farming facility in Eastern Europe has opened[6].

In the transition pathway, several milestones related to CEA have been produced by participants in the workshop:

- In 2040 : Hydroponic agriculture.
- 2022: CEA (greenhouses), vertical farming. New production spaces with specific monitoring. Construction of renewable energy modules for new equipment.
- 2028: Crop monitoring in the production areas - field, greenhouses, solariums.

Vertical farming, hydroponic agriculture have the advantages of allowing pesticide free production and elimination of chemicals. In addition, efforts are being done and will increase in the coming years to reduce their energy consumption (UV light, LED bulbs …).

The transition pathway has therefore been completed to include a line dedicated to the transition of the Controlled Environment Horticulture, as part of the cropping systems. The transition of CEA for vegetable growing will require consumer's education to make these new production schemes known and accepted by consumers. Research is also needed to study the nutritional quality of these vegetables, in comparison with vegetables grown in open fields.

Transition of the diets and vegetable market

The education of consumers in schools is a very impotant milestone in the transition, as it should contribute to changing consumers' food behaviors towards adoption of healthy diets. The transition pathway was completed in that regard to include « **initiatives for food education run by voluteer profesors** », before the milestone « school curricullum revised to inlcude food education.

In addition, a milestone related to the development of a **vegetable market policy** was added, to develop the market for locally produced vegetables, affordable to all. This will contribute to supporting the development of the local sector, while encouraging the dietary changes towards healthier diets. This question of affordability was identified in the workshop as one of the challenges to achieve the scenario.

Dealing with the impacts of climate change

In the retrospective analysis, future trends related to climate change and water use were identified. Indeed, water use will in the future become a challenge due to climate change. At the moment drip irrigation covers more than 90% of the vegetable sector.

In the transition pathway several milestones will contribute to more resilient cropping systems, more adapted to water scarcity and extreme events such as the management of the soil, the plant holobiont, the crop diversification. In addition, the monitoring of the phenology of the plants will allow to get information about how vegetable plants react to these extreme events, namely late spring frost, summer droughts, and to draw some modelling and provide advice to farmers about sowing dates, varieties selection.

[6] https://www.romania-insider.com/kaufland-ultragreens-first-vertically-integrated-greenhouse-romania, *a partnership between Ultragreens (company producing micro plants and herbs) and Kaufland (supermarket chain) near the city.*

The transition pathway was completed regarding the water management practices by a new milestone: **"new ways of preserving water are implemented in at least 35% of the farms from the region (2030**)". To reach this milestone, the necessary actions are:

- Awareness, education, trainings organized by universities and other stakeholders (as of 2025);
- Input providers opened to affordable solutions implemented in farms (2026) ;
- Recovery and resilience plan for Romania finance projects focused on water management (2024).

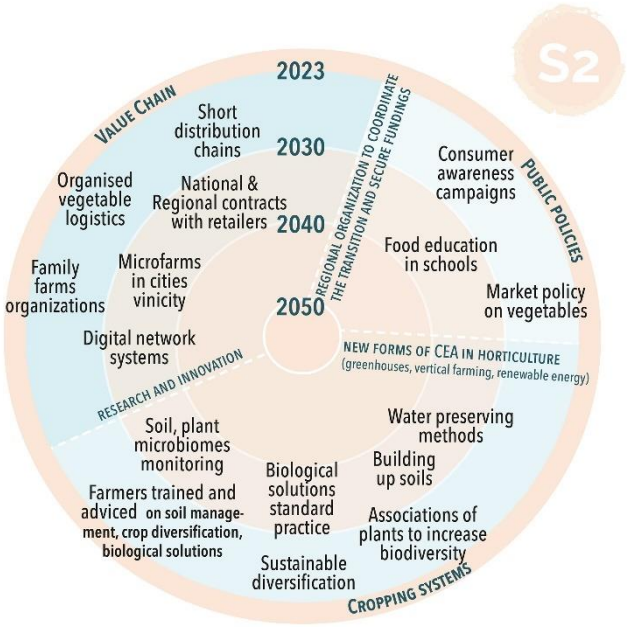
Funding of the transition – "de-risking" the non use of chemical pesticides

To fund the transition towards chemical pesticide-free cropping systems, EU funds can be used, for example through the second pillar (rural development program) of the Common Agriculture Policy. In addition, retailers can implement funding schemes in their contracts with associations of farmers, for example to invest into warehouses. In SSE Romania, some major retailers such as Carrefour, Lidl have recently developed direct contracts with farmers to build big warehouses[7].

Therefore, a new milestone was added "**National contracts between cooperatives / association of farmers and retailers**", completing the transition pathway on the vegetable value chain, by explaining how the association of farmers will manage the supply of the vegetables produced.

Figure 8 (next page) presents the final version of the transition pathway with its main milestones and actions, and the figure 7 below presents a simplified version of the transition pathway.

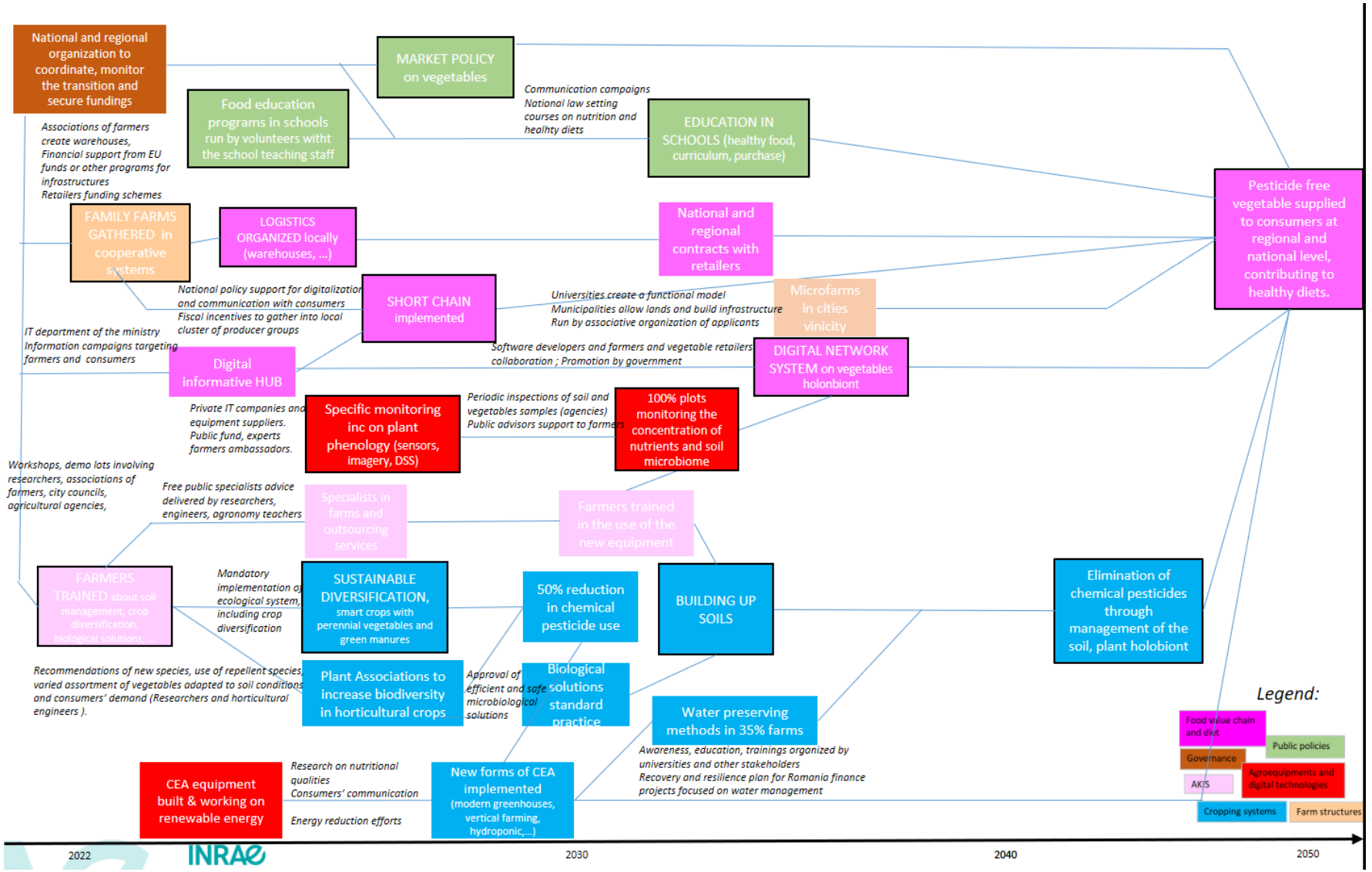
Figure 7: Simplified version of the transition pathway



CEA: controlled environment agriculture

[7] see for example : https://www.carrefour.com/en/news/carrefour-romania-launches-varasti-farming-cooperative : in *2017 Carrefour Romania launched the Vărăști Carrefour Farming Cooperative, the first cooperative of its kind to be supported by a retailer. The Vărăști Farming cooperative is less than 30 km from Bucharest and extends over 60 ha (including 15 ha of solaria), with annual production of some 5000 tonnes of vegetables. The Cooperative brings together vegetables grown by 80 families of farmers from the local region. To ensure that the vegetables and plant products produced by the Cooperative get to customers as quickly as possible, Carrefour has built a 300 m² warehouse in Vărăști in which local farmers can store their produce.*

Figure 8: Transition pathway for vegetable production without chemical pesticides in SSE Romania – final version including additions and changes agreed in the meeting with regional coordinators



VI.5- Narrative of the transition pathway towards chemical pesticide-free vegetable production in SSE Romania

A narrative accompanying the transition pathway has been prepared.

In order to organize, monitor and secure the transition towards healthy diets including pesticide free vegetable consumption, a national/regional ***organization (in charge of implementing the healthy food systems policy)*** *is created. The transition is articulated around four main workstreams on 1) organizing the logistics and supply chain, 2) developing the information systems, 3) the evolution of cropping systems towards the management of the holobiont, and 4) leading consumers' diet change.*

The organization first addresses education of consumers on healthy diets and purchase behaviors. For this, media nutrition campaigns are financed and delivered by the ministry, promoting the nutritional benefits of consumption of pesticide-free vegetables. Also, school curriculum includes courses on nutrition, healthy food. Market policy on vegetables is set up in order to enable the accessibility of these healthy products to all.

The value chain work stream starts as of 2023 with the organization of the logistics locally: associations of farmers create warehouses, with the financial support of local and national authorities through European funds and other programs supported by retailers. Once these warehouses are created, three different distribution channels for vegetables are developed. First, the association of family farms grow into ***cooperative systems****, to share agroequipment, crop and soil monitoring data. They are supported by the national policy for the development of the production, and by European funding for the infrastructure provision (subsidies provided by the holistic European food system policy for logistics storage facilities, protected cultural areas).* ***They contract with retailers*** *for the distribution of vegetables on the* ***national market****. Second, a* ***short chain distribution*** *channel is developed, connecting directly farmers to consumers. Farmers' market, cooperatives local outlets open close the farms. The national policy supports their development, and in particular the digitalization so that they can communicate with consumers through digital platforms. Farmers are encouraged by fiscal incentives to gather into local cluster of producer groups and develop these short chain distribution channels. Third (in the 2040's),* ***microfarms*** *are developed in the vicinity of the cities, for individual chemical pesticide-free vegetable production. Universities together with other stakeholders create a functional model for these farms, municipalities identify and allow lands, protect them, and build relevant infrastructure (roads, fencing, utilities, plots). These microfarms are run by associative organization of applicants.*

To facilitate the development of the vegetable supply chains, and to educate consumers about the importance of healthy diets, information systems are necessary. Digitalization starts with the creation of an ***informative digital platform*** *where data on vegetables are provided by farmers and shared with consumers (who, where, which product). The IT department of the organization sets up the platform, where data are collected from farmers. Information campaigns are run through these digital platforms, targeting farmers and consumers. By 2035, this platform gathers more and more data thanks to the monitoring tools on the vegetable cropping systems. The platform now includes information on the plant holobiont, and becomes a* ***digital network system*** *shared with all the actors of the value chain. Software developers collaborate with farmers and vegetable retailers to facilitate the access to this network and make it user-friendly. The network is heavily promoted and widely adopted by consumers who are now very well aware about the importance of healthy diets.*

The national organization puts in place several initiatives to ***train and educate farmers:*** *workshops, demo lots involving researchers, associations of farmers, city councils, agricultural agencies, …. From 2025, public incentives favor the adoption of vegetable cropping systems achieved in an ecological system, including crop diversification. Farmers are supported in their transition by free public specialist's advice delivered by researchers, engineers, agronomy teachers. This leads to the* ***large implementation of diversification of crops****, use of green manure and* ***increased biodiversity in horticultural crops*** *through plant associations. Researchers and horticultural engineers provide recommendations for introducing new species that do not have the same specific pests, use of repellent species with multiple functions, and varied assortment of vegetables adapted to the soil conditions and to consumers' demand. By 2030, efficient and safe microbiological solutions are approved for use in vegetable crop protection, and Romanian vegetable production achieve* ***a 50% reduction in chemical pesticide use****, according to the regulatory objective set in the food system policy.*

*The digitalization also reaches the different vegetable cropping systems, the fields, the greenhouses... **Monitoring tools** are developed by private IT companies and equipment suppliers. Their adoption by farmers is funded under the "food system policy" and European funds, supplier investment, etc, and facilitated by experts' farmers who have already been advised how to use the equipment. Starting from sensors, satellites information, these tools evolve by 2032 to enable the **monitoring of the soil nutrient and micro-ecosystem** (holonbiont). Agencies provide analytical services based on periodic inspections of soil and vegetables samples, informing farmers about the soil and microbiomes conditions. Farmers – helped by public advisors - use these data to **build up their soils** and adapt their vegetable cropping systems accordingly, to maintain healthy soils (choice of varieties, crop rotations, biofertilization, micro-organisms inoculation, windbreaks, reforestation, …), without the use of chemical pesticides.*

*In 2050, the vegetable production in South South-East Romania has succesfully managed the transition towards chemical pesticide-free practices. In addition to the management of microbiomes and vegetable holobiont at field level, other forms of horticulture have developed according to the food systems policy for a healhty and sustainable vegetable supply. **New forms of pesticide-free horticulture have emerged** such as vertical farming, hydroponic horticulture. Horticulture in controlled environment is now modular and using renewable energy modules developed by new companies. The different value chains deliver these pesticide free vegetables to Romanian consumers, contributing to a large part of their healthy diets.*

VI.6- Overall feedback from participants

At the end of the workshop the regional case study coordinators organized a roundtable among participants, to ask them for one word summarizing their experience with the workshop. The figure below gathers all the words proposed by the participants in a word cloud.

Figure 9: Word clouds of final keywords expressed by participants

After the workshop, the regional case study coordinators sent a questionnaire to all participants to aks for their more complete feedback on the day. There were seven questions asked to the participants: 12 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 usefull 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 5 gives the full details about the questionnaire results. The **overall satisfaction of participants was rated at average 4,75 out of 5**. They overall presentation of the foresight and backcasting methodology, the identification of milestones and of actions were listed as the most interesting parts 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. 92% of them stated that the objective of the workshop was clearly given, and that the backcasting methodology helped to build the transition pathway. More than 80% of them considered that the participatory process succeeded in taking advantage of the different types of knowledge and expertise of the participants. Finally, half of the respondents considered that the time allocated t the discussion among the groups was not enough.

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

- To allocate more time to participants for individual thinking, for discussing within the groups and for networking;
- To send ahead of the workshop some information about the foresight method, examples
- To have a group with participants from all 4 regions, for a permanent exchange of ideas about organic farming and an acceleration of change.

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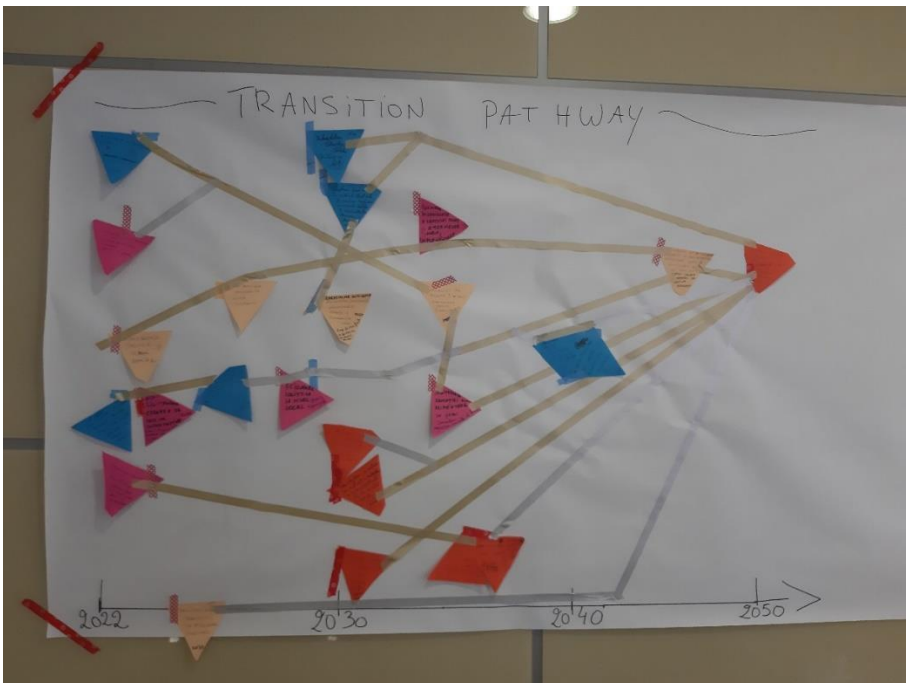
APPENDICES

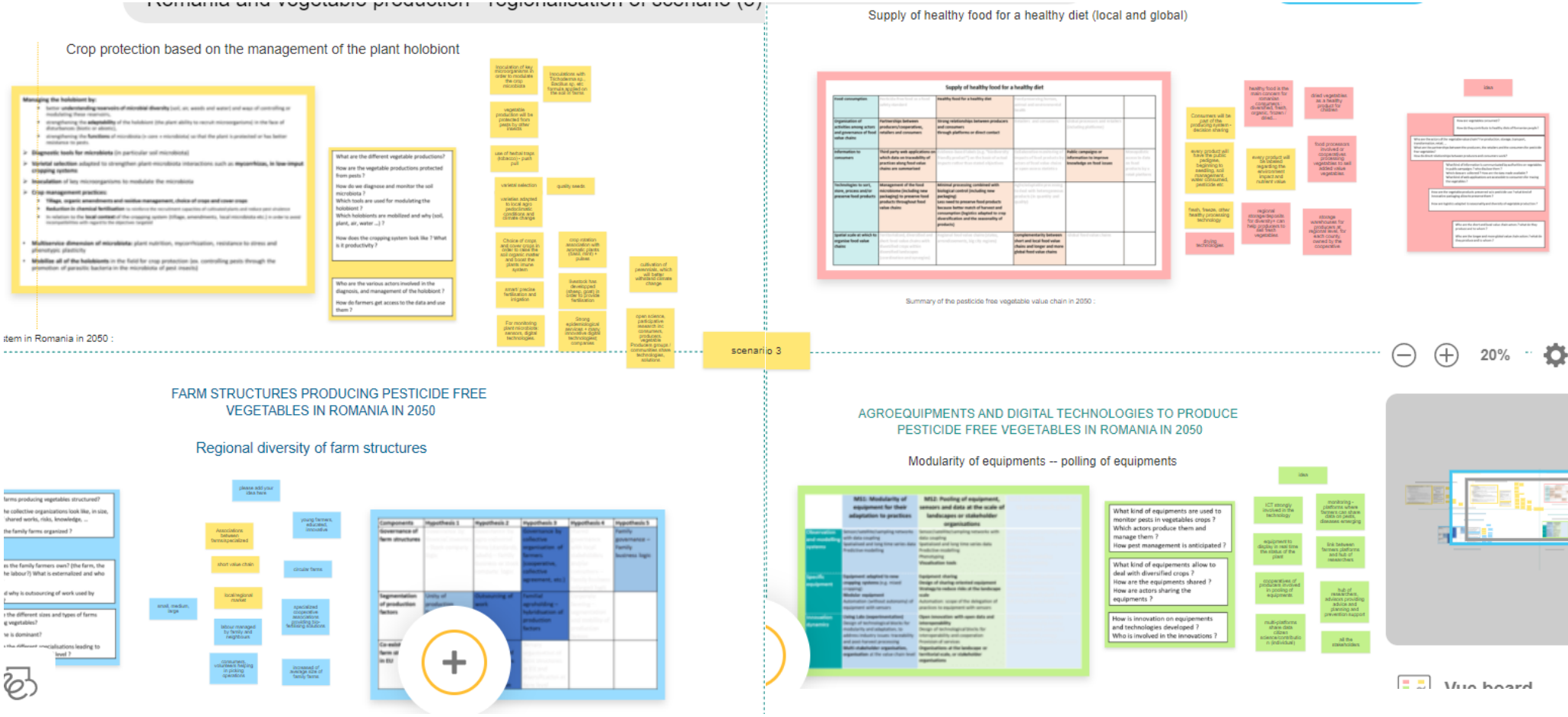
APPENDIX 1 – Pictures from the workshop

Milestones, obstacles, opportunities in cropping systems and agricultural equipments

Transition pathway created during the workshop



APPENDIX 2 – Overview of the klaxon page generated during the “regionalization meeting”



APPENDIX 3 – Detailed outcomes of the group discussions around the scenario

Group 1 discussions over the scenario

KEYWORDS identified by the group after reading the scenario

soil – fertility

(recipes) strategies for farmers to control diseases and pests

Soil monitoring, pests

Sale

cooperatives, other forms

education of farmers

biodiversity, species association

regional warehouses

use natural (organic) fertilizers responsibly

Health

biological control, beneficial organisms

precision agriculture

Varieties

farm typology

distribution chain

Ecosystem

CHALLENGES identified in order to achieve the scenario in 2050

Farmers' reluctance

lack of training of farmers

food education

Retail

poor technology

(global warming / climate change)

socio-economic factors

small number of protected areas

lack of associations

vegetable diversity

Legislation

CLARITY OF SCENARIO 4

SUGGESTED ADDITIONS

coherence, clarity, restructuring

link manufacturers - big cities (infrastructure)

urban agriculture

Hyperlocation

Pollution

spectrum of varieties / alternative cropping systems

short chain, ...

legislation (development, differentiation), guided (dotted)

Clarity integrated pest strategies

Group 2 discussions over the scenario

KEYWORDS

Health

Fertile soil - microbiome

family farms / association

short chain of capitalization

education

information (dissemination of research results)

social character

resistance to change

products / processing units

legislation

support

digitization and blockchain

brand and marketing

storage

logistics

CHALLENGES

resistance to association

educating small producers and consumers

legislative framework

culinary education

buyers vs. Consumers

CLARITY OF SCENARIO : 5

SUGGESTED ADDITIONS

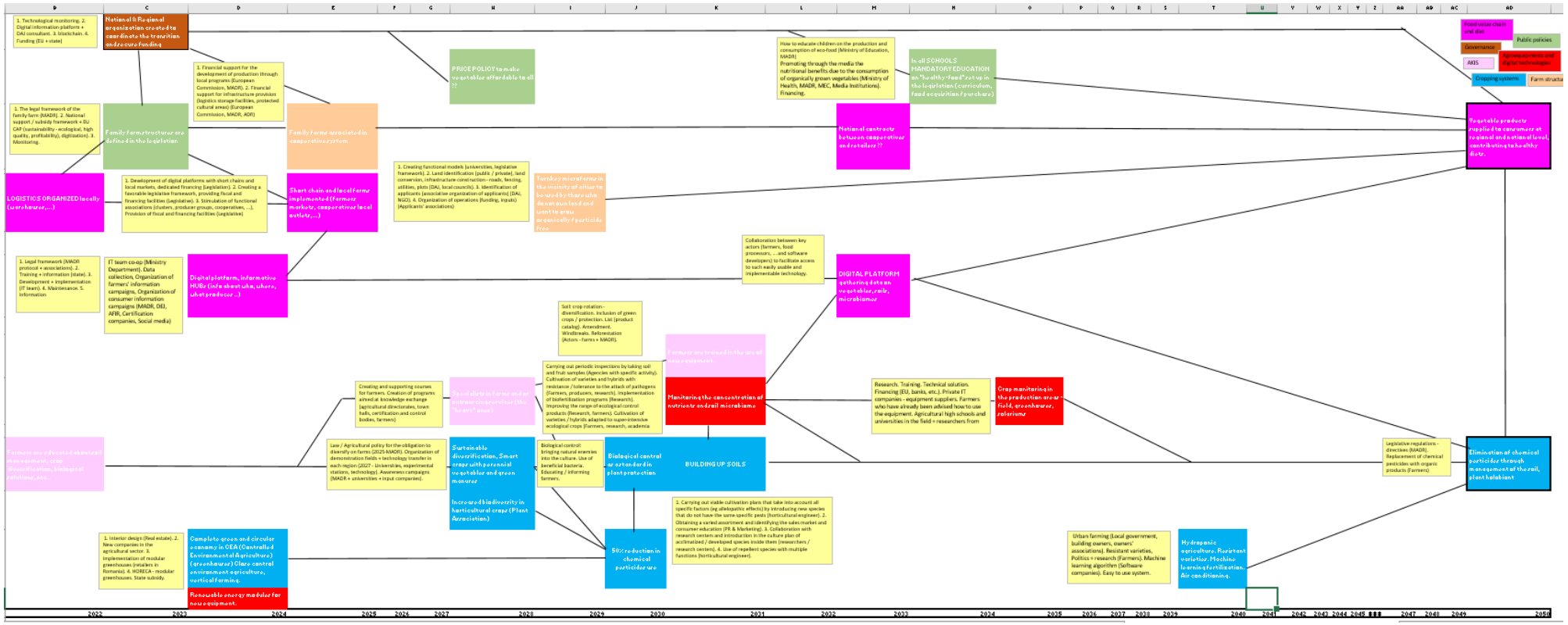
Cooperation between producers, consumer, legislator, education and research, quality assurance

technological innovation (robots)

social issues - community supported agriculture (CSA)

urban horticulture

APPENDIX 4 – Transition pathway (including milestones and actions)



APPENDIX 5 – Detailed results from the survey conducted after the workshop

Nom	**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 to 5*	**How usefull was the workshop for your work ?** *Please rate from 1 to 5*	**Do you think you will use the outcomes of the workshop in your future work ?** *Please rate from 1 to 5*	**Do you agree with the following statement?**				**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	
INCONNU	5	1-Overall presentation of the foresight and backcasting method/5-Building transition pathways	5	5	2	I totally agree	I totally agree	I totally agree	I disagree	Leave more time for networking.

INCONNU	5	3-Activity on identification of milestones, opportunities and obstacles/4-Activity for identifying actions and actors/5-Building transition pathways	4	4	5	I totally agree	I totally agree	I totally agree	I totally agree	53 / 5,000 Translation results I consider the current form of organization correct and useful
INCONNU	4	3-Activity on identification of milestones, opportunities and obstacles	4	4	5	I totally agree	I totally agree	I totally agree	I agree to some extent	The participants need more time to think about the activities (the main ones)
INCONNU	5	1-Overall presentation of the foresight and backcasting method/2-Scenario presentation and discussion/5-Building transition pathways	5	5	5	I totally agree	I totally agree	I totally agree	I totally agree	-
INCONNU	5	4-Activity for identifying actions and actors	3	3	4	I totally agree	I totally agree	I totally agree	I mainly agree	Give a bit more time for discussions in the initial part. Maybe a breakdown in sub-grups of 2-3 persons will improve the dynamics.

INCONNU	4	1-Overall presentation of the foresight and backcasting method	5	1	2	I totally agree	I totally agree	I agree to some extent	I disagree	Double the time
INCONNU	5	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-Building transition pathways	5	5	5	I totally agree	I totally agree	I mainly agree	I mainly agree	It would be interesting to have a group with participants from all 4 regions, for a permanent exchange of ideas about organic farming and an acceleration of change.Thank you!
INCONNU	5	3-Activity on identification of milestones, opportunities and obstacles	5	5	5	I totally agree	I totally agree	I totally agree	I totally agree	more time allotted to the workshop

INCONNU	5	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-Building transition pathways/6-Other	5	5	5	I totally agree	I totally agree	I totally agree	I totally agree	5
INCONNU	4	1-Overall presentation of the foresight and backcasting method/3-Activity on identification of milestones, opportunities and obstacles/4-Activity for identifying actions and actors	3	4	4	I mainly agree	I mainly agree	I totally agree	I totally agree	I think you should focuse more on the profile, history and challenges for each country

INCONNU	5	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	5	5	I totally agree	I totally agree	I totally agree	I totally agree	Congratulations to the organizers!
INCONNU	5	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-Building transition pathways	5	5	5	I totally agree	I totally agree	I totally agree	I mainly agree	adding pre-workshop some animated/short examples/ideas - very shortly about foresight examples, for easier translate the participants in the future thinking

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