cities2030

D3.3 Systems Thinking Methodology

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Revision history

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Executive Summary

The purpose of *D3.3 Systems Thinking Methodology* deliverable is to incorporate a precise framework for the implementation of a methodological CRFS systems thinking and scenarios interventions in reference to systems dynamics. The report is based on co-creation and innovation activities which aim at learning the issues of urban food systems starting from the stakeholders within these systems. If the methodology is built on the systems thinking approach, the philosophy behind this report rests on the idea that stakeholders are already in possession of a deep knowledge (yet in a latent state) of urban food systems and this dormant knowledge can be uncovered with the help of themes and narratives related to Urban Food Systems.

From a structural perspective, the report is divided into three large chapters, namely:

- The first chapter (Introduction) briefly introduces the CITIES2030 project and the ways in which Task 3.4 meets the concept and objectives of this project, according to the systems thinking methodology.

- The second chapter (Methodology to Develop Systems Thinking) presents the methods and models employed during the activities run within Task 3.4. Furthermore, the stages and ways in which these methods and models were used for running the co-creation, innovation, and formative activities are also shown. The Methodology is based on an iterative Project Based Learning and a Data-driven approach to design and implement systemic transformation in CRFS through data and text mining.

- The third chapter (Result & Lessons Learned & Next Steps) shows the results obtained within the activities of Task 3.4, unforeseen circumstances, impact upon beneficiaries of these activities, and the possible developments or implementations of the used models and framework developed for urban food systems thinking. It focuses on the CRFS Logic Framework Approach (CLFA) developed internally and the iceberg model. The main findings are listed below.

Based on the debates from Tutorial I and Tutorial II, organized within Task 3.4, the following conclusion has been reached: the stakeholders, in the coming activities organized in the project, should be regarded as either change actors or transformation agents. This approach is closely connected to the idea that change means mainly short-term modifications of certain issues in the urban food system, while transformation concerns radical modifications on medium and long-term within an urban food system.

Concurrently, for the following activities focused on innovation and knowledge transfer, the Quadruple or Quintuple Models can be quite useful for interacting with stakeholders and facilitators. To secure community building durability, policy and living labs which are to run activities based on the simulations and instruments created in Task 3.4, it is recommended to increase the durability level of these labs, so they can continue the activities in the post-implementation period of the project.

Regarding the intended results, and in agreement with the objectives of Task 3.4, we expect this report to become an effective tool for the experiments of CITIES2030 (CRFS living and policy labs developed within the working packages 4 and 5). Simultaneously, the framework suggested in Task 3.4 can be used in other projects or institutions beyond CITIES2030 projects, in activities such as data collection and structuring, and also engaged in the systemic understanding of the urban food systems.

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Applications

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- Padlet: https://padlet.com/dashboard
- Google Drive Excel workbook
- Minitab 20, Statistical & Data Analysis Package: https://www.minitab.com/en-us/products/minitab/
- Microsoft Power BI: https://powerbi.microsoft.com/en-us/

Abbreviations

CIL	CRFS Intelligence Lab
CITIES2030	Project CITIES2030
CLFA	CRFS Logic Framework Approach
CRFS	Cities and Regions Food Systems
CRFS-LL	Cities and Regions Food Systems Living Labs
CSA	Community Supported Agriculture
EIP	Extended Innovation Pattern
FAO	Food and Agriculture Organization of the United Nations
FSE	Food Systems and Ecosystems
FSD	Food Systems Dimensions
GI	Geographical Indication
GYO	Grow Your Own
IMA	Impact Analysis
KPI	Key Performance Indicator
NLP	Natural Language Processing
PBL	Problem Based Learning

PESTLE	Political-Economical-Social-Technology-Legal-Environment
PGI	Protected Geographical Indication
PDO	Protected Designation of Origin
SFSC	Short Food Supply Chains
STW	Systems Thinking Workshop
TSG	Traditional Speciality Guaranteed
UFSP	Urban Food Systems Policies
WP	Work Package

Methodology: Systems Thinking (Urban Food Systems Thinking)
Models: Food Systems Dimensions, Iceberg, PESTLE, The 4 Pillars of Food Security

1. Introduction

1.1 CITIES2030 project concepts and methodology on systems thinking

CITIES2030 responses on programme H2020-EU.3.2.2. — Sustainable and competitive agri-food sector for a safe and healthy diet, topic CE-FNR-07-2020 - FOOD 2030 — Empowering cities as agents of food system transformation[1].

The very first scope of the call CE-FNR-07-2020 is to *support cities and its peri-urban areas develop and implement Urban Food Systems Policies (UFSP) to meet the FOOD 2030[2] goals*. The UFSP improvement, development and sustainable transformation is in the focus of the call.

CITIES2030 response on the first scope is: "CITIES2030 generate a comprehensive set of result-driven, actionable and deployable instruments to support cities: an observatory on UFSP (intelligence), a tailored Systems Thinking Methodology, a community of practice, policy and living labs, capacity building programmes, blueprints, an investment action plan, business models, a digital impact monitoring and action tool, a data-driven Cities and Regions Food System (CRFS) management blockchain platform, to name but these few."

CITIES2030 defines a total of 12 concepts which are to be applied to the project. All the 12 concepts refer, explain or include either systems thinking or food system or both. System thinking, food system, and the aim to direct transformation are thus deeply embedded transversally in the project concepts and implementation. CITIES2030's 12 concepts are listed below:

- (a).1 - On the complexity of Food Systems and Ecosystems (FSE)
- (a).2 – On the need for FSE resilience
- (a).3 – CITIES2030 dynamic CRFS management solution
- (a).4 – Harvesting and structuring CRFS intelligence
- (a).5 – Policy and living labs to facilitate co-creation and production
- (a).6 – Future-proofing CRFS in pilot cities
- (a).7 – Securing efficient learning environments
- (a).8 – Setting accurate CRFS indicators
- (a).9 – Blockchain-based technology
- (a).10 – Citizen-driven
- (a).11 – Positioning
- (a).12 – Synergies and/or links with international research and innovation activities

CITIES2030 assists cities and regions to implement sustainable cities and regions food systems (CRFS) and achieve five specific objectives (Figure 1).

[1]https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/ce-fnr-07-2020
[2]FOOD 2030
https://ec.europa.eu/info/research-and-innovation/research-area/environment/bioeconomy/food-systems/food-2030_en

Figure 1. CITIES2030 specific objectives

Bill Gates gives a good reasoning why understanding the big picture is a good starting point. He has written in his book *How to Avoid A Climate Disaster*: "Eventually, I built a mental framework for the things I was learning. It gave me a sense of how much was a lot and how much was a little, and how expensive something might be. It helped me sort out the most promising ideas. I've found that this approach helps with almost any new topic I'm digging into: *I try to get the big picture first because that gives me the context to understand new information*. I'm also more likely to remember it."

CITIES2030 generates innovation action instruments and facilitates co-creation of the solutions (products, services, and mechanisms), with a tailored Systems Thinking Methodology, CRFS Logic Framework Approach (CLFA), which is the deliverable of Task 3.4.

CITIES2030 harnesses directly three work packages — WP3, WP4 and WP5 — to prepare the cities and regions environments, equip resources, to define and experiment concepts and novel solutions and to secure replicability and scalability. All other work packages — WP1, WP2, WP6, WP7, WP8, WP9 — support, amplify and also review and reflect on the work of the three work packages.

WP3 — CRFS INTELLIGENCE aim is to create knowledge that is structured and actionable, and which valorizes the urban food system broadly. The knowledge creation process input is gathered from the project partners, food system and city/region multi-actor stakeholders, past research, and deep dives into specifically defined topics (Fig.2). One of the WP3 outcomes is CRFS Intelligence Lab (CIL), an observatory on sustainable urban food policies. WP3 implements the participatory (multi-actor) design and production of policy and living labs. Labs develop in groups of 4 key actors of the urban food system environment with the city/region acting as driver, incorporating one research body, a business, and a civil society organization. WP3 structures ten (10) working groups based on the FAO-UN CRFS concept. Accordingly, the CIL data is structured in 10 key categories by dedicated working groups. 6 categories reflect the supply chain as such (e.g. from production to waste), and 4 work on correlated key arenas. The working groups tackle key themes of the food system arena and corresponding operations, within result-oriented workshops activities to compile stakeholder requirements elicitation and deliver pathways towards sustainable CRFS developments.

Structured intelligence creates preconditions for the System Thinking activities that will take place in policy labs (WP4) and living labs (WP5) which aim at enhancing foresight and consolidating development scenario analysis on food systems, e.g. future-proofing sustainable and resilient food systems. WP4 implements the anticipated Systems Thinking Methodology, CRFS Logical Framework, within 5 on-site and 5 online events, a solid and result-oriented instrument to facilitate co-creation mechanisms in 10 identified thematic and corresponding working groups. WP4 ensures the reaching out of 50+ cities. WP5 executes participatory and practice oriented innovation procedures at Living Labs to explore, build and experiment improvements, best practices and innovations on the CRFS value chain, and on the food system as well. The aim is to facilitate the systemic transformation in CRFS.

Figure 2 presents the aims and synergies of technical work packages (WP3, WP4 and WP5) to explore, embrace, and implement systems thinking into CITIES2030.

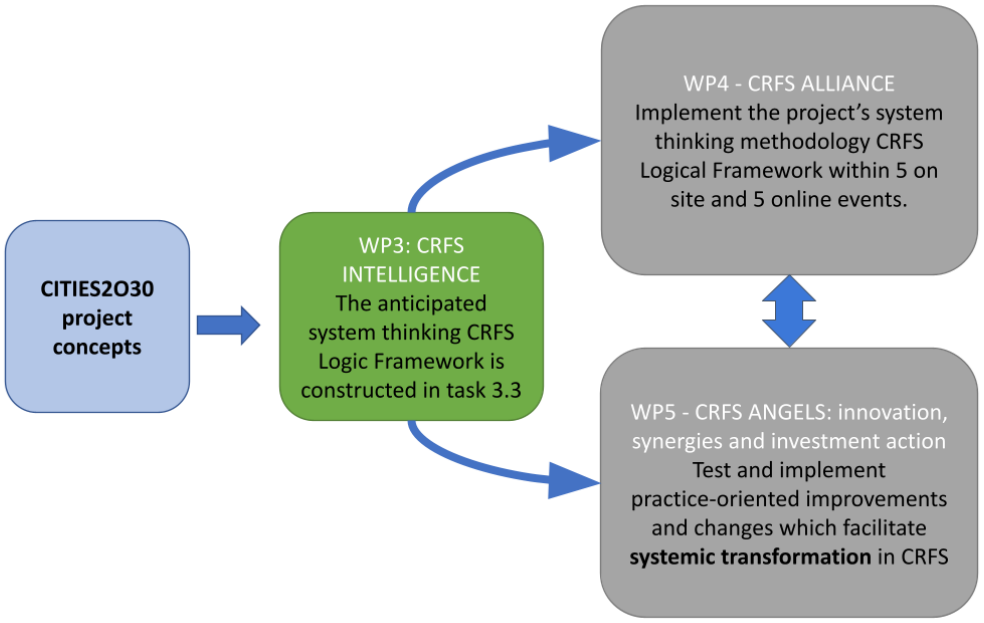

Figure 2. Synergies of work packages 3, 4, 5 to facilitate CRFS transformation

1.2 Objectives of the Task 3.4 on Systems Thinking Methodology

1.2.1 Co-creation of the CRFS Logic Framework Approach (CLFA)

The task 3.4 and the deliverable 3.3 are defined in the Grant Agreement as follows:

Discuss a methodological framework for CRFS systems thinking and scenarios interventions, based on systems dynamics [1]: what (problem structuring), why (influence diagrams to demonstrate the relationship between variables), how (dynamic modelling, e.g. develop high-level systems diagrams, define variable type), within (scenario planning and modelling).

CRFS Logic Framework Approach (CLFA), practised in all co-creation processes hosted by WP4, WP5 and WP6, promotes exploring CRFS inter-relationships (framework and connections), perspectives and boundaries (agreeing on the meaning of scope, scale, enhancement, approach, mechanisms, etc.).

Produce and submit a deliverable D3.3 — Systems Thinking Methodology provision which is a report to incorporate a precise framework for the implementation of a methodological framework for CRFS systems thinking and scenarios interventions, based on systems dynamics.

2. Methodology to develop systems thinking

2.1 Participatory and multi-actor approach to raise awareness and build capacity on systems thinking and CRFS

Problem Based Learning (PBL) is defined as follows: ''A learning method based on the principle of using problems as a starting point for the acquisition and integration of new knowledge." The goal of PBL is to close the gap between theory and practice and use problems as a focus for learning science and practical knowledge in an integrated, rather than separated manner [2].

PBL is an activating and collaborative activity that urges participants to think, ask questions, integrate prior knowledge into the common problem analysis, elaborate new knowledge and share knowledge with each other. Although the PBL is conducted in small groups (5-8 people), the groups are to be diverse, multidisciplinary and multi-actor. PBL has a learner-centred approach focused on building problem analysing skills, critical thinking, reasoning skills, self-directed learning and creativity.

In this project, the problem for PBL is "What is systems thinking and Cities and Region Food System? ". The PBL method is used to raise project participants' awareness and build capacity on systems thinking and Cities and Region Food Systems.

Task 3.4 encourages participants to become tutors, in their turn, facilitates co-creation and brainstorming sessions in their contexts (local problem setting and local stakeholders), and uses the facilitation instruments piloted and suggested here.

PBL activities were organized in a scheme (Figure 3) consisting of 3 elements: Tutorial I (step 1 to step 5), Individual Study (step 6), and Tutorial II (step 7 and step 8).

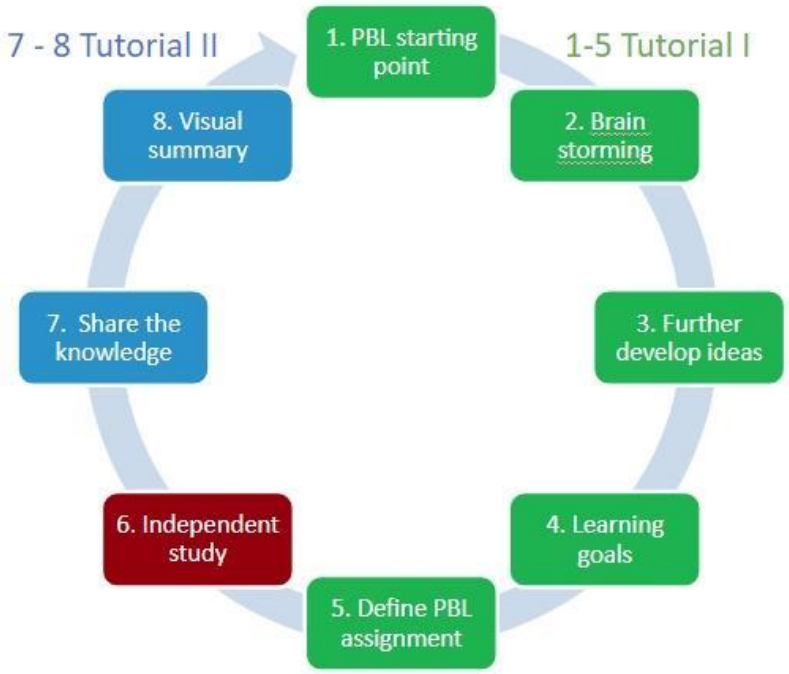

Figure 3. Problem Based Learning (PBL) circle

2.1.1 PBL - Tutorial I

Tutorial I is more co-creation oriented and aims at constituting the conceptualization basis for the innovative framework. This has the following objectives:

- Identifying issues in the System Thinking and cities/regions food systems.
- Establishing the learning goals and an individual learning assignment starting from these over 300 issues for identifying possible action courses.

In terms of methodology, for Tutorial I, in the co-creation process we have generally taken a WHAT & WHY approach. Based on the objectives defined, Tutorial I consisted of the following components:

STEP 1: Introduction of the conceptual frame for the training activities developed within Tutorial I.
STEP 2: A co-creation activity consisting of a brainstorming session with the assistance of Padlet application[3] by adding digital Post-its on the Padlet platform.
STEP 3: Voting the most interesting proposals written on Post-its.
STEP 4: Establishing the learning goals for addressing these issues.
STEP 5: Developing in a collaboration an individual assignment for the group members.

1. Introduction of the conceptual context

The following were briefly presented: City and Region Food System theory, Systems Thinking Methodology and Problem Based Learning methodology. This first component was mainly theoretical, and its purpose was to explore City and Region Food Systems by using Problem Based Learning approach. On the conceptual level, the main aim was to create a novel logical framework for identifying issues and opportunities in food systems and learning the corresponding courses of action.

2. The co-creation activity consisting of a brainstorming session

The kick-off for this co-creation and brainstorming session is the "starting point"- material selected for the purpose of orienting and boosting the ideation capacity of the participants. Within this session, each participant shared some specific issues in their own food systems. With the help of the Padlet app (based on interactive positioning of some Post-its on a digital whiteboard), the participants were invited to put on the whiteboard the main issues identified in their own food systems. Then they were invited to vote for the resulted Post-its. At this stage, the resulting ideas should be considered in terms of phenomenology (taken as such, as they were initially expressed without being subjected to any verification or falsification process). This component is substantially narrative because all participants told their own experiences, yet they were also influenced by the experiences shared by other participants. So, we could very well talk about the narrative basis of the entire process. Starting from this narrative basis, in terms of analysis instruments, we can identify the occurrences to set up the highest frequencies. The same narrative basis can provide data for establishing theme networking for the entire process of co-creation. Based on this activity, it was created the discursive community of the co-creation process. This stage can be regarded as the first level of conceptualization of some issues within the food system.

3. Voting the most interesting issues identified during the brainstorming session

This component had strong cognitive determinants as the participants were influenced by their own affective memory, personal history, and field of activity. This stage could be viewed as the second level of structuring the narrative basis.

4. Discussing the most voted issues for identifying the learning goals and the corresponding courses of action

The participants were invited to identify the learning goals based on the most voted issues (Post-its in Padlet) from the brainstorming session. Similarly, this component had emotional cognitive triggers as the

[3] A brainstorming application: https://padlet.com/dashboard

participants were influenced by their own affective memory, personal history, and field of activity. This stage can be considered as the first level of structuring the learning process.

The definition of the learning goals is the preliminary synthesis of Tutorial I. The synthesis is a mode where the group makes sense of the co-created and shared data and insights. The synthesis i.e. the learning goals is a 'models of reality' to gain a better understanding of the problem at hand and uses it next to formulate the individual assignment which is the final synthesis of Tutorial I.

5. Developing in collaboration an individual learning assignment for the group members.
The individual learning assignment was expressed in a question form. Each group member's task is to provide in the next step (6) their unique and own response to the set learning assignment and continue the exploration and learning pathway in his/her own direction.

2.1.2 PBL - Individual learning assignment

The purpose of step 6 "(Independent Study)" is to give all group members an opportunity for personalized knowledge exploration and study about the learning assignment agreed on in step 5.

The aim is to study independently and, above all, learn more about the topic. The focus is on value-adding learning that is self-directed by the learner. Another aim is that the learner prepares to teach other group members and share his/her opinion and perspective. The concrete outcome of the learning process is a synthesis that is produced by the learner. The synthesis can be a max. 2-page writing, drawing, scheme, figure, poem, video, etc.

2.1.3 PBL - Tutorial II

Tutorial II is oriented on learning and capacity building by implementing social-, peer- and group learning methods. Tutorial II's main objective is to create a social space that promotes trust, openness, and sharing. The final outcome of Tutorial II is a visual summary - a synthesis - that is a mirror of the group's understanding of the set problem. Tutorial II consists of the following two steps:

STEP 7: Sharing and exchanging the acquired knowledge in the group
STEP 8: Closing the PBL cycle in a conclusion rendered in a visual format

7. Sharing and exchanging the acquired knowledge in the group
All group members, one by one, give a presentation based on their study and the summary produced at the independent learning assignment. The length of the presentation is a maximum of 5 minutes. It is complemented by a common discussion that is moderated by the chairperson of the group. The group members' active participation by listening, questioning, and complementing are crucial elements for peer- and group learning sessions. The length of the common discussion is also limited to 5 minutes.

8. Closing the PBL cycle into the conclusion in a visual format
In order to close the PBL cycle, the final task for the group is to summarize the presentations, narratives, and discussions into one visual presentation. The visualisation format is up to group decision and the working environment. When Tutorial II is run in the face-to-face situation then the A1 or A2 size paper and pens are the right and simple tools. If Tutorial II is conducted in the virtual environment, e.g. Google Drive, Microsoft Office PowerPoint provides a simple platform for making the visual summary together.

2.1.4 The Problem Based Learning cycles implementation

The implementation of the 6 PBL cycles is organized into two sequential waves. The first wave: At the beginning of Task 3.4 the forthcoming 5 tutors of the Problem Based Learning cycles are gathered to Group 1. The task of Group 1 is to pilot the PBL cycle and train the participants to become PBL tutors for the next 5 groups. The second wave: The purpose of the five more groups is to test different approaches to systems thinking by using the PBL procedure. The two waves gather a total of 34 of 41 consortium partners, a total of 43 individual participants. 21 of these participants are female and 22 of them are male from 16 different countries.

The tutors of 6 PBL groups gather the non-structural text data that is produced at PBL cycles. It encompasses the background information of participants, kick-off material e.g. videos for brainstorming sessions at Tutorial I, prioritized issues (310 pcs) produced also at Tutorial I, independent learning assignment descriptions, narratives and outputs that participants produced for Tutorial II, and finally the visual summary for each group. In addition, all tutorials (12 pcs) were recorded. This data package is the input to the next step to form a structural framework for CRFS systems thinking.

After the meetings, tutors gathered positive and negative reviews to improve PBL cycles for future usage. The summary of the feedback from participants can be seen in Table 1 below.

Table 1: The participants' feedback on PBL cycles

Positive Reviews	Negative Reviews
• Participants found tutorials interesting. • They like active participation. • They liked working on Padlet. • They like meeting co-workers from the project • They enjoyed hearing a different perspective	• Some participants felt lost during the tutorials. • Some participants found tutorials complex. • Face-to-face might be more effective for these tutorials. • Difficulties to understand self-assignment. • Difficulties to understand visual summary • Organizers were too involved.

2.2 Methodology for analysing data collected in stakeholders workgroups

The methodology used within the activities of Task 3.4 is based on the design of the following narrative scheme (Figure 4). Here are introduced the following:

- levels of activities interaction
- interactions between these levels
- logical circuits of the activities.

The levels are as follows:

- Urban Food System Level: here we come across issues which can be identified as themes or narratives.
- Stakeholders Interface: here the stakeholders can play as actors of the system since they enforce the system or agents since they can change it as well. When they are actors, they are in possession of latent knowledge that can be expressed by themes and narratives of the Urban Food System and turned into unstructured knowledge from the Knowledge Level. When they are agents, they can change the system starting from Urban Food System Deep Understanding.

- Knowledge Level: here are shown the methods employed for collecting data provided by stakeholders.
    - Unstructured Knowledge: within a Living Lab or Policy Lab, data can be collected through working groups with stakeholders, by running co-creation activities. Learning the issues from Urban Food System is made in accordance with the principle of Problem Based Learning.
    - Structured Knowledge: the methods of System Thinking and iceberg Model are applied for data structuring.
    - Deep Understanding: to have a deeper understanding, the Iceberg Model can be integrated with other models. For instance, in the activities run within Task 3.4, the following models were employed: Food Security Dimensions, Four Pillars of Food Security, and PESTLE (slightly modified).

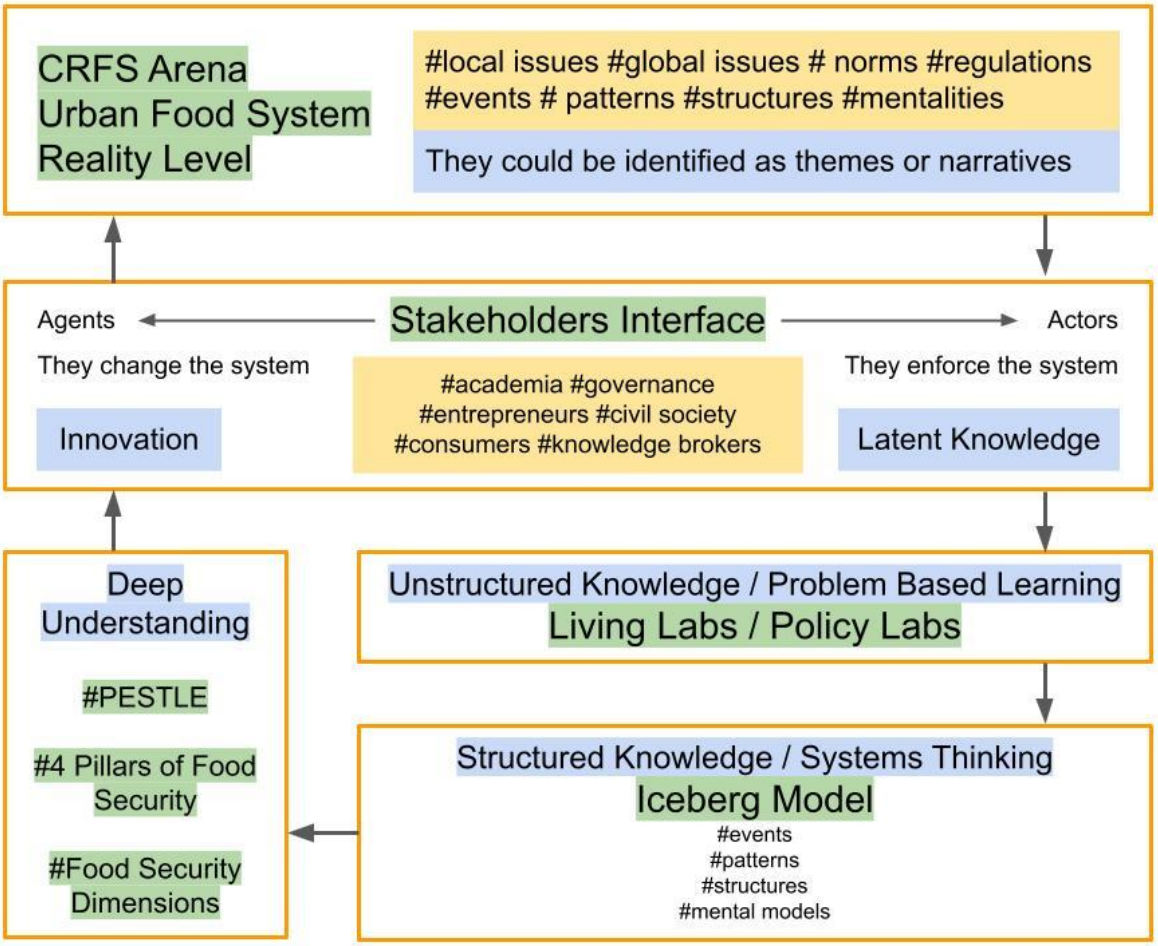

Figure 4. Narrative Schema

Six (6) working groups were formed within Task 3.4, where 3 suggested activities have been developed, namely: Tutorial I, Individual Study, and Tutorial II. Between 6 and 9 persons took part in these above-mentioned tutorials. Therefore, following the six tutorials of type I, 310 issues (problems) were registered in the brainstorming activities with the assistance of the Padlet application and Co-Creation Workbook (Annex A). These issues are linked to food systems which are particular to various regions across Europe (France, Italy, Germany, Slovenia, Finland, Romania, Belgium, Luxembourg, and Spain).

In terms of methodology, Tutorial I has tackled a WHAT & WHY approach.

These 310 issues were divided on codified categories starting from a series of pre-existent models, such as:

- The Iceberg Model with its 4 layers (Events, Patterns, Structures, Mental Models)
- The Food Security Dimensions: Food security, Food safety, Nutrition security, Nutrition safety
- The PESTLE Model (Political, Economic, Social, Technological, Legal, and Environmental)
- The Four Pillars of Food Security Model (Availability, Accessibility, Utilization, Food security stability).

The Iceberg Model has been employed for collecting themes, issues, and narratives from all levels of a food system aiming at getting an analysis in line with systems thinking methodology [3-6].

The Four Pillars of Food Security model, as expressed by FAO philosophy, was used for observing all levels where Food Security influences the consumer, especially in terms of purchase and consumption habits [7].

The traditional PESTLE Model was slightly modified due to the particular nature of the data obtained. Therefore, we went for the following dimensions: Social, Cultural, Political, Economic, Environmental, and Technological. The Legal dimension was excluded and a new dimension Culture was adopted. This moderately altered model was engaged for analyzing the data obtained at all societal levels of a food system.

The Four Pillars of Food Security Model was used for analyzing food systems [8] across all supply chains.

Further, the data were codified based on their semantics too, and a series of themes (organized in mapping or networking structures) were set up.

The data, as they were structured depending on all these previously-mentioned models, were analyzed by integrating 2 models at a time, and the first model of reference was the Iceberg Model. The Iceberg Model provided the possibility of analyzing the dynamics of the issues: singularity (Events), repetitivity (Patterns), institutionalization (Structures), and ideological consolidation (Mental models). The other models (distributed according to the dimensions of the Iceberg Model) were mainly engaged for tracking down the impact of these issues at the level of purchase and consumption, at the level of society and, also, at the level of supply chains.

The results obtained are useful for structuring issues at the level of food systems, with the intention of later expressing them in terms of possible solutions, policies, and strategies.

The Words Cloud of the issues spotted by stakeholders during the six initial tutorials from Task 3.4 can be seen in Figure 5. As it is noticeable, the most frequent themes are related to the following: food, local products, local producers, production, consumers, system, and change.

Figure 5. Soft interpretation of the food systems concepts from the Tutorial I Padlet in all 6 Groups

In terms of activities run within Tutorial I, the focus was on identifying the conceptual framework of a food system. This conceptual framework allows us to observe the connections between the identified issues, and last but not least, the resilience level of food systems (degree of resilience to change and transformation).

Based on this conceptual framework, and for the purpose of running the activities within Individual Study and Tutorial II, the issues expressed here were reformulated in brainstorming activities and brought to a more general level, so they could be used as narratives concerning the food system.

In terms of methodology, Tutorial II, in the innovation process, tackled a HOW & WITHIN approach.

The data obtained within Individual Study and Tutorial II have a narrative approach and were regarded, in terms of epistemology, as data related to the common knowledge of stakeholders at the level of food systems. These narratives form the background of the co-creation of short-term solutions for the identified issues and, also, for identifying medium and long-term policies and strategies.

2.3 Data-driven system modelling

2.3.1 Data-driven approach to design and implement systemic transformation in CRFS

The WP5 deliverable D5.2[4] describes in detail how the Extended Innovation Pattern (EIP) in the figure 6 directs and leverages a data-driven and systematic approach in the living labs development and innovation activities. The theories of systems thinking and system modelling are turned into practical and real-life

[4] D5.2 is prepared and written parallel with T3.1.

measures to benefit city/region food system transformation. This chapter demonstrates how systems thinking, system modelling, data mining and transformation planning meets.

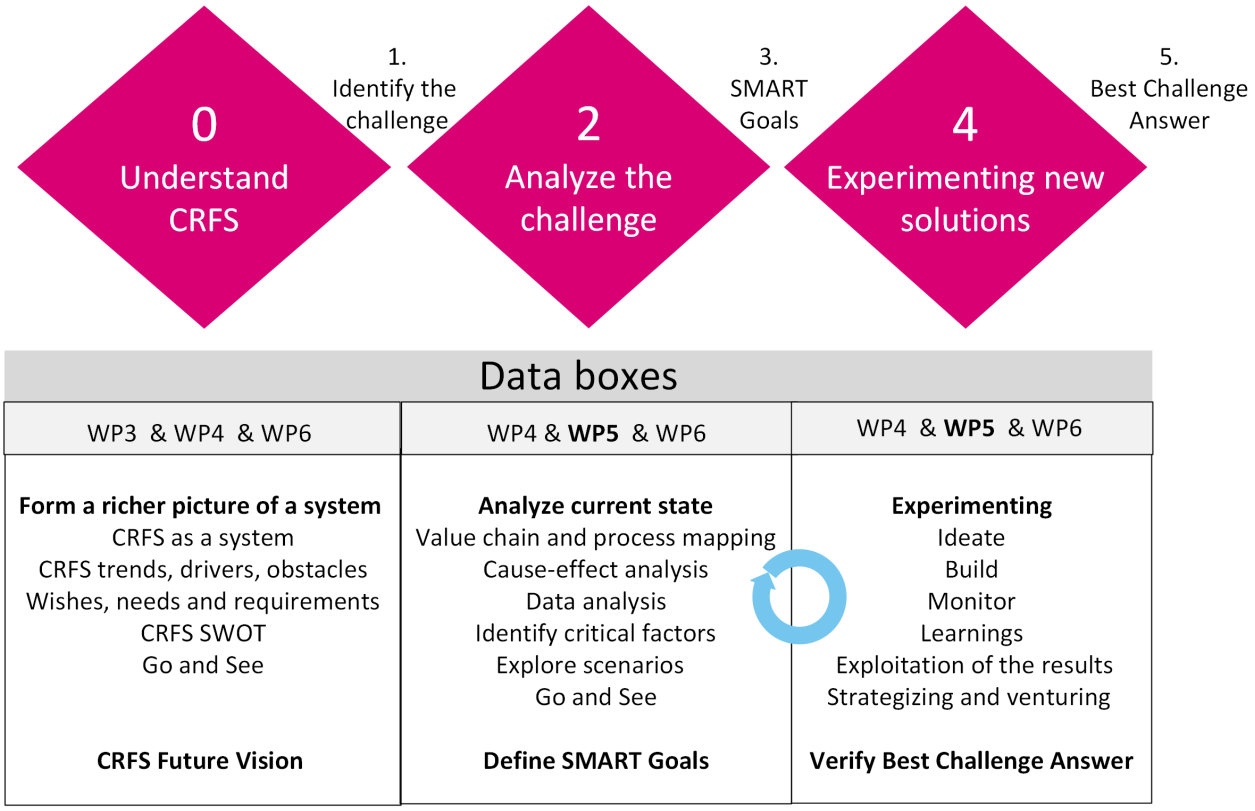

Figure 6. Extended Innovation Pattern (EIP)

Defining accurately the Extended Innovation Pattern (EIP) assists in forming a clear pathway for the CRFS Living Lab (CRFS-LL) experiments for the project time span. To enhance the planning of CRFS-LL activities, engaged actors must have a vision of forthcoming requirements and know the needs from the WP's management side. In addition, it is vital to coordinate and synchronize tasks and results in all related WPs (WP3 to WP6) to generate the maximum benefits for the project's partners and engaged actors, and support their common activities to achieve the project objectives and KPIs.

The objectives for data collection, mining, analysis, and visualizations are two-fold: Firstly, to help to structure a common understanding of the current situation both on city/region food system scope and in selected challenge scope. Secondly, the data-driven approach supports the process to define alternative scenarios and the future vision 2030 for the city/region food system. Data-driven implementation is applied in all **3 sequential diamonds** (Figure 6).

The first diamond: Understand CRFS focuses on understanding the city/region food system at the systemic level. It explores external and internal factors and phenomena to form a picture of the current and future state of CRFS. The first diamond's scope is the broadest of the three. It represents policy-decision and strategic management level. The time span of the execution is year 1 in the CITIES2030.

The second diamond: Analyze the challenge addresses modelling the field of the specific challenge identified by the multi-actor CRFS-LL while they explore CRFS (ref. first diamond). This challenge provides a

frame for the CRFS-LL actions e.g., map processes and functions, recognise variables, gather, categorise, and examine data. The outputs of the second diamond are: a data-based system model, an improved and shared understanding of the challenge's field, and a plan for the CRFS transformation including SMART Goals.

ANNEX B demonstrates a real-life example of what is meant by "Analyze the challenge''. ANNEX B is "A demonstration of data mining — Analysis of the honey value chain in Romania and Finland".

The third diamond: Experimenting new solutions is dedicated to the rapid, sequential and designed experimentation which aim to find solutions to the challenge. Each experiment is planned, built, monitored and analysed by living lab multi-actor participants in a participatory manner. The result of the third diamond is called Best Challenge Answer.

2.3.2 Data mining meets systems modelling

The System Dynamics Method is defined as follows: *"A rigorous method for problem identification, system description, qualitative modelling and analysis of change in complex systems; which facilitates and can lead to quantitative modelling and dynamic analysis for the design of the system structure and control."* [1]. Wolstenholme divided the systems thinking and modelling process into 5 phases [9].

1. Problem structuring
2. Causal loop modelling
3. Dynamic modelling
4. Scenario planning and modelling
5. Implementation and organisational learning

CITIES2030 implements systems thinking and system modelling on City/Region Food System transformation. The aim of Task 3.4 is "to discuss a methodological framework for CRFS systems thinking and scenario interventions, based on systems dynamics defined by Wolstenholme 1997" [9].

Table 2 shows how systems thinking and systems dynamics modelling [1] are built into the CITIES2030 project implementation over the work packages.

Table 2: Systems thinking and systems dynamics modelling at CITIES2030

System modelling phases		**Extended Innovation Pattern**	**Work package**
1. Problem structuring	**What** - understand the system and define the problems and challenges	The first diamond - Understand CRFS -implement systems thinking	WP1 WP3
2. Causal loop modelling	**Why** - influence diagrams to demonstrate the relationships between variables	The second diamond - Analyze the challenge -value chain mapping -process mapping	WP1 WP4 WP5
3. Dynamic modelling	**How** - develop systems diagrams, define variable type	The second diamond - Analyze the challenge -cause and effect analysis -data analysis -identify critical factors	WP1 WP4 WP5 WP6
4. Scenario planning and modelling	**Within** - scenario planning and modelling	The second diamond - Analyze the challenge -explore scenarios -define SMART Goals	WP1 WP4 WP5 WP6

5. Implementation and organisational learning	**Way Forward** - chosen options are converted into action steps which will lead to achieving the set goals	The third diamond -Experimenting new solutions -plan and execute experiments -test scenarios -peer- and group learning	WP1 WP4 WP5 WP6

2.3.3 Text mining to explore Food Systems by using ICT

Task 3.4 developed a cities and regions logic framework approach (CLFA) to gain unstructured, structured, and deep knowledge of CRFS via multi-actor platforms (see the chapters 2.1 and 2.2).

The supplementary input on Task 3.4 is to conduct a literature review addressed to food systems, but not traditionally, but by using a text mining application. The results of the text mining complement the results of the discussions and knowledge transfer obtained at workshops. It's clear that no text mining application can substitute a human researchers' work. However, since CITIES2030 is an innovation action, it is pertinent to seek and test new models also for the information acquisition and research work.

The used application is called Semantic Explorer[5] (SemEx) which is developed at the ongoing PoliRural[6] Horizon2020 project. PoliRural project's title is Future Oriented Collaborative Policy Development for Rural Areas and People. PoliRural is designed to advance rural policy development in the age of disruptive data and technologies. CITIES2030 partner P14 SLEAN is also a PoliRural consortium partner and thus this experiment serves two needs: exploitation of the PoliRural outputs and experimental approach in CITIES2030.

Semantic Explorer (SemEx) is one of the technical and innovative outputs of the PoliRural research project. SemEx's ambitious vision is to provide support to researchers and facilitators by reducing the cognitive load related to tasks that are essential to research, development, and innovation actions. Text mining purpose is to mine and extract systems thinking, system modelling, and CRFS knowledge from selected digital sources i.e. internet sources and social media. The specific goal of text mining is to identify city/region food system elements, and their interconnections.

SemEx is addressed to analyse unstructured data which is related to rural development and rural attractiveness. The application delivers mining results through effective graphical representations [10]. SemEx is developed to provide support to researchers and facilitators of development and innovation. The tool is based on Natural Language Processing (NLP) functions including Topic Extraction, Named Entity Recognition, and Sentiment Analysis. The SemEx semantic features are: the creation of a text summary, named entities extraction, geo-parser, topic extraction, keywords extraction, estimation of sentiment, and analysis of sentiment vs. topics or keywords (polarity score).

The first thing is to teach SemEx that besides rural development it should also understand issues such as "food system" and "systems thinking". The training of the SemEx model and algorithm requires that at least 800 new resources are added to the SemEx source library. The adding of the sources into the main library is manual work. The new sources must encompass quality and relevant texts which are focusing on CITIES2030 topics e.g. systems thinking, food system, urban food system, food value chain, system modelling, problem structuring, causal loop modelling, dynamic modelling and scenario planning. The 800 resources are added by P14-SLEAN which is a consortium partner of both PoliRural and Cities2030 projects. After adding the new sources, the model needs to be trained and fine-tuned. It requires PoliRural IT expert's contribution.

[5] Semantic Explorer, www.semex.io
[6] H2020 PoliRural project web-page, https://polirural.eu/

Topics related to rural areas and food systems are of course connected. It means that SemEx sources which have been added before this experiment into the SemEx, include a remarkable amount of text references to the food system. This is an advantage that should make the experiment results more reliable.

Below the figure 7 prints out one example of the visualizations that SemEx provides on the main topic that is Food Systems. The figure 7 shows the polarity score analysis on the topic "Food Systems". It displays a histogram with bars, which are the most recurrent topics in the Library. The various colours represent the sentiment of the text with the red colours indicating negative polarity and green colours suggesting positive sentiment [11]. The height of the bar shows the number of findings in text sources i.e. the most often written word in the sources was "food chain".

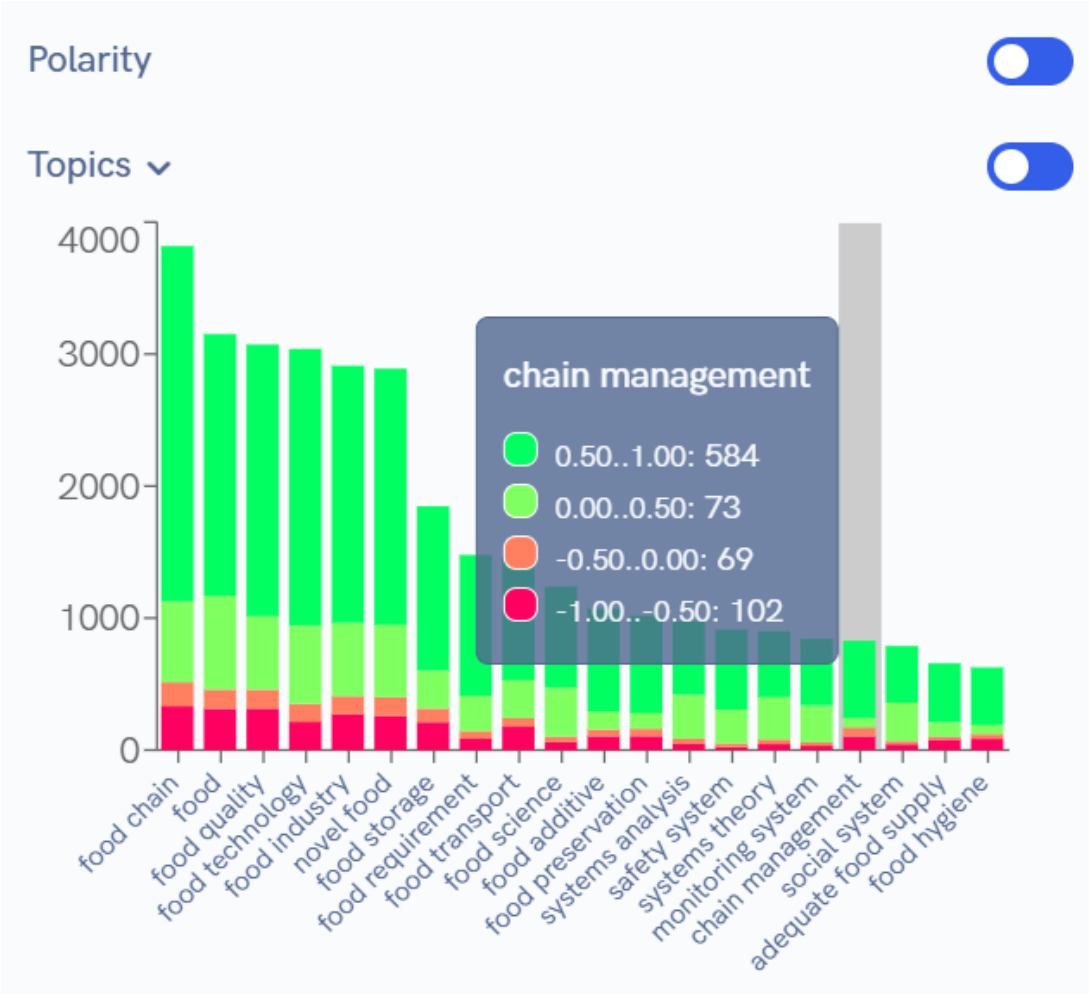

Figure 7. A polarity score analysis that visualizes sentiment analysis related to the topic of Food Systems

The report of the text mining experiment results are presented in the ANNEX C. Text mining to explore Food Systems.

3. Results & Lessons Learned & Next Steps

3.1 Co-creation of the CRFS Logic Framework Approach (CLFA)

All the activities run within Task 3.4 can be regarded as models of good practices for the activities from living and policy labs which are to be organized within the CITIES2030 project. The following organizing principles have been respected:

- They are participatory activities aiming at a more active involvement of participants.
- They are co-creation activities which aim at reaching conclusions of high innovation degree, yet in agreement with the insights provided by participants.
- The participants' insights are regarded as information of high validity degree at the level of food systems as they are part of the tacit knowledge of the participants, and yet provide common knowledge with a high degree of expertise.
- The identified issues are seen as basic problems within the heuristic process of Problem Based Learning.
- The discussions on food systems have been geared towards systems thinking models.
- A data-driven approach to the model system has been used for data structuring.
- Data gathering and analysis was carried out by employing both quantitative and qualitative methods.
- Data collection has been carried out in line with the GDPR legislation.

The Analysis Models used in T3.4 activities:

- The Iceberg Model with the following layers: Events, Patterns, Structures, and Mental Models.
- The Food Security Dimensions with the following subdimensions: Food Security, Food Safety, Nutrition Security, Nutrition Safety.
- Adjusted PESTLE model with the following societal categories: Social, Cultural, Economic, Political, Environmental, and Technological. Thus, Social and Cultural Dimensions have been separated since the participants from various working groups are part of different cultures (from 16 countries).
- The Four Pillars of Food Security model, with the following dimensions: Availability, Accessibility, Utilization, and Food Security Stability.
- 3 Sequential Diamonds Model — Extended Innovation Pattern

Methods Employed:

- Systems thinking and dynamic modelling approach.
- Problem Based Learning (PBL) to understand food systems thinking.
- PBL for participatory approach and co-creation through activities organized within working groups.
- Semantic analysis in text mining to mine and extract systems thinking, system modelling, and CRFS knowledge.
- Since there were structured and unstructured data, both quantitative and qualitative methods have been used.

Limitations

Task 3.4 limitations, which can also become limitations for policy labs (organized in WP4) and living labs (organized in WP5), have a complex nature, namely: technological, cultural, psychosocial, social, economic, political, urban, and of force majeure.

Technological limitations

They are generally related to the communication process. Most of these limitations are as follows: development level of communication infrastructure with impact upon Internet access and traffic speed

(technological availability), price of premium applications along with the quality of open source apps (technological accessibility), digital education and culture (technological utilizability), end user oriented technologies (technological accessibility and utilizability).

Cultural limitations

In the case of the CITIES2030 project, the cultural limitations are associated with the fact that the consortium consists of 41 partners from 16 countries. This fact represents a limitation in the sense that there are many cultural differences, yet they can be turned into an opportunity since certain experiences of some partners can become models of good practices. Through policy and living labs which are to be developed within the project, the cultural differences mainly manifest at the level of subcultures, whether it involves occupational subcultures or it is about social subcultures. At the same time, through the process of co-creation of the stakeholders that may derive from different subcultures, these limitations can become opportunities and thus contribute to the innovative nature of specific activities.

Psychosocial limitations

These limitations are mostly related to the fact that, during direct meetings of data gathering, certain psychosocial phenomena occur, namely: the brainstorming is driven by the extroverted participants, self-esteem is either a catalyst or an inhibitor, roles and social status embraced by participants or assigned to them lead to ideational or value hierarchy in the discussion groups.

Social limitations

Perceptions, representations and suggestions provided during the activities of brainstorming and co-creation can be also influenced by the family organization, social classes or socioeconomic success of an individual or family where he/she belongs to. These limitations usually turn into ideological limitations of a profound activist nature. During the meetings organized within Task 3.4, no such limitations were registered, yet they may prove real challenges in the locally organized living and policy labs.

Economic limitations

Economic limitations are generally associated with issues of availability or accessibility. When we refer to availability, we are talking about the development of the local economy which conducts the use of resources or commodities. When we speak about accessibility, we mainly make reference to the individual, family or community power engaged in using resources and commodities.

Political limitations

Political limitations are closely connected to the organizational functions of a society or community, and they are normative, regulative, prospective, and strategic. The activities from Task 3.4 were mainly focused on issues related to medium and long-term laws and strategies. The activities from policy labs, in particular, and also those from the living labs, which are to be held within the project, need to take into account the complexity of the political dimensions and the instruments, discourses, and strategies related to the following: policies, strategies, laws, regulations, political consensus, governance, political durability, institutions, bureaucracy, local administration, and communication.

Limitations related to the urban organization

The urban organization primarily influences the following dimensions of the urban life: food supply chains, lifestyle, air quality, commute between home, work and places of food purchase. They all materialize in the wellbeing degree of the urban human.

Force Majeure

The risks associated with force majeure have been always present in society and have directly impacted, in most cases, food systems. In the working groups organized within Task 3.4, for instance COVID-19 pandemic

has been also regarded as a food system problem [12] based on the idea of an event of force majeure. Besides pandemics, it also involves uncontrollable events such as extreme weather, economic crisis, war conflicts, earthquakes, volcanic eruptions. Under the circumstances, even the most developed economies or societies have experienced difficulties in risk prevention and problem-solving which originated from the materialization of these risks. Policy labs and living labs perhaps should open these topics about counteraction techniques and management of the force majeure effects.

3.2 Results

3.2.1 Frameworks for food systems understanding

Task 3.4 aims at identifying a framework designed for analyzing and understanding food systems. The activities from this task have provided the opportunity of getting more frameworks as it is shown below:

F1. Iceberg Model and Problem Based Learning Framework

This is a conceptual framework which has been implemented within a working group, and it is mainly oriented on activities of brainstorming and co-creation. This is a conceptual framework that has been implemented within PBL cycles. It is mainly concerned with activities of brainstorming and co-creation to classify issues within a food system. With the assistance of the Iceberg Model, the issues and problems are structured using the following layers: Events, Patterns, Structures, and Mental Models. This framework is especially useful when the intent is on pursuing the distribution of a food system at the level of day by day events, patterns, institutions, discourses, and ideologies.

F2. Iceberg Model and Food Security Dimensions Framework

A conceptual framework which is similar to F1 yet here the Iceberg model is integrated along with the Food Security Dimensions model. This framework is helpful particularly when the primary focus lies on the analysis of events, patterns, structures, and mental models of a food system depending on their impact upon the food purchase and consumption.

F3. Iceberg Model and Societal Dimensions Framework

A conceptual framework similar to F1, but in this case the Iceberg Model is integrated with the Societal Dimensions model. This framework is especially useful when we wish to analyze events, patterns, structures, and mental models of a food system depending on their impact upon societal layers.

F4. Iceberg Model and Four Pillars of Food Security Framework

A conceptual framework similar to F1. However, here the Iceberg Model is incorporated along with the Four Pillars of Food Security model. This framework becomes effective when the interest lies in analyzing events, patterns, structures, and mental models of a food system and their impact, especially upon supply chains.

F5. The Narrative Analysis of the Identified Issues by Stakeholders within Food Systems

This framework can be a continuation to any framework from the categories ranging from F1 to F4, and can be built by analyzing issues identified during the co-creation activities which are considered as problems related to the process of Problem Based Learning. The discussions held on these issues can become the basis for a narrative analysis of the stakeholders' tacit knowledge.

F6. The comparative analysis of 2 food systems according to the same identified problem within them

Based on the current statistical data in the national or international databases, it is possible to run comparative analyses between food systems from different countries, regions, or cities by simply following the similarities or dissimilarities. These similarities and dissimilarities can be further discussed within working groups with stakeholders from the field of identified issues and thus get a better understanding in

terms of systems thinking of food systems. This approach also provides the advantage of collaboration between partners and living labs or policy labs from different countries.

They could be different tools, yet they could be also integrated. Each of these frameworks can be used separately for analyzing and interpreting a problem and its possible solution(s) depending on the degree of interest shown for understanding it. However, at the same time, all these conceptual frameworks can be integrated for developing more complex instruments of analysis for a food system in agreement with systems thinking. At the same time, we have to remember that comparative analysis is part of data-driven system modelling.

3.2.2 New methods

The newly obtained methods in the activities developed within T3.4 do not have a high degree of innovation in terms of methodology. The innovation is rather given by way of relating to the stakeholders and the combinations between the models used for obtaining the data and running their analysis.

Therefore, in terms of relating to the stakeholders and information provided by them, it has been generally considered that we are dealing with experiences and representations of these actors with the following epistemological features:

- The day by day experience of the stakeholders in food system give them a high degree of expertise
- Facing, on a daily basis, the challenges of a food system draws an adaptive behavior to the current and general issues within the entire food system
- The stakeholders, by their daily battles, develop a thinking system which comes quite close to the systems thinking approach
- The knowledge achieved by the stakeholders is largely tacit and can be directly delivered through direct conversation
- Stakeholders have a material and pragmatic knowledge of a food system
- Stakeholders often face the negative impact of the issues raised within a food system
- Stakeholders can be easily activated as informal vectors, facilitators, and even agents of transformation for a food system.

Merging models used for analysis has provided the possibility of reaching integrated interpretations of the issues within a food system depending on the analysis opportunities offered by the models employed. Thus, by using the Iceberg Model as a reference analysis model, other 3 models have been integrated, namely the Food Security Dimensions, the Societal Model Dimensions (similar to PESTLE model), and the Four Pillars of Food Security model. These integrations have been used for tracking the dynamics and impact of the issues from a food system at the level of food purchase and consumption, societal levels, and supply chains.

3.2.3 Tools and resources

- PBL Tutorials. Two (2) tutorials have been organized for each of the six (6) working groups (Tutorial I and Tutorial II).
- Data collection tools. For data collection, the PADLET application has been used (for identifying the main concepts of food systems) along with the narratives (through brainstorming exercises).
- Working groups. Six (6) working groups have been organized with a total of 43 participants. In Group 5 it has been simulated a working group with participants from the same food system (Iași CRFS, Romania).
- Individual study. Between Tutorial, I and Tutorial II, the participants have been encouraged to express their opinions on the goals of Problem Based Learning (Tutorial I) as individual study.
- Data structuring based on these models: Iceberg Model and Food Security Dimensions, PESTLE, and the Fours Pillars of Food Security models.

- Co-creation Workbook. P29 ARFI planned and built the Co-creation Workbook upon Google Drive excel. The workbook includes a common working space for the issues listed at PBLs, a voting method to prioritize issues, a structured manner to connect issues to the four models (a theme codifications), and a scoring system to sort issues based on multi-criteria choice (ANNEXES A1, A2, A3).
- Data analysis supported by Co-Creation Workbook. To analyze the data obtained within the 6 PBLs i.e. 310 issues, theme codifications have been used (theme distribution depending on the dimensions of the models used) along with interpretations on correlations between different models (integrated 2 by 2, in reference with Iceberg Model) (ANNEXES A1, A2, A3)
- Data-driven system modelling. In the case of statistical data used for the comparative analysis of the honey production from Finland and Romania, the following tools for statistical analysis and visualisation have been employed: Minitab 20[7] and Microsoft Power BI[8]. The 3 Sequential Diamonds Model encompasses a roadmap to adapt a data-driven system modelling approach (ANNEX B).
- Literature review. To complete the research, innovation and training activities, the literature reviews have been looked up on matters such as Food Systems Thinking, Problem Based Learning, Iceberg Model, and Food Security.
- Text mining. Text mining tool, SemEx, has been employed for analyzing the occurrences and correlations between the main topics in food systems and systems thinking. The results obtained are quite interesting and can be further developed in the coming policy and living labs. However, the analyses are at a prototype stage, and further testing is necessary (ANNEX C).
- Verification of the Co-creation Workbook. The verification workshop has been conducted with the end-users. The purpose of the workshop of 10 people was to verify that the Co-creation Workbook is easy to use, understandable and meaningful for the end-users, and the user's intrinsic manner to use it meets the Co-creation Workbook designers' (P29 ARFI) intention.

3.2.4 Capacity building

The activities from Task 3.4 are focused on the idea of capacity building. At the same time, the idea of capacity building and methodology need to be passed on in the policy labs and living labs which are to be developed within the CITIES2030 project.

In terms of knowledge and knowledge transfer, it has been thought that the objective of raising awareness on food systems thinking is the most significant epistemological challenge since the contemporary challenges of a food system require a complex integrated understanding similar to systems thinking. We can no longer understand a food system in the absence of its structural, societal, functional or individual dimensions.

For this very reason, we consider that the capacity building can have a structural, societal or functional impact.

In terms of structural impact, based on the Four Pillars of Food Security, the issues are particularly related to Pillar 1 (Availability) and Pillar 4 (Food security stability), and thus the impact can be especially felt on the food supply chains: the big retail chains, food street innovation, structures for integrating local producers in the retail system, organizing farmers markets and event promotion of local products, digital development of a food system, systems for reducing the urban food waste, social media infrastructure, and (re)localization of food systems [13].

[7] Minitab 20, https://www.minitab.com/en-us/products/minitab/
[8] Microsoft Power BI, https://powerbi.microsoft.com/en-us/

In terms of societal impact, in agreement with the same model of the Four Pillars of Food Security, the issues are rather associated with the Pillar 2 (Accessibility) and Pillar 3 (Utilization of food), and thus the impact can be mostly felt at the DIMENSIONS level from the PESTLE model, with the adjustments suggested by the Deliverable 3.3 (adding the Cultural dimension). This way discussion topics can be further developed on the following: Horeca sector (seen as an independent distribution circuit), and its importance in the urban food system (local food, beverages, Horeca sector) as elements of city/region branding [14], European certification (Protected designation of origin - PDO, Protected geographical indication - PGI, Geographical indication of spirit drinks and aromatised wines - GI and Traditional speciality guaranteed - TSG), agrifood systems transitions [15], innovative digital technologies for food purchase and consumption [16,17], gastronomic culture, food heritagisation [18,19], urban gastronomic tourism, European Green Deal & From Farm to Fork strategy, civic agriculture [20], Community Supported Agriculture (CSA), urban gardens, Grow Your Own (GYO).

In terms of functional impact, this may mainly occur at these levels: developing collaboration between main actors/ stakeholders of the food market - policy makers, public administration, entrepreneurs, civil society, research, consumers [21], logistics, location, and accessibility of big retail chains, farmers markets, access to specialized stores, difference between standardized food and local food, consumers orientation towards healthy food, concept of local product, promotion and development of the concept of short food supply chains (SFSC) in urban food system [22-24], food banks - food aid system as solution for the vulnerable urban population [25].

In terms of individual impact, during the activities run in the Task 3.4, the participants took the role of stakeholders. At the same time, it was pointed out the possibility of becoming facilitators as well. For future activities, the participants, as direct and indirect beneficiaries of CITIES2030 project, should become aware of this double role they can play within an urban food system: stakeholder and facilitator.

The instruments suggested by the activities from Task 3.4 can be employed for answering all these challenges. Thus, CITIES2030 project, through the activities from the next work packages (WP4-6), will have a double result in what concerns the capacity, namely: the capacity of the internal capacities and that of the structures and functionalities which are beneficial to the project.

3.2.5 Community building

The activities run within Task 3.4 have also focused on getting data and tools which can enable CITIES2030 project to take part in the urban community building within sustainable food systems.

As any other project implemented in the current paradigm of development, CITIES2030 has also direct and indirect beneficiaries. Further, CITIES2030 project, by its declaration of intent, is largely oriented on the urban consumer as the main driver for developing food systems in line with the policies and strategies of European Development: Milan Urban Food Policy Pact (MUFPP)[9], CRFS Programme FAO[10], Glasgow Food and Climate Declaration[11], UN Food System Summit[12], Food 2030[13], European Green Deal[14], From Farm to Fork strategy[15].

[9] https://www.milanurbanfoodpolicypact.org
[10] http://www.fao.org/in-action/food-for-cities-programme/toolkit/defining-the-crfs/en/
[11] https://www.glasgowdeclaration.org
[12] https://www.un.org/en/food-systems-summit/about
[13] https://ec.europa.eu/info/research-and-innovation/research-area/food-systems/food-2030_en
[14] https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en
[15] https://ec.europa.eu/food/farm2fork_en

The direct beneficiaries of CITIES2030 project are the following: the implementing teams of the participants from the project, institutions involved in the project, projects which are eligible for synergies, stakeholders drawn in the projects, major actors from the food arena who benefit from the results, deliverables, and knowledge transfer achieved in the project.

Due to the fact that it concerns a project with 41 partners from 16 countries, the project community can become a significant community for innovation and knowledge transfer. At the same time, the cultural diversity within the project can provide a good opportunity for implementing models of good practices.

Based on the debates from Tutorial I and Tutorial II, organized within Task 3.4, the following conclusion has been reached: the stakeholders, in the coming activities organized in the project, should be regarded as either change actors or transformation agents. This approach is closely connected to the idea that change means mainly short-term modifications of certain issues in the urban food system, while transformation concerns radical modifications on medium and long-term within an urban food system.

Concurrently, for the following activities focused on innovation and knowledge transfer, the Quadruple or Quintuple Models can be quite useful for interacting with stakeholders and facilitators.

To secure community building durability, policy and living labs which are to run activities based on the simulations and instruments created in Task 3.4, it is recommended to increase the durability level of these labs, so they can continue the activities in the post-implementation period of the project.

3.3 Next actions

3.3.1 Consistency on CITIES2030 scope, objectives and philosophy

The activities from Task 3.4. have a complex nature, and, in agreement with the goal, objectives and philosophy of CITIES2030 project, they have focused on actions of co-creation, innovation, data collection, knowledge transfer, dynamic modelling, Problem Based Learning, tools development, and simulations. By running these activities, a series of frameworks for urban food systems thinking were obtained, as well as action tools for innovation and knowledge transfer in food systems. In the same task, there were a few recommendations formulated for the good development of activities from WP1, WP2, WP4, WP5 and WP6. The frameworks and action tools have been explained in the previous chapters.

3.3.2 Recommendations. How to exploit the tools and results in CITIES2030

WP1 analyzes the impacts of the project

- The Impact Analysis (IMA) of CITIES2030 should monitor the stakeholders' awareness and capacity development on systems thinking.
- The Impact Analysis (IMA) builds upon the same models that are used in the Co-Creation Workbook: Iceberg Model as reference analysis model, the Food Security Dimensions, the Societal Model Dimensions (similar to PESTLE model), and the Four Pillars of Food Security model.

WP2 incorporates systems thinking into the House of CITIES2030 Ethics

- Systems thinking is a perspective. It helps us to think better. Thinking well is ethical and ethics requires thinking well. Whether the topic is community building, processes, materials, monitoring, or ethics management at CITIES2030, the human factor is involved and humans deserve good thinking.

WP4 and WP5 explore and implement systems thinking in living- and policy labs

- CRFS Logic Framework Approach (CLFA), should be applied in co-creation processes hosted by WP4 Policy labs and WP5 Living labs.
- Within policy and living labs, a structured framework which combines different models, methodologies and tools can be concurrently used and adjusted to the suggested topics of debate or specific issues of each food system.
- To make comparative analyses and exchange of good practices, it is encouraged the collaboration between policy and living labs between different countries.
- To get as current as possible data, as well as specific as possible data for a food system, it is also recommended the integrated use of qualitative and quantitative methods for data collection and interpretation.
- The stakeholders from the project should be encouraged to become systems thinking facilitators by both taking part in the dissemination of the results obtained in policy and living labs and by replicating these activities.
- The Co-creation Workbook is built on Excel which provides a flexible and adjustable co-creation environment in a shared document in Google Drive. By using Excel features it's possible to sort, prioritize, drill down, search, and extract specific topics and issues.
- The Co-creation Workbook serves as a co-creation, innovation, documenting, and sharing tool for living and policy labs.
- 6 people at the consortium have a minimum of one-time experience in running and facilitating a Problem Based Learning cycle.
- 43 people at the consortium have the first experience to participate in the Problem Based Learning cycle. Supported by guidance material, templates, and experts' assistance, they are capable and equipped to run a PBL cycle in their local environment as a part of WP4 and WP5 acts. They can use PBL to explore and learn about systems thinking or about any other topic they find useful.
- 14 people at the consortium have knowledge and understanding of the underlying models and functions of the Co-creation Workbook.
- Task 3.4 leader, P14 SLEAN, is responsible for the preparation and provision of the guidelines and templates to carry out Systems Thinking Workshops (STW) at living and policy labs. The material package is available at CORRELATE board D5.2 by M12.

WP6 develops platform to collect and analyse data

- CRFS Logic Framework Approach (CLFA) should be applied in co-creation processes hosted by WP6 Platform to include systems thinking perspectives also into ICT solutions.
- To promote preliminary systems modelling and visualization in the CRFS-LL's challenge context.
- To get as current as possible data, as well as specific as possible data for a food system, it is also recommended the integrated use of qualitative and quantitative methods for data collection and interpretation.

WP7 communicates, disseminates and exploits the results, observations, and experiments collected at WP4, 5 and 6 about Urban Food Systems.

- The obtained results should be promoted across all communication and dissemination channels of CITIES2030 project. For this purpose, it is recommended a permanent integration of the activities from policy and living labs with those from the communication and dissemination from WP7.
- The tasks in WP7 that build action plans to secure the exploitation of the result consider e.g. the systems thinking approach, the applied models of the framework, and the results of the impact analysis in WP1.

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Annex A1, A2 and A3.

Co-Creation Workbook

Annex B.

Data mining - Analysis of the honey value chain in Romania and Finland

Annex C.

Text mining to explore Food Systems

A1

Issues expressed in working groups	Iceberg Model Layers	Votes in working groups	The Four Pillars Dimensions	P1 - Availability	P2 - Accessibility	P3 - Utilization	P4 - Food security stability	TFP Relative score of the four pillars	TFP Total score (Formula = CxJ+J)
Recycling - food waste	Mental Model	5	Utilization	1	1	1	1	4	24
Create more personal connection with food: kids need to learn about seasons, foods, farming...	Mental model	6	Utilization	0	1	1	1	3	21
Food Suply Chains - Political decision making has a huge impact on your every day life	Structure	4	Stability	1	1	1	1	4	20
Food Suply Chains - the trust is the most important trigger in producer - consumer	Structure	4	Stability	1	1	1	1	4	20
Authorities' legislation and recommendations for the consumption of local products	Structure	4	Availability	1	1	1	1	4	20
IT development	Pattern	4	Accessibility	1	1	1	1	4	20
Local small scale producers face competition from large food companies/distributors.	Pattern	5	Availability	1	1	0	1	3	18
Climate change affecting	Event	5	Stability	1	0	1	1	3	18
There is a need to educate consumers, starting from youngers in schools and universities.	Mental model	3	Stability	1	1	1	1	4	16
Public procurement systems	Structure	3	Accessibility	1	1	1	1	4	16
Local incentives for healthier food prodution	Structure	3	Availability	1	1	1	1	4	16
Relaxed legislation on the food ingredients which contain preservatives, additives, MSG, etc.	Structure	3	Stability	1	1	1	1	4	16
Starting a food platform in cities with agriculturers, schools, business, activists, NGO's, citystaff,...	Structure	4	Stability	0	1	1	1	3	15
Start-ups needed - Promote an understanding of new business opportunities in the sustainable transformation of the food chain.	Pattern	4	Stability	1	1	0	1	3	15

A2

Issues expressed in working groups	Iceberg Model Layers	Votes in working groups	Themes (key Societal Level)	Social	Cultural (mentalities, education, knowledge)	Political (policies, laws, strategies)	Economic	Environmental	Technology	SL Relative score	SL Total score
Local small scale producers face competition from large food companies/distributors.	Pattern	5	Economic	1	1	1	1	0	1	5	30
Starting a food platform in cities with agriculturers, schools,	Structure	4	Political	1	1	1	1	0	1	5	25
The importance of consuming locally sourced produce for the community.	Pattern	5	Economic	1	1	0	1	1	0	4	24
Create more personal connection with food: kids need to learn about seasons, foods, farming...	Mental model	6	Cultural	1	1	0	1	0	0	3	21
Start-ups needed - Promote an understanding of new business opportunities in the sustainable transformation of the food chain.	Pattern	4	Economic	0	0	1	1	1	1	4	20
Use speculative design to develop circular city models, test and replicate the successful ones, including (monetary) incentives (although perhaps these are short-run solutions)	Structure	4	Technology	0	0	1	1	1	1	4	20
Plastic is at the heart of our food system - needs to change	Structure	3	Technology	0	1	1	1	1	1	5	20
Virtual food tastings & food	Pattern	4	Cultural	1	1	0	1	0	1	4	20
Food Suply Chains - Political decision making has a huge impact on your every day life	Structure	4	Political	1	0	1	1	1	0	4	20
During the pandemic, consumers' expenses for purchasing high-quality food products have increased (other expenses have been cut down).	Pattern	4	Social	1	1	0	1	1	0	4	20
Food Suply Chains - the trust is the most important trigger in producer - consumer	Structure	4	Social	1	1	0	1	1	0	4	20

A3

Issues expressed in working groups	Iceberg Model Layers	Votes in working groups	CODES - Subdimensions	Food Security Dimentions	Food security	Food safety	Nutrition security	Nutrition safety	FSD relative score	FSD total score
IT development	Pattern	4	Digital society	Food security	1	1	1	1	4	20
Green Deal	Structure	3	Laws and regulations	Food security	1	1	1	1	4	16
Building a Living Lab in a village of the Mediterranean, focused on food and climate - A phisical space which can represent a campus for training people, feeding people with sustainable dishes, facilitating networking and multi actors meetings to act on climate through food.	Event	4	Knowledge and innovation	Nutrition security	0	1	1	1	3	15
Start-ups needed - Promote an understanding of new business opportunities in the sustainable transformation of the food chain.	Pattern	4	Knowledge and innovation	Food security	1	1	1	0	3	15
Starting a food platform in cities with agriculturers, schools, business, activists, NGO's, citystaff,...	Structure	4	Digital society	Food safety	0	1	1	1	3	15
Use speculative design to develop circular city models, test and replicate the successful ones, including (monetary) incentives (although perhaps these are short-run solutions)	Structure	4	Knowledge and innovation	Food security	1	1	1	0	3	15
Unhealthy food	Pattern	4	Consumer behavior	Nutrition security	0	1	1	1	3	15
Create more personal	Mental model	6	Food in schools	Nutrition safety	0	0	1	1	2	14
Local consumers frequently mix up locally sourced produce with traditionally certified products (no product certification mark is available/provided).	Mental Model	5	Consumer intelligence	Nutrition safety	0	0	1	1	2	12
Acknowledge the system	Mental model	2	Knowledge and innovation	Food security	1	1	1	1	4	12
Local small scale producers face competition from large food companies/distributors.	Pattern	5	CRFS	Food security	1	0	1	0	2	12

Data mining demonstration on honey value chain in Romania and Finland

15.5.2021

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Kalle Karlsson, Smart & Lean Hub Oy, Finland

The purpose of this document is to demonstrate what is meant by data mining in the context of CITIES2030. The used data is accurate and true.

The data analysers' (Tuula Löytty and Kalle Karlsson) comments, questions and interpretations are not based on the process knowledge which explains the possible errors and misunderstandings.

Contents

1. Honey value chain from the production to consumption

Process mapping is presented in a simple flowchart format in the figure 1. It focuses on the production phase but gives also some information on the distribution.

Figure 1. A simple flowchart of the honey value chain

Production phase: The amount of honey produced is expressed in tons. Potential critical factors on the amount of produced honey are: number of beehives (pcs), age of the queen, the room and condition of the beehive, number of bees, weather (temperature, rain).

Distribution phase: Distribution is based on direct sales from the honey producer sites either directly to consumers or via retailers. Web-shops are common, particularly in Finland.

2. Data from Romania and Finland from 2000 up to 2019

Honey production data is mainly collected by Finnish Honey Production Association [1,2] and National Institute of Statistics, Romania [3]. Temperature and rain data was provided by Finnish Meteorological Institute [4] and National Meteorological Administration of Romania [5]. Romania data is collected by Romanian Academy, Iași Branch by using past researches [6]. Data on bee honey imports and exports from Finland and Romania were collected from the TradeMap database [7].

The data includes following information:

- Country: Romania and Finland
- Years: Romania 2003-2019, Finland 2000-2019
- Beehives/pcs
- Harvested production/tons
- Production/beehive/kg
- Honey consumption/tons

- Population in Romania and in Finland
- Honey consumption/person/g
- Average temperature in summertime in Helsinki
- Total summer rain in mm in Finland Helsinki
- Price bought from producer EUR/kg, only Romania
- Import and export data from Finland and Romania in a separate file.

Table 1: Honey value chain data in the excel-sheet

Country	Year	Beehives/pcs	Harvested production/tons	Production/beehive/kg	Honey consumption/tons	Population	Honey consumption/person/ g	Average temperature summertime	Rain in mm in summertime	Price bought from agricultural producers: EUR/kg
Romania	2000	648808	11746	18			224,2	18		
Romania	2001	744807	12598	17			417,8	18		
Romania	2002	781159	13434	17			395,4	18		
Romania	2003	839973	17409	21	7526	21627509	258,6	19	259	
Romania	2004	888239	19150	22	8781	21521142	378,3	17	378	1,66
Romania	2005	888180	17703	20	9750	21382354	552,3	17	552	1,13
Romania	2006	891043	18195	20	10714	21257016	402,1	17	402	1,22
Romania	2007	982368	16767	17	11410	21130503	373,4	19	373	1,36
Romania	2008	998359	20037	20	12134	20635460	346,6	18	347	1,67
Romania	2009	1057186	19937	19	13491	20440290	320	18	320	1,82
Romania	2010	1274917	22222	17	13882	20294683	459,5	18	460	2,09
Romania	2011	1249610	24127	19	14059	20199059	299,2	18	299	2,37
Romania	2012	1254039	23062	18	14710	20095996	289,8	20	290	2,25
Romania	2013	1354218	26678	20	14655	20020074	359,5	18	360	2,59
Romania	2014	1350998	18040	13	14606	19947311	445,5	18	446	3,11
Romania	2015	1392846	27893	20	17172	19870647	308,6	19	309	3,29
Romania	2016	1437394	21202	15	18496	19760585	397,4	18	397	3,36
Romania	2017	1602453	30177	19	19565	19643949	342,8	19	343	3,53
Romania	2018	1689500	29162	17	20159	19533481	391,6	19	392	3,58
Romania	2019	1843026	25269	14	21434	19414458	355,4	19	355	3,51
Romania	2020						389,9	18		
Finland	2000	41700	1100	26	2233	5181115	429	16	230	
Finland	2001	44300	1800	41	2677	5194901	515	17	232	
Finland	2002	46900	1700	36	2605	5206295	501	18	113	
Finland	2003	37000	1700	46	2535	5219732	488	17	181	
Finland	2004	46000	1400	30	2469	5236611	475	16	343	
Finland	2005	53000	2300	43	2720	5255580	523	17	302	
Finland	2006	54000	3040	56	2899	5276955	547	18	35	
Finland	2007	53000	1400	26	3084	5300484	582	17	193	
Finland	2008	43000	1500	35	3083	5326314	582	16	195	
Finland	2009	41000	1500	37	3028	5351427	571	16	255	
Finland	2010	37000	1700	46	3114	5375276	588	18	179	
Finland	2011	37000	1700	46	2968	5401267	550	18	278	
Finland	2012	39000	940	24	2322	5426674	430	16	181	
Finland	2013	43000	1600	37	3200	5451270	593	18	210	
Finland	2014	47000	2600	55	3556	5471753	646	17	206	
Finland	2015	50000	1500	30	3849	5487308	700	16	217	
Finland	2016	52000	1200	23	3168	5508297	576	17	271	
Finland	2017	54000	2100	39	4026	5513130	732	15	204	
Finland	2018	55000	2600	47	4089	5517919	743	18	136	
Finland	2019	64600	3300	51	4333	5525292	785	17	170	

The data was analyzed and visualized by using Minitab[1] and Power BI[2] applications.

The following chapters present the charts and analyser's comments, questions and interpretations for each chart. First country-based analyses, secondly comparison between Finland and Romania, and lastly import/export charts.

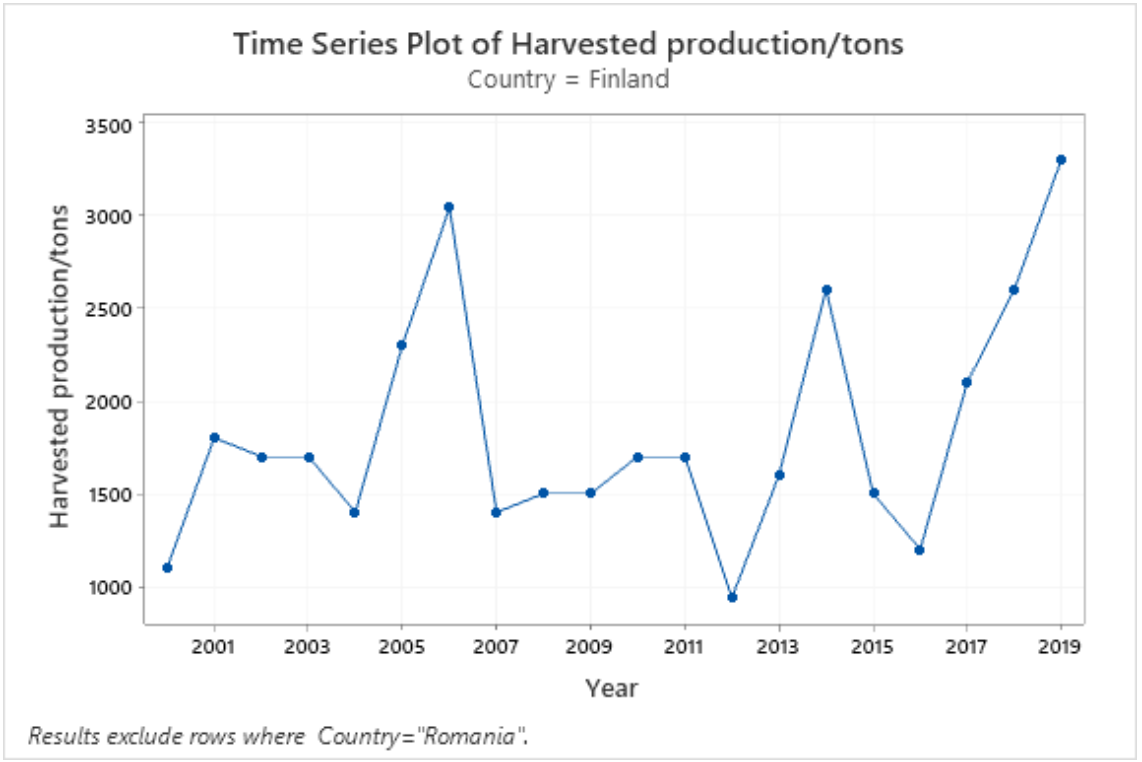
3. Finland

3.1 Trends by time series in Finland

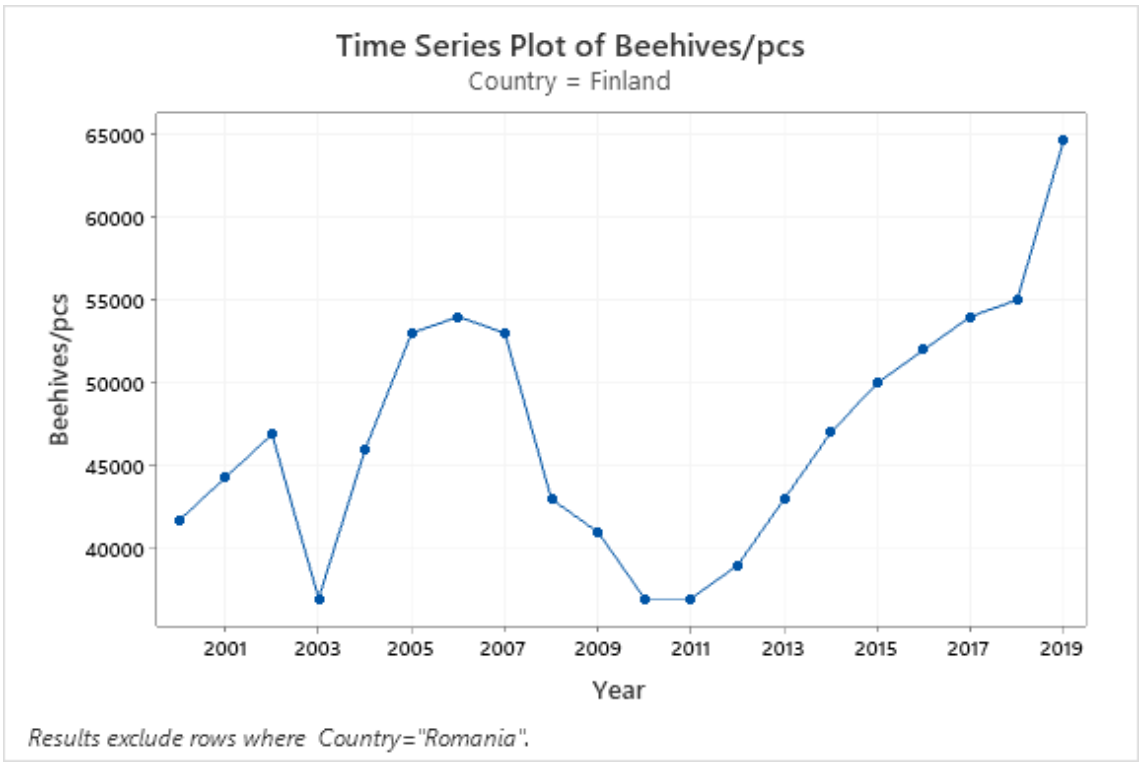
Why does the total amount of honey produced vary so much in different years? What are the factors that cause variation? Is it possible to control the factors? What is the biggest cause for the variation?

The yearly total production has not increased in the last 20 years? Does it mean that there is no interest to establish a honey farm? Is there lack of demand for Finnish honey? The last 4 year have been increasing? Why is that?

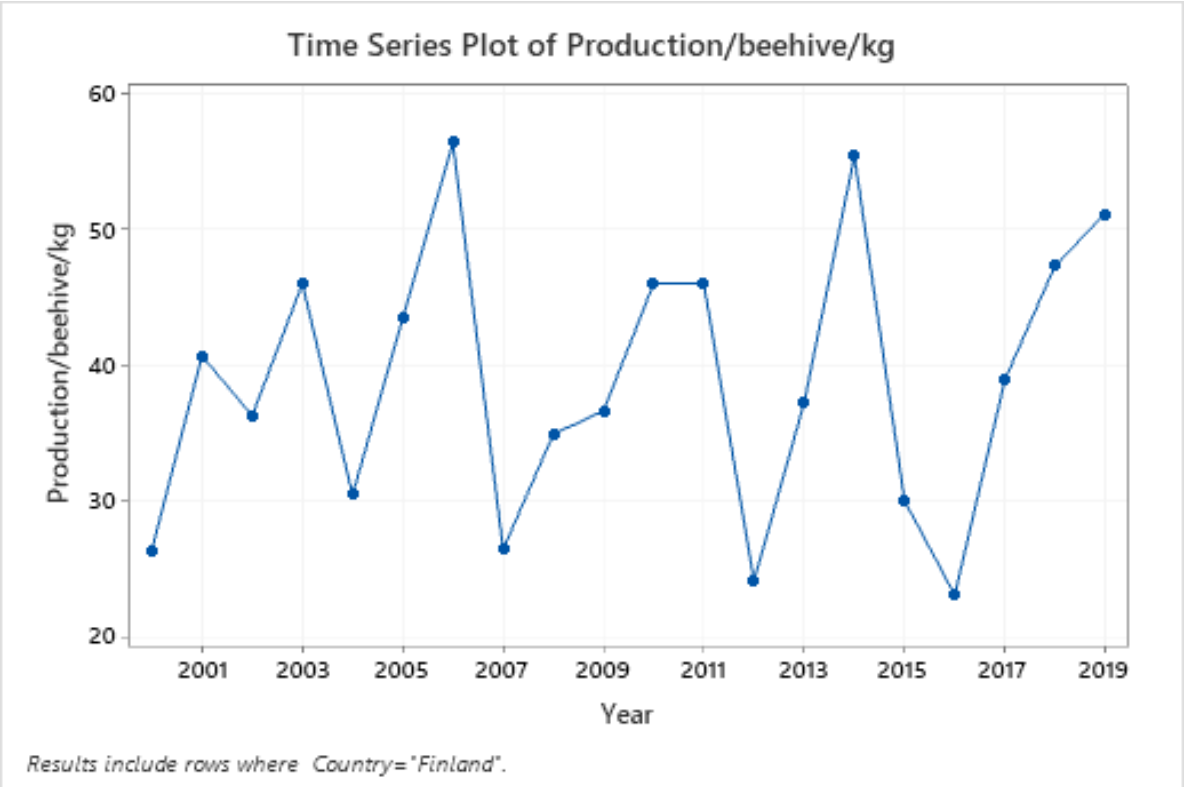
[1] https://www.minitab.com/en-us/products/minitab/
[2] https://powerbi.microsoft.com/en-us/



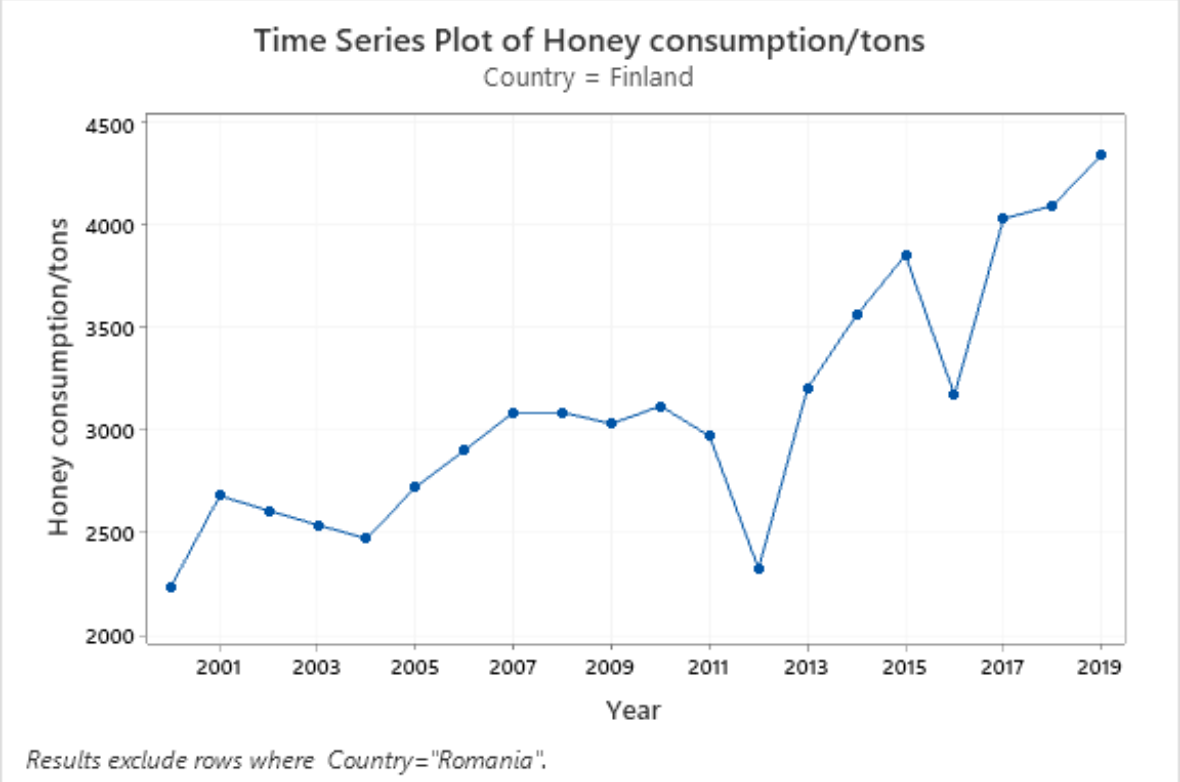
Amount of beehives has increased since 2011. What is the reason for this?



The production kg per beehive varies from 20 up to 50 kg. How is this compared to other countries? Why is the variation so high? Is there a cyclic trend - every third or fourth year is poor?



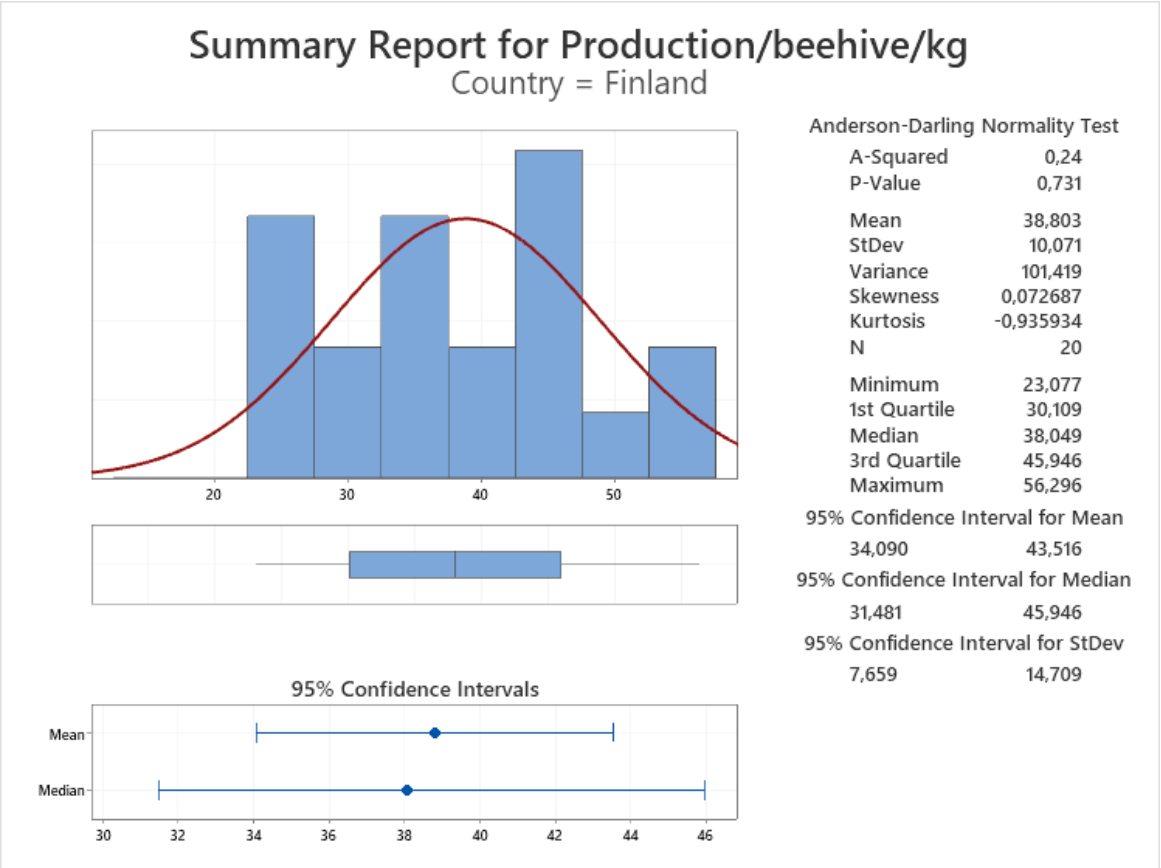
The amount of honey consumption is on a rising trend? Finnish production doesn't cover the demand and import is necessary? What has been done to increase Finnish own production? What is the price difference between imported and Finnish honey?



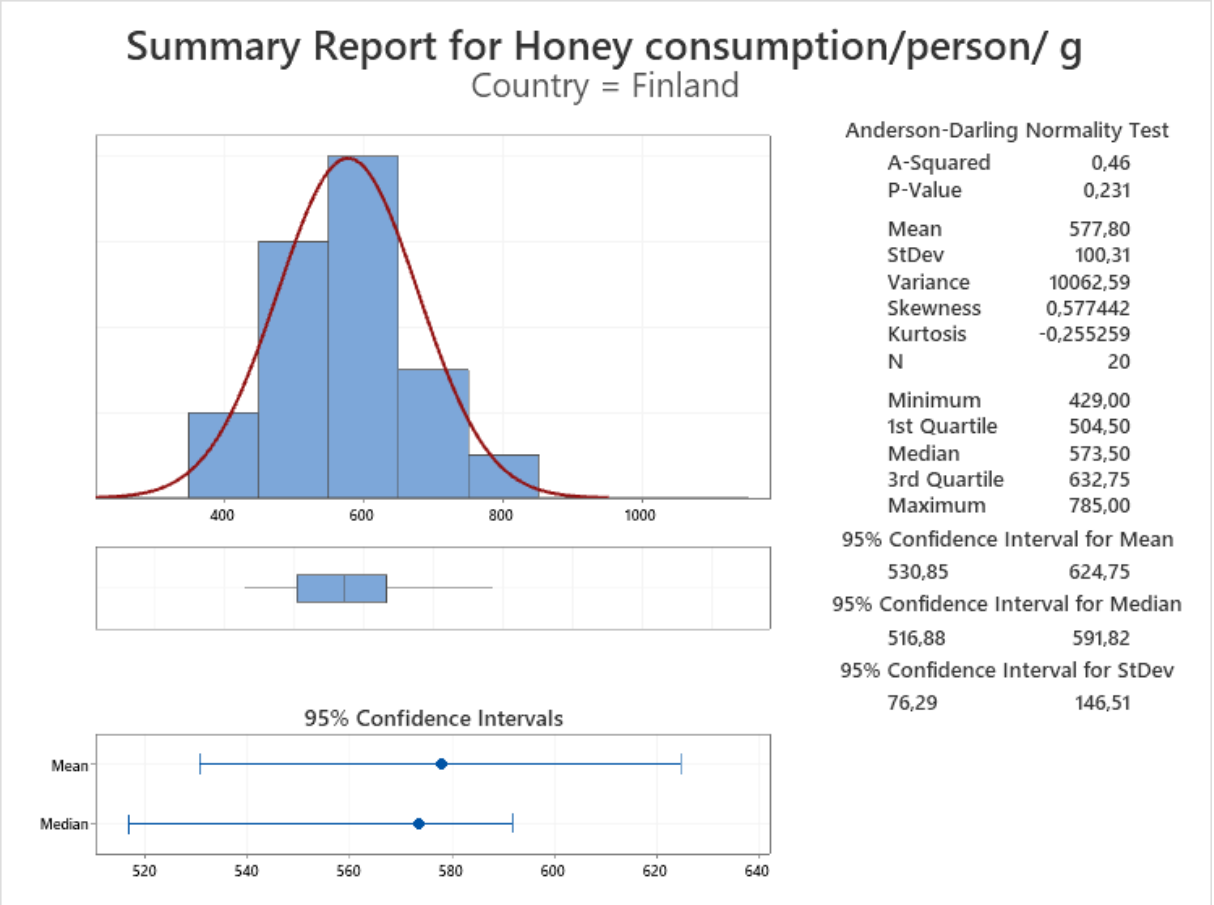
3.2 Performance in Finland

Performance analysis purpose is to give an idea of the process performance in relation to the expectation which can be expressed in specification ranges.

The production/beehive varies from 23 up to 56 kg. The average is 38 kg. It is written that the production/beehive may vary 0-100 kg.



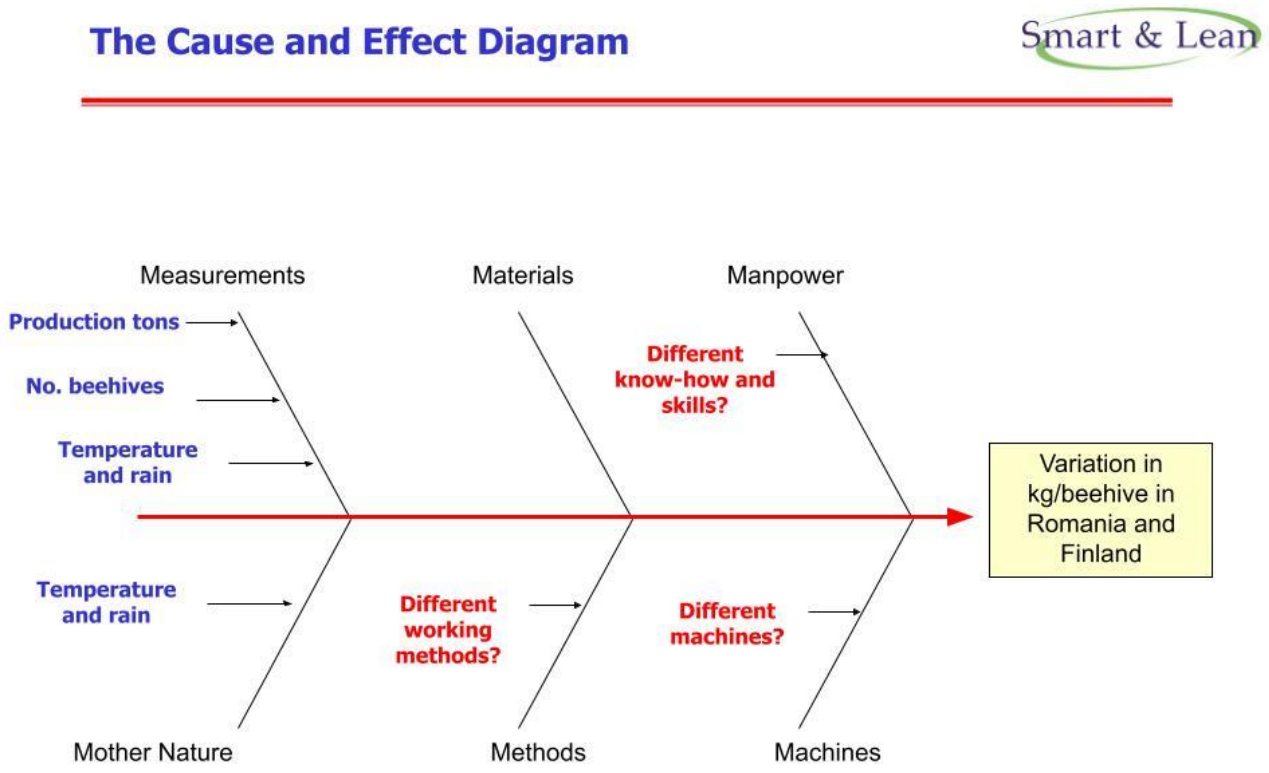
The consumption/person is 577 g according to the data which is based on the whole population. The Finnish Honey Association informs that the consumption is 700 g/person and it has increased 20 % during the last years. The domestic honey proportion is 55 %.



3.3 Testing causes and effects - correlations in Finland

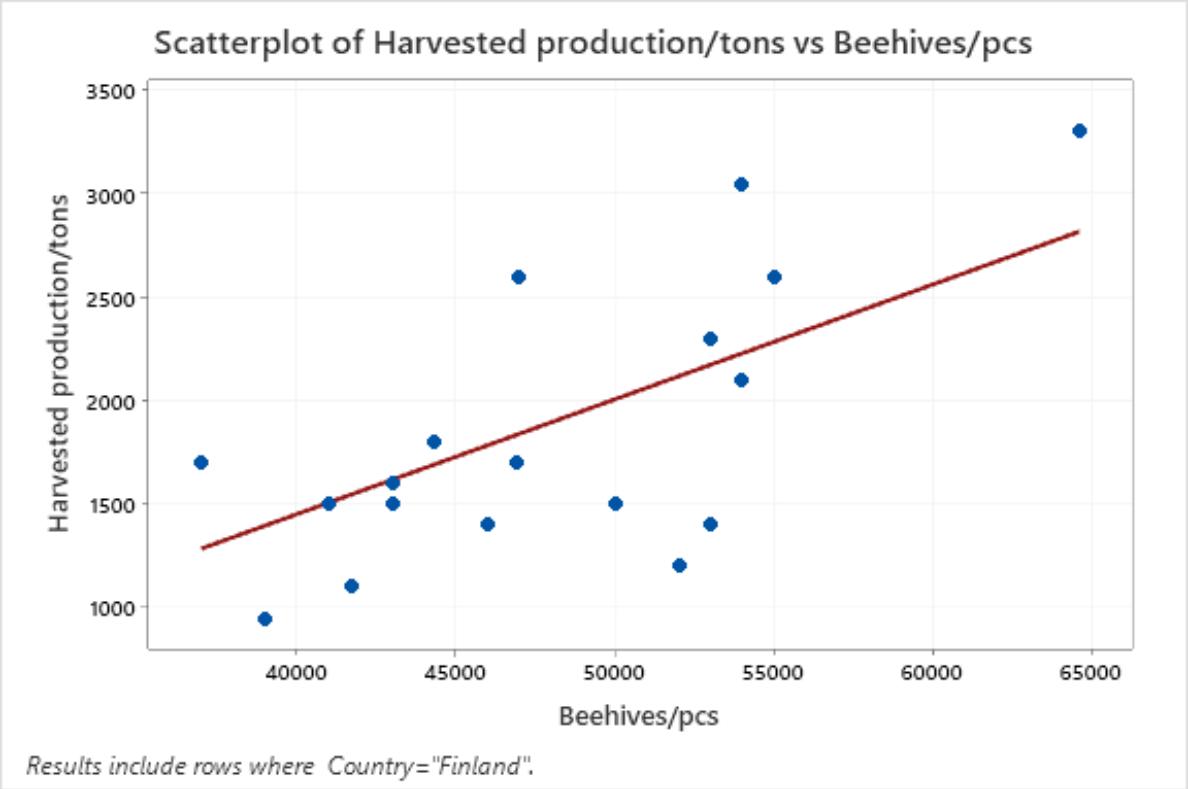
The below cause and effect diagram performs a hypothesis of possible causes for variation in production per beehive. The potential causes which are blue are later tested in this chapter.

The potential causes which are red are not tested, but they are included in the cause and effect diagram for documentation purposes and for the future.

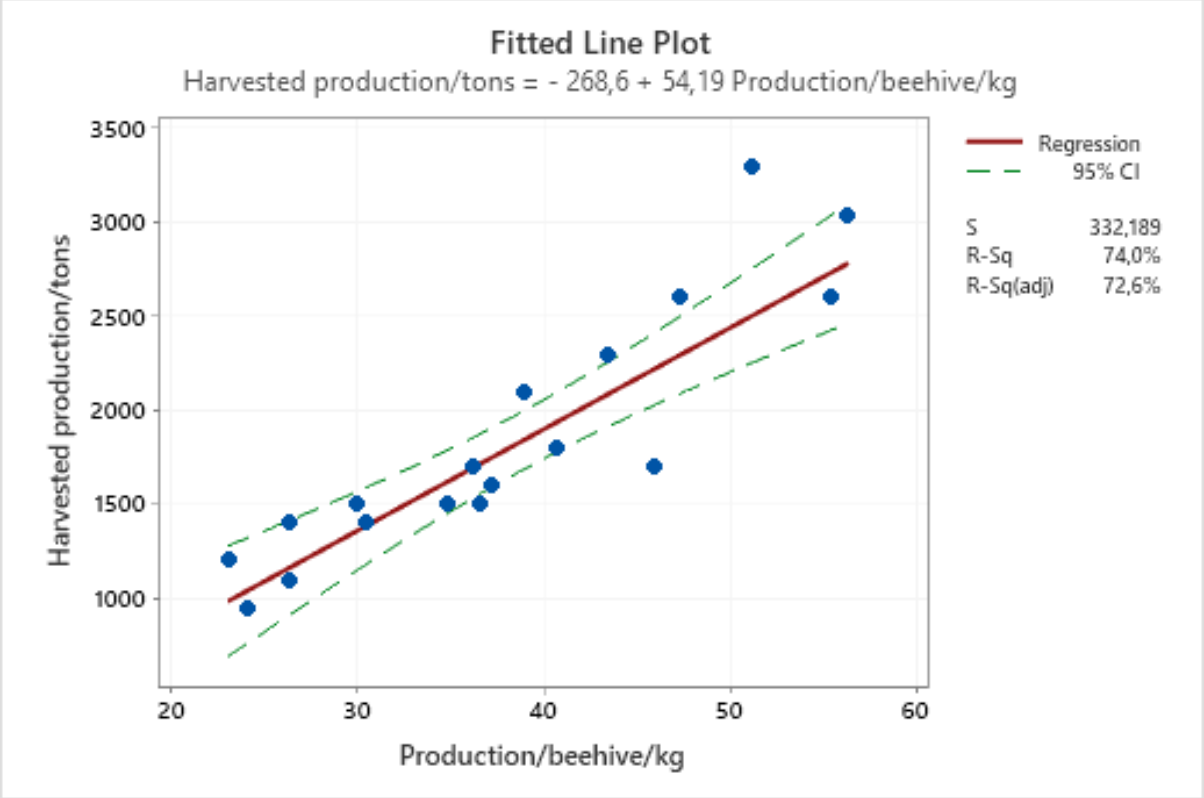


The amount of honey produced and the amount of beehives is plotted. There seems to be a correlation that makes sense - the more beehives the more production.

However, the production varies a lot. Is the variation due to the “natural process” which is hard to control or is there also a measurement error. How reliable is the data?

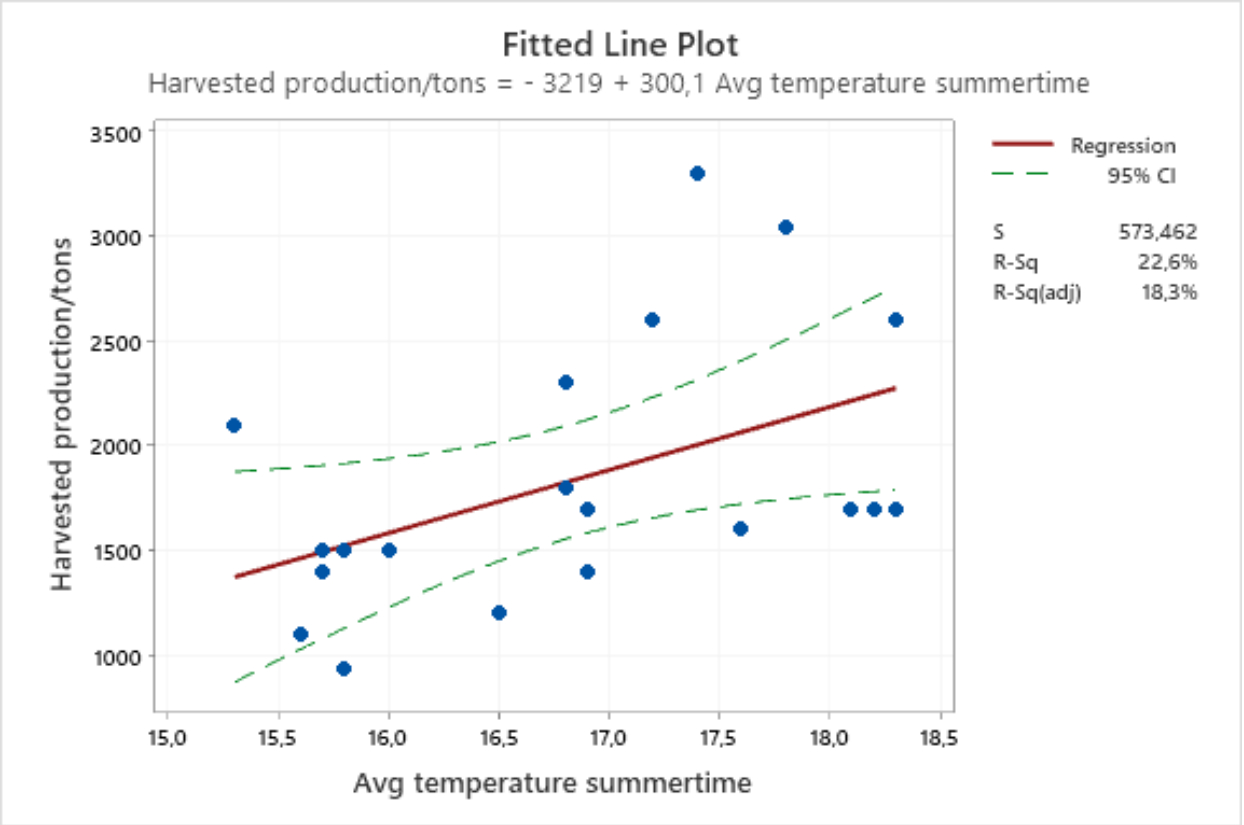


The correlation between harvested production and production in one beehive is strong.



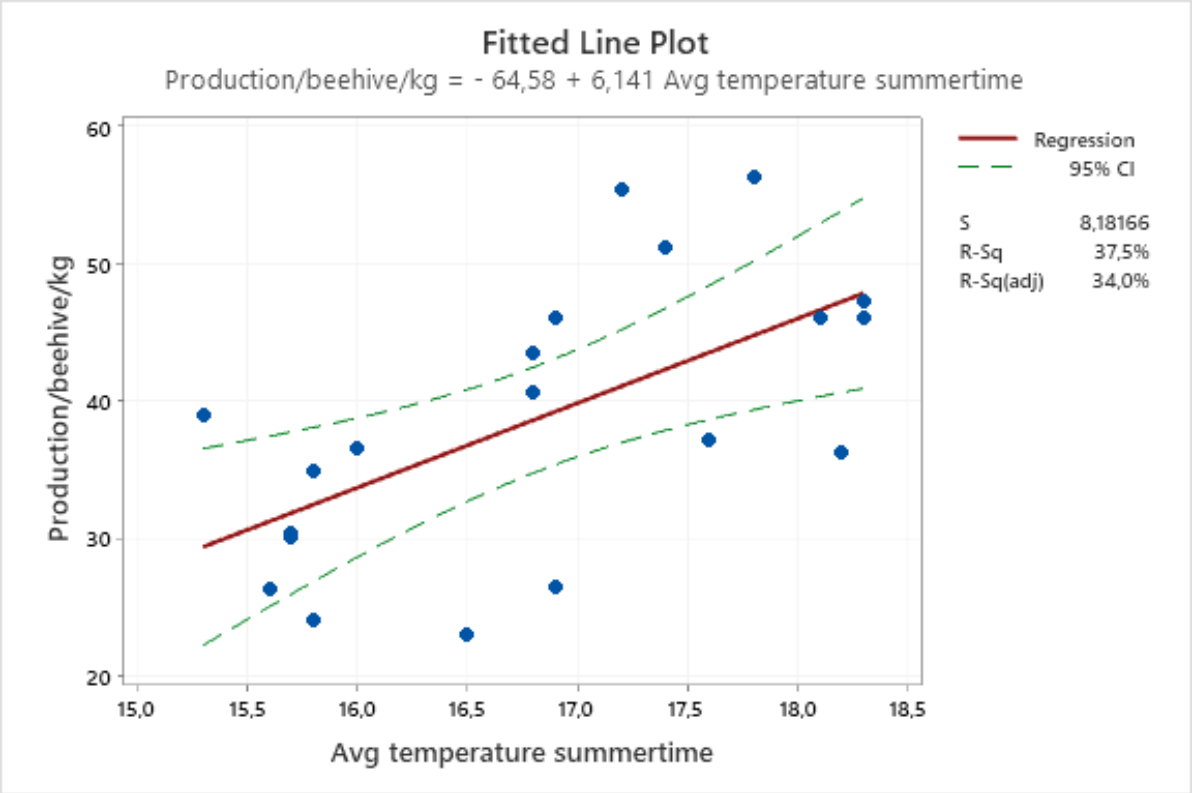
Average summer temperature (C) in Helsinki vs. honey production tons shows that the higher the temperature the higher is also the total production.

The result is a rough approximation because the average summertime temperature is average in one location in Finland whereas honey production is in different locations. The average is also a day (24 h) average. Maybe it should be only the daytime average?

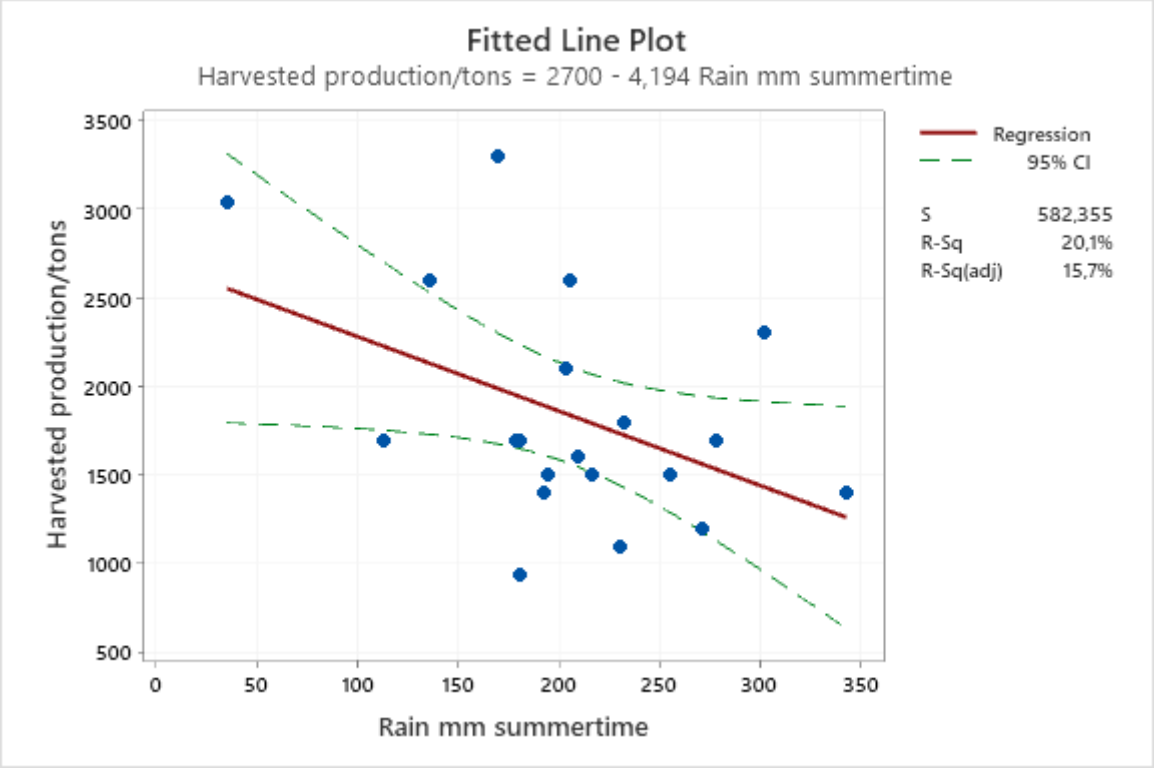


Production/beehive/kg versus Avg temperature summertime (below) is aligned with the above image. The higher the temperature, the higher the production per beehive.

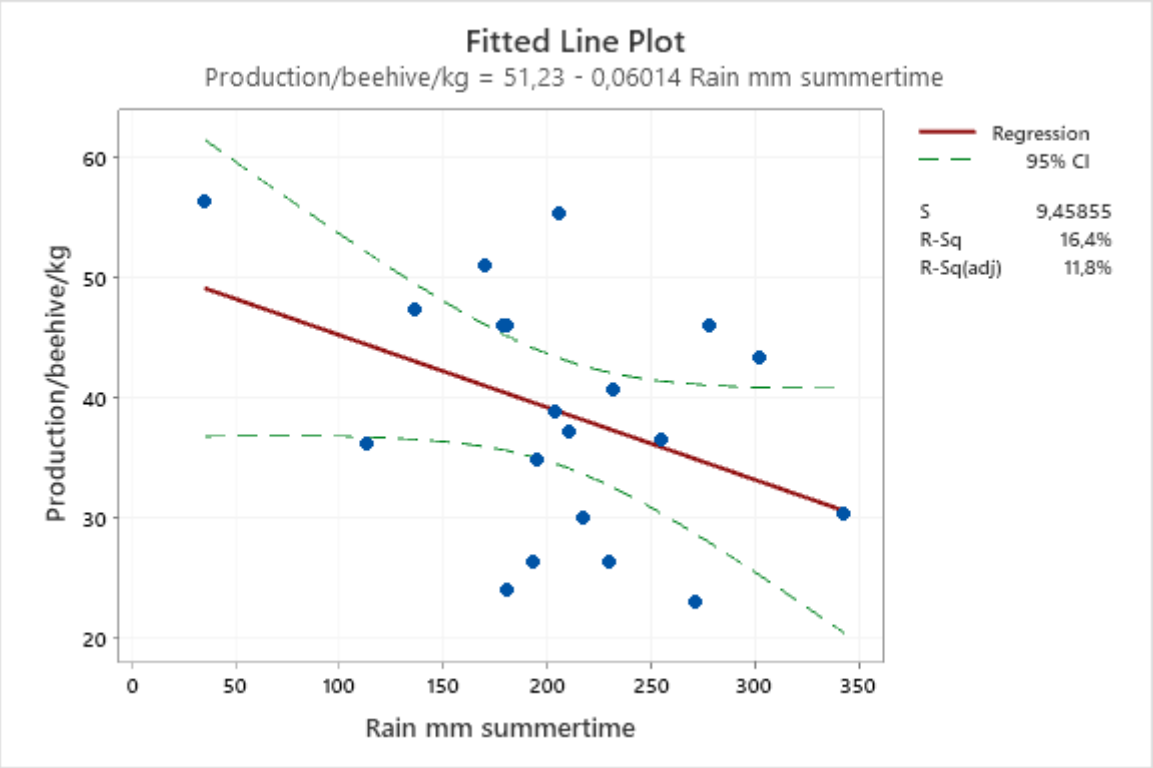
The variation of production/beehive is from 20 - 55 kg. Is this in line with other countries?



Total rain in summertime in Helsinki vs. honey production tons. The more rain, the less production. Again the production numbers are from several locations and the rain measurement only from one location. Not a reliable analysis but it gives some kind of estimation.



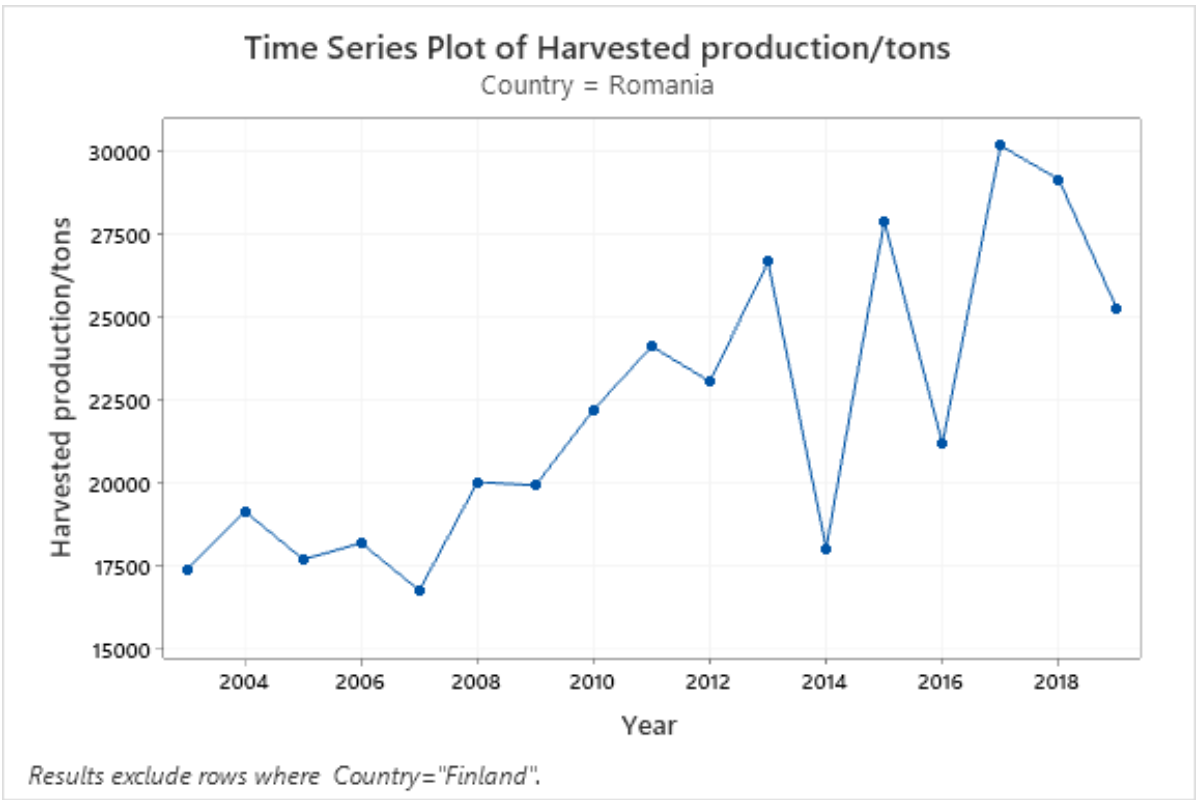
Production/beehive/kg versus Rain mm summertime is in line with above chart.



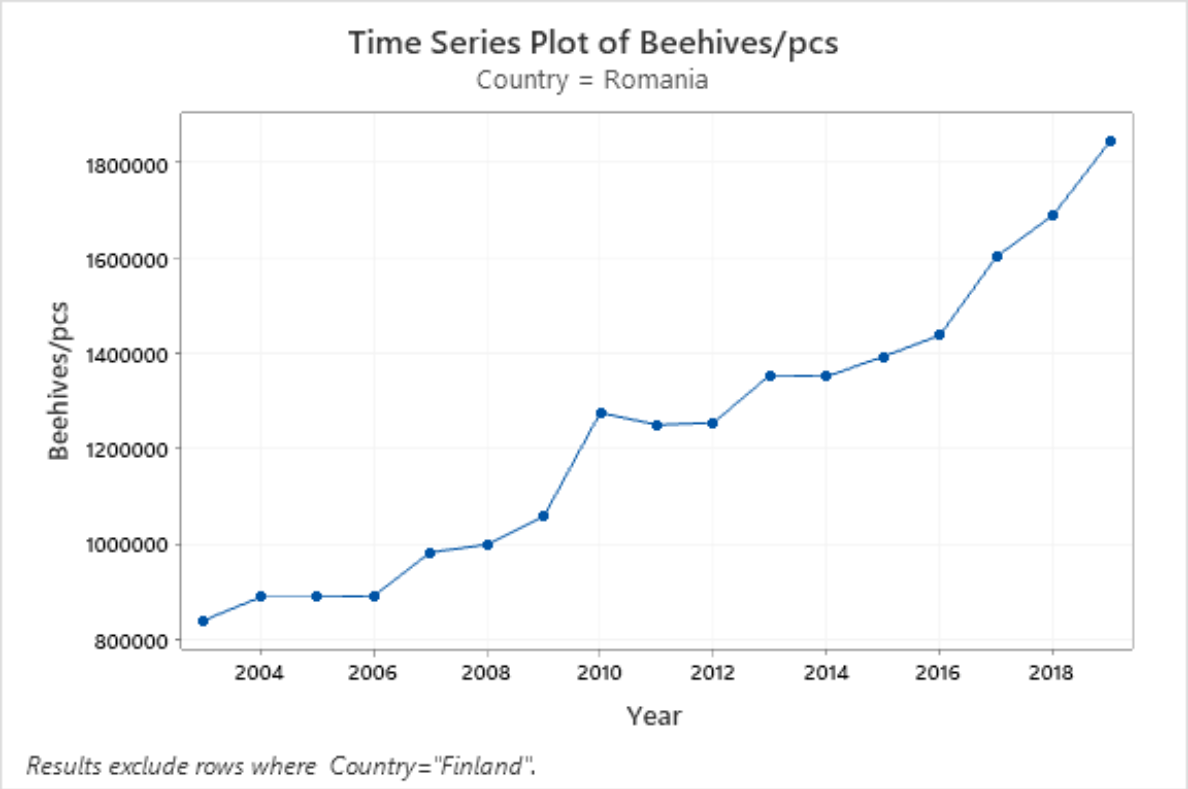
4. Romania

4.1 Trends by time series in Romania

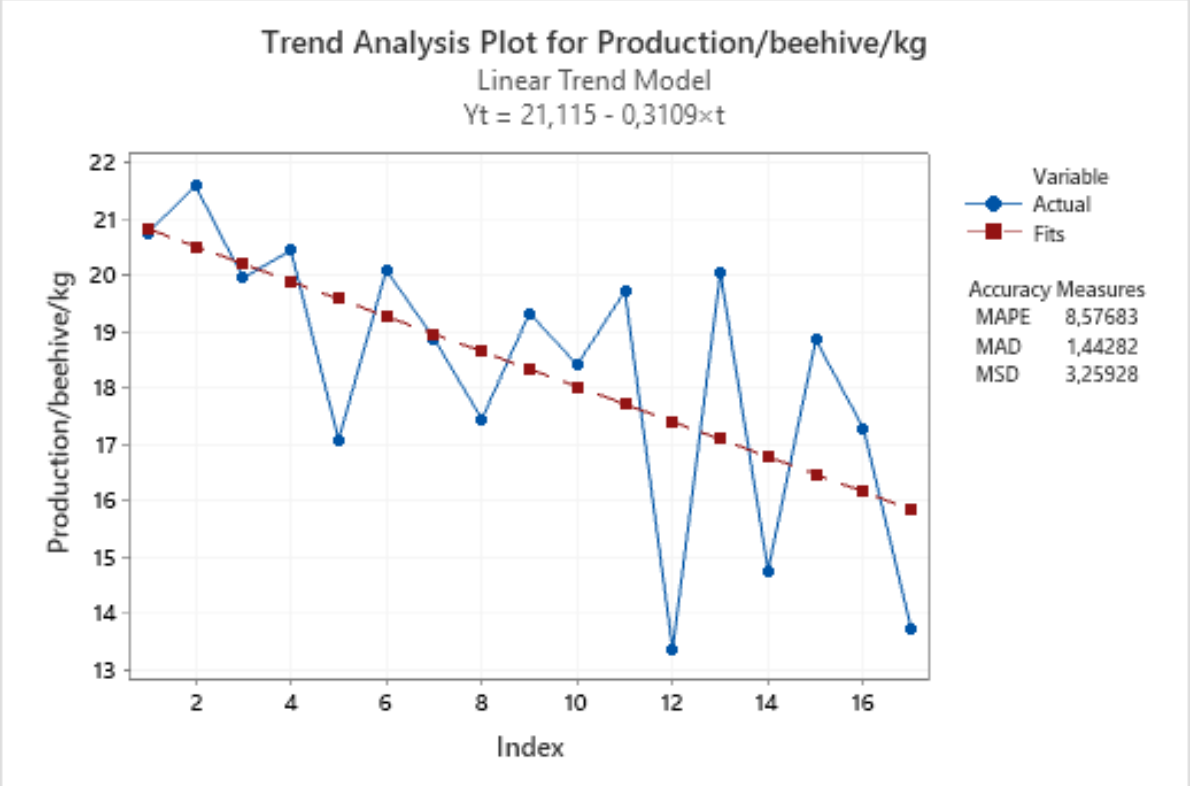
Amount of honey produced in tons. The rising trend is disturbed by three different years. What happened in 2014, 2016 and 2019?



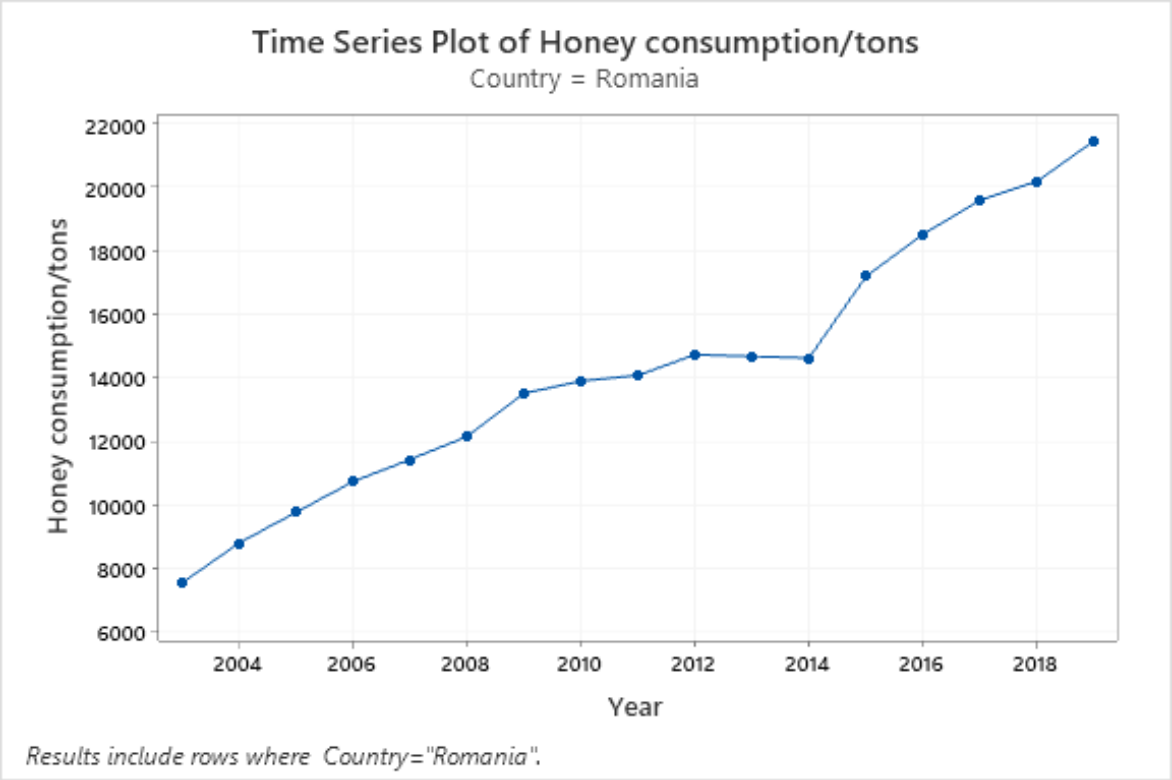
Amount of beehives has increased accordingly.



The trend of production/beehive has been decreasing. Why is that? Also what happened in 2014, 2016 and 2019 when the production collapsed? What has been done to change the trend?



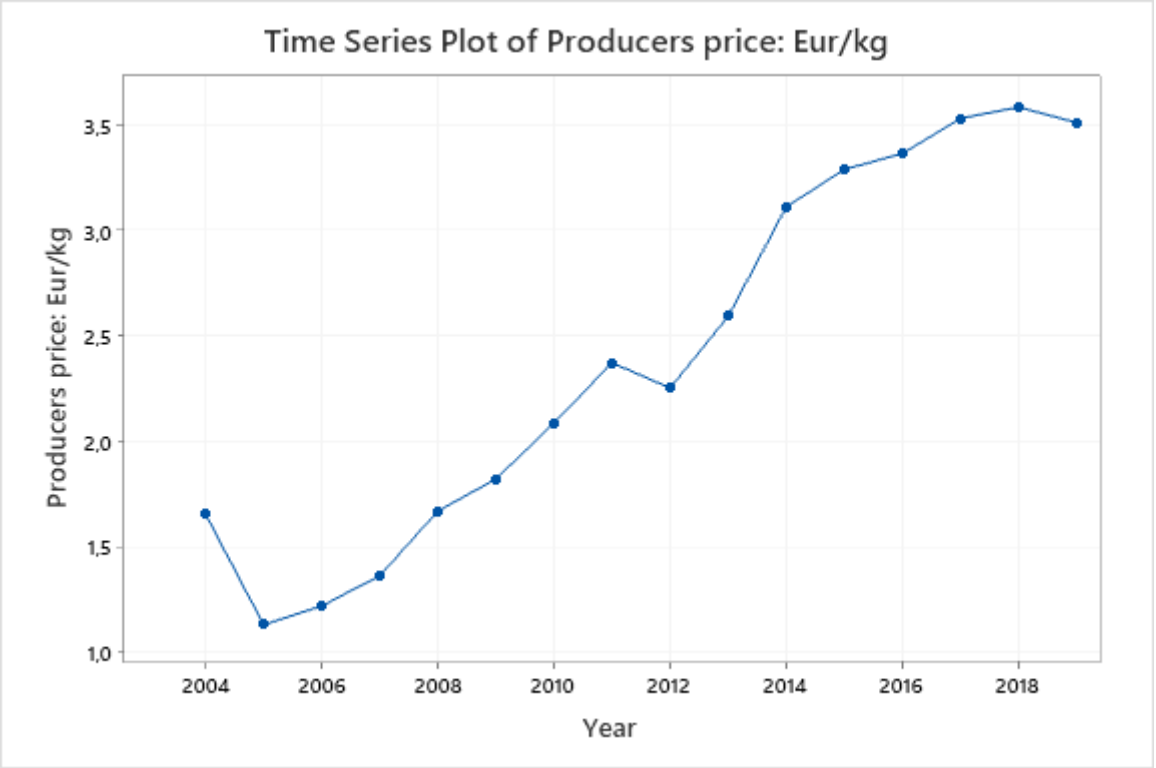
Honey consumption has increased steadily during the last decades.



The time series plot shows the trend for producers price EUR/kg.

NOTE In Finland In 2013, the production of one kilogram of honey cost the beekeeper an average of EUR 13.26. The average income was 11.30 euros per kilogram of honey, so each kilogram of honey generated a loss of just under two euros. This information is based on the news published by LUKE in 2013. LUKE is the research institute on natural resources[3]. Honey production is not a viable business in Finland. It's a hobby.

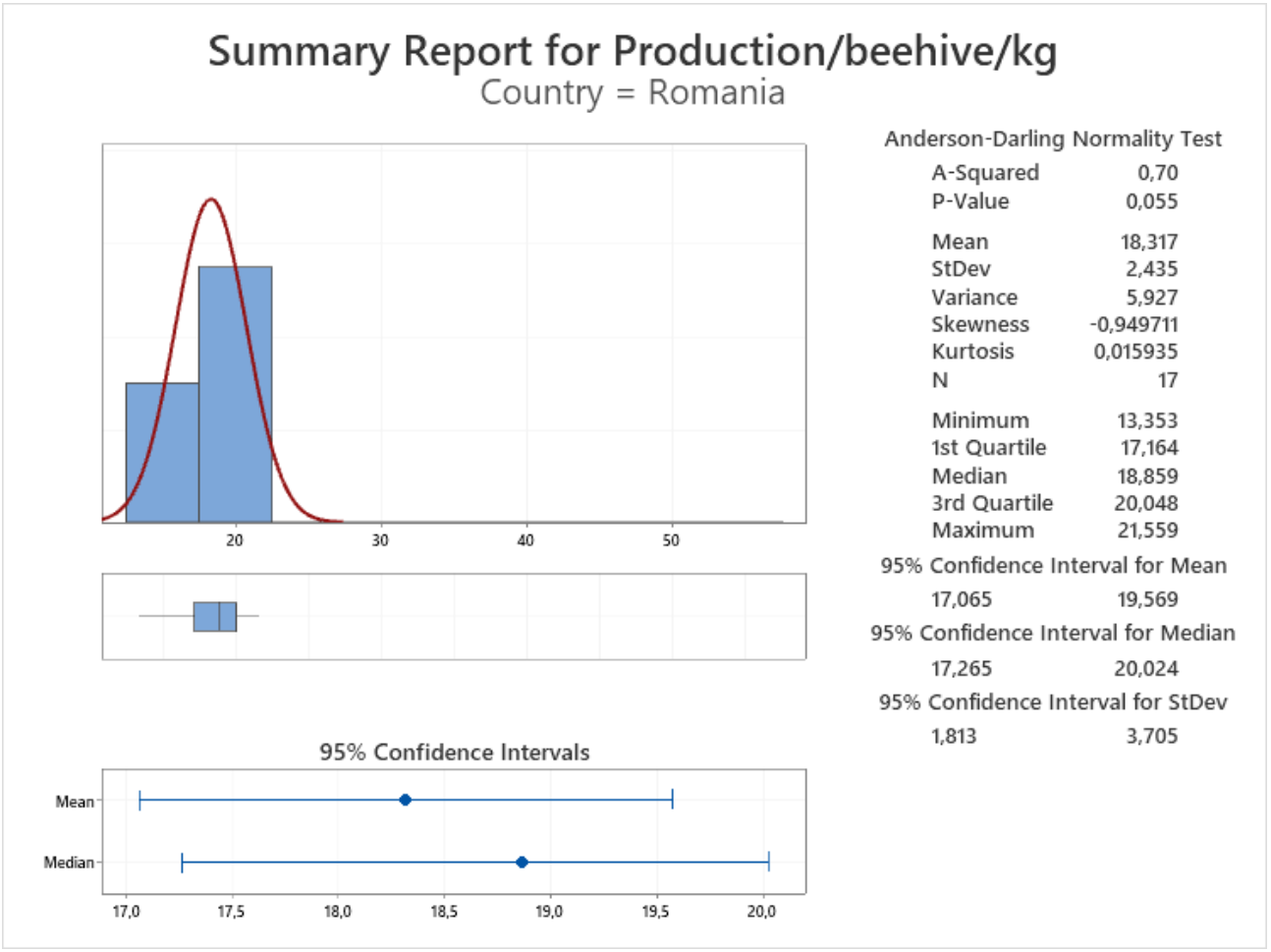
[3] https://www.luke.fi/uutinen/hunajantuotanto-on-kannattavaa-vain-suurilla-mehilaistarhoilla/



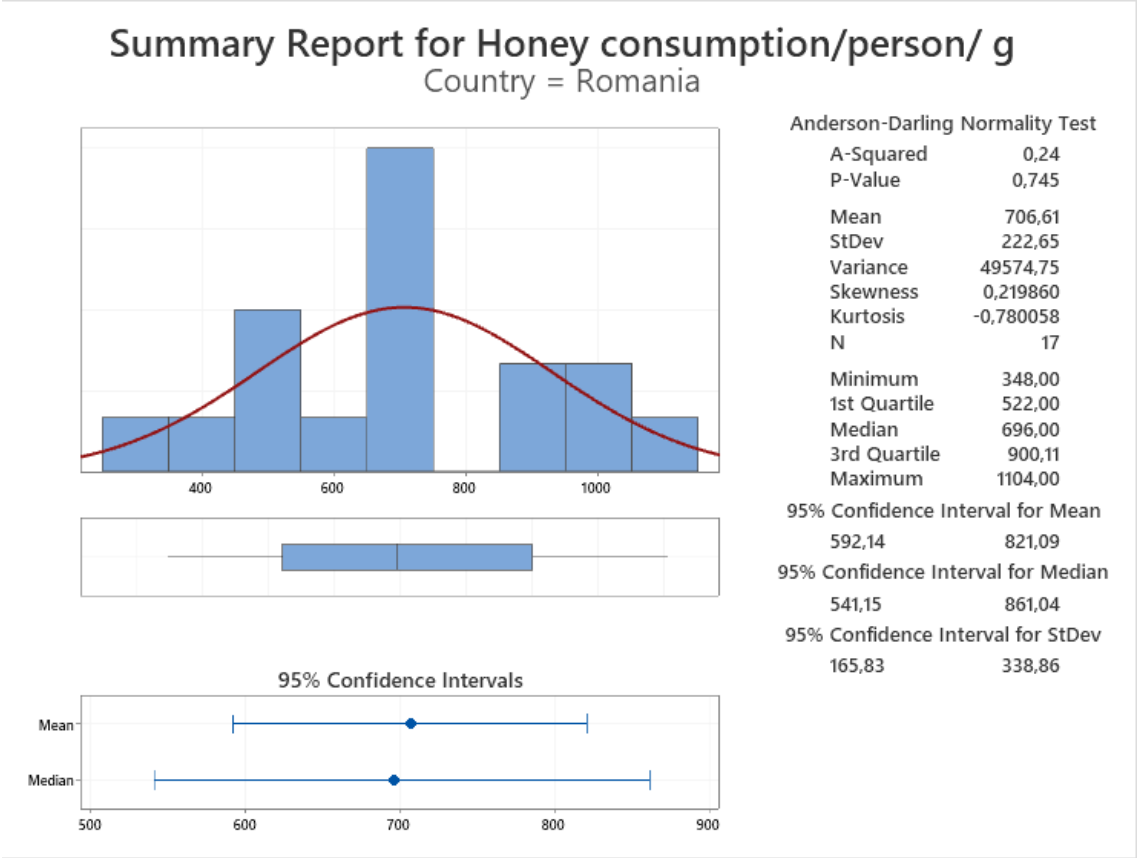
4.2 Performance in Romania

Performance analysis purpose is to give an idea of the process performance in relation to the expectation which can be expressed in specification ranges.

The production/beehive varies from 13 up to 21 kg. The average is 18 kg. The production/beehive is pretty low. Is this correct?



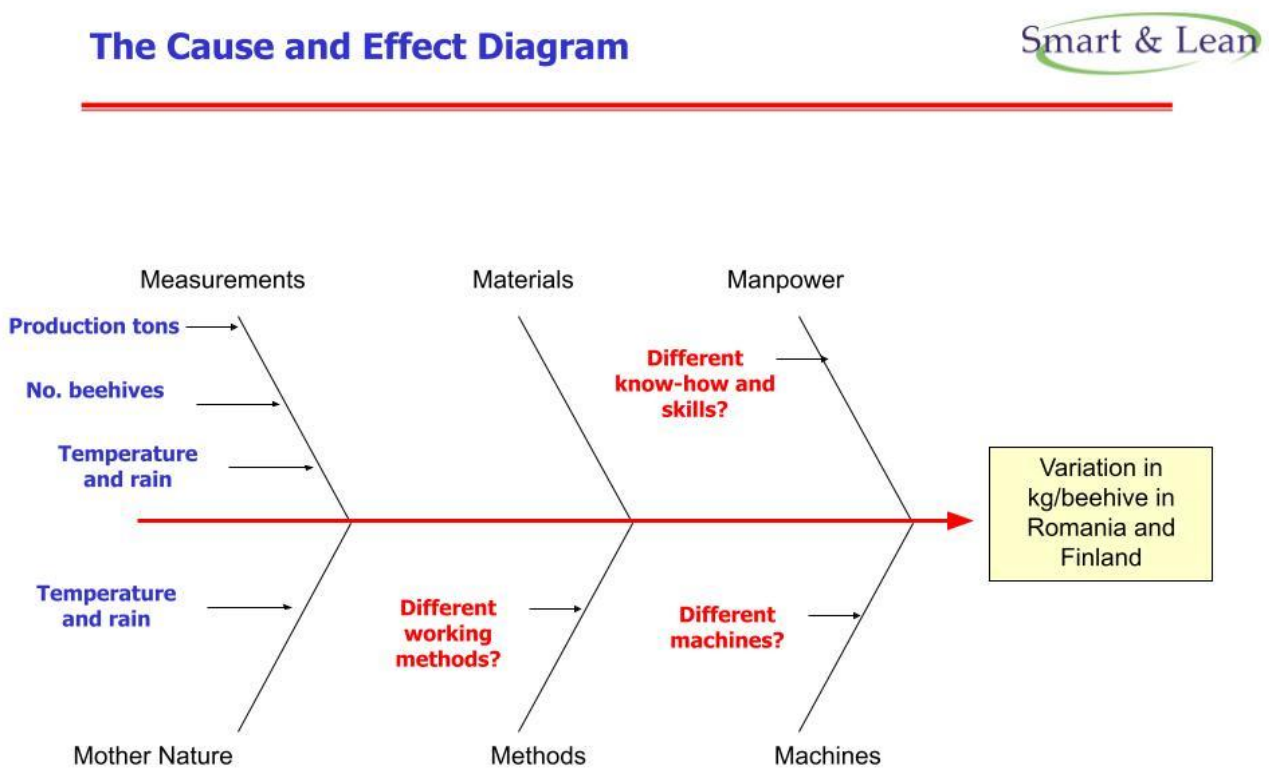
The consumption/person is 700 g according to the data which is based on the whole population.



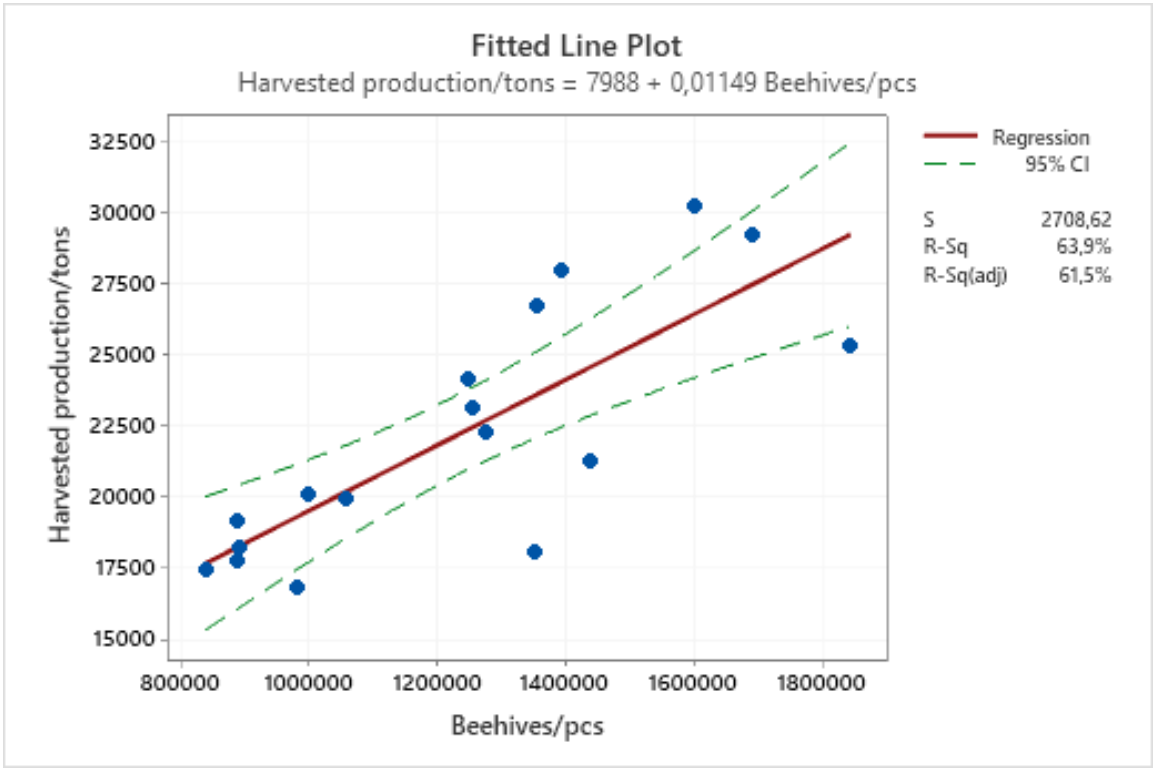
4.3 Testing causes and effects - correlations in Romania

The below cause and effect diagram performs a hypothesis of possible causes for variation in production per beehive. The potential causes which are blue are later tested in this chapter.

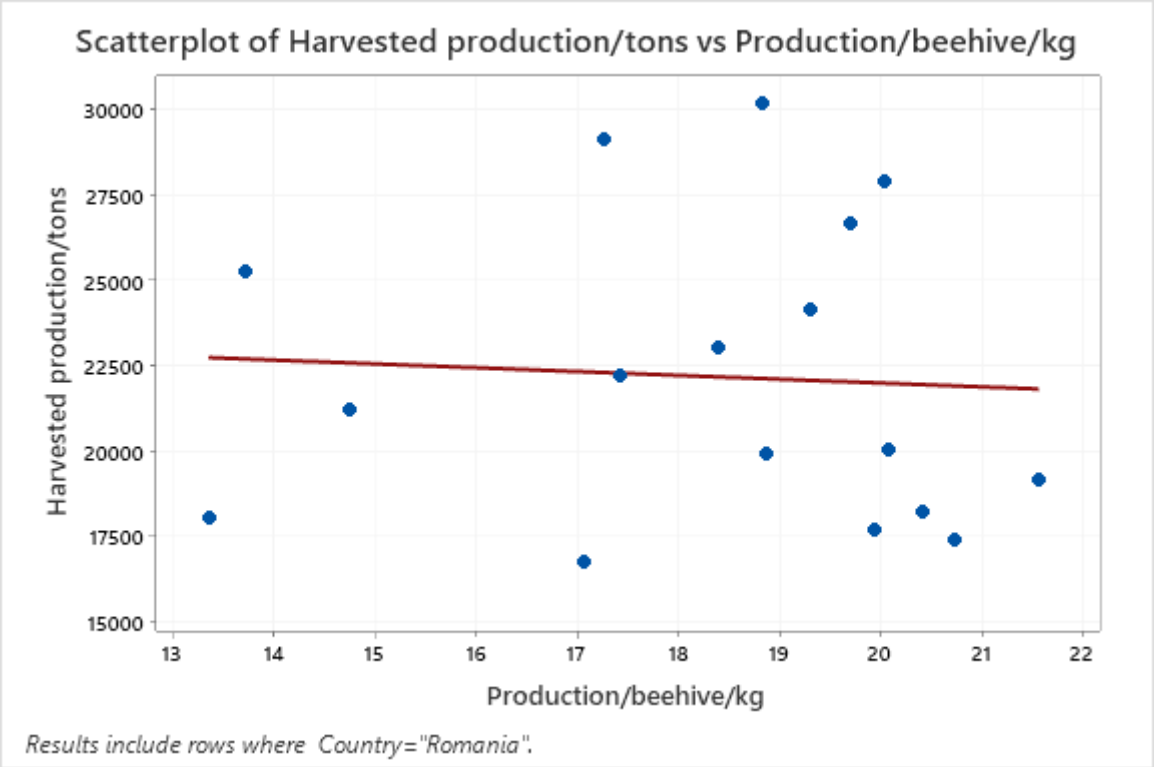
The potential causes which are red are not tested, but they are included in the cause and effect diagram for documentation purposes and for the future.



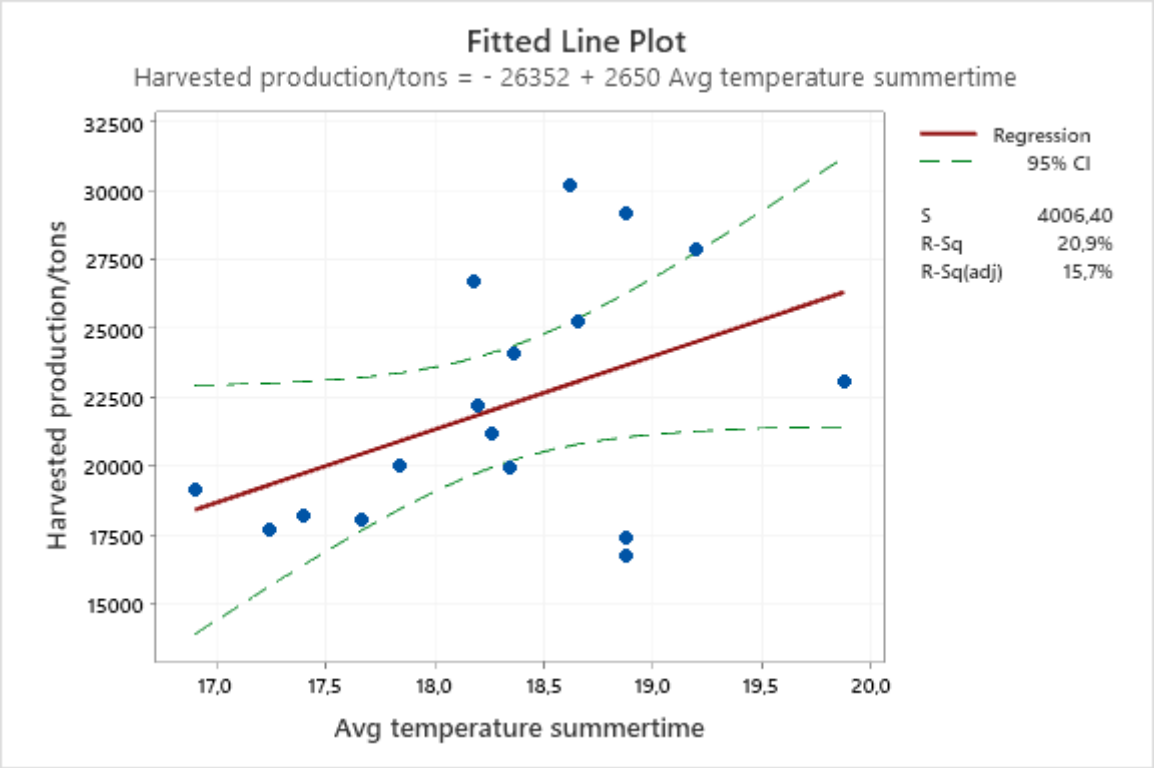
The correlation between total production and number of beehives is strong.



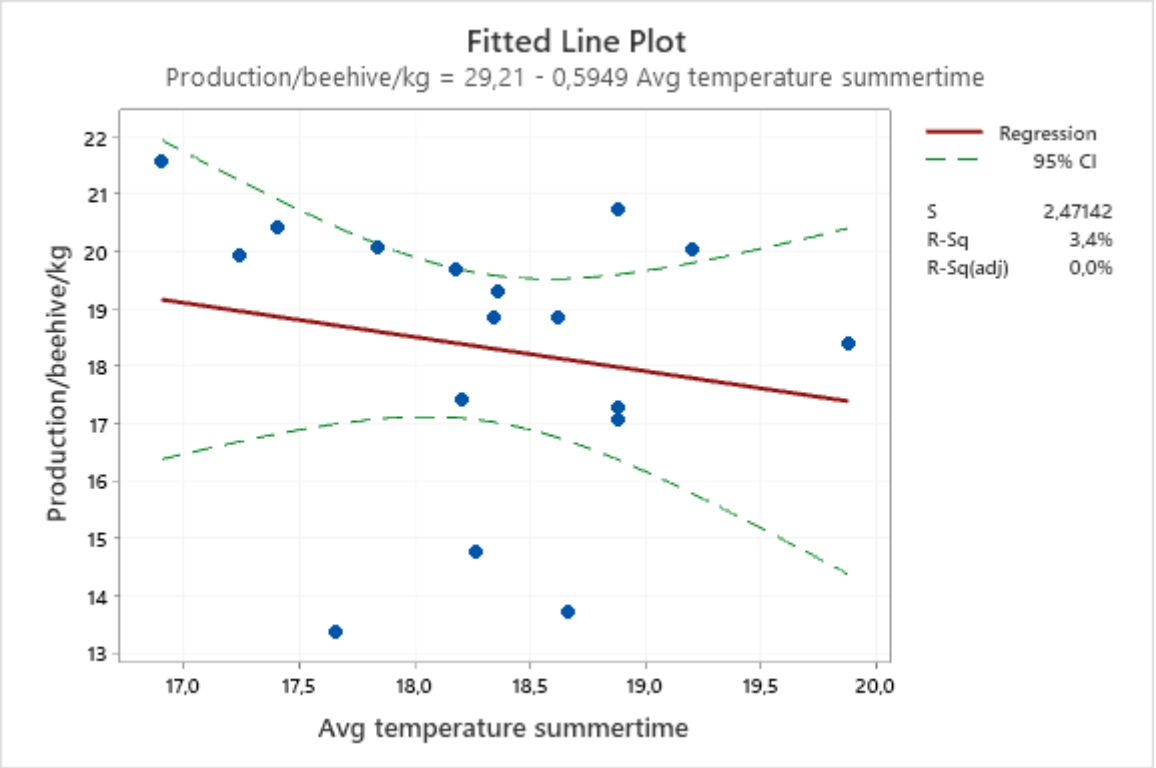
There is no correlation between the total amount of honey produced and amount of beehives. This is odd and requires explanation. Is the data correct?



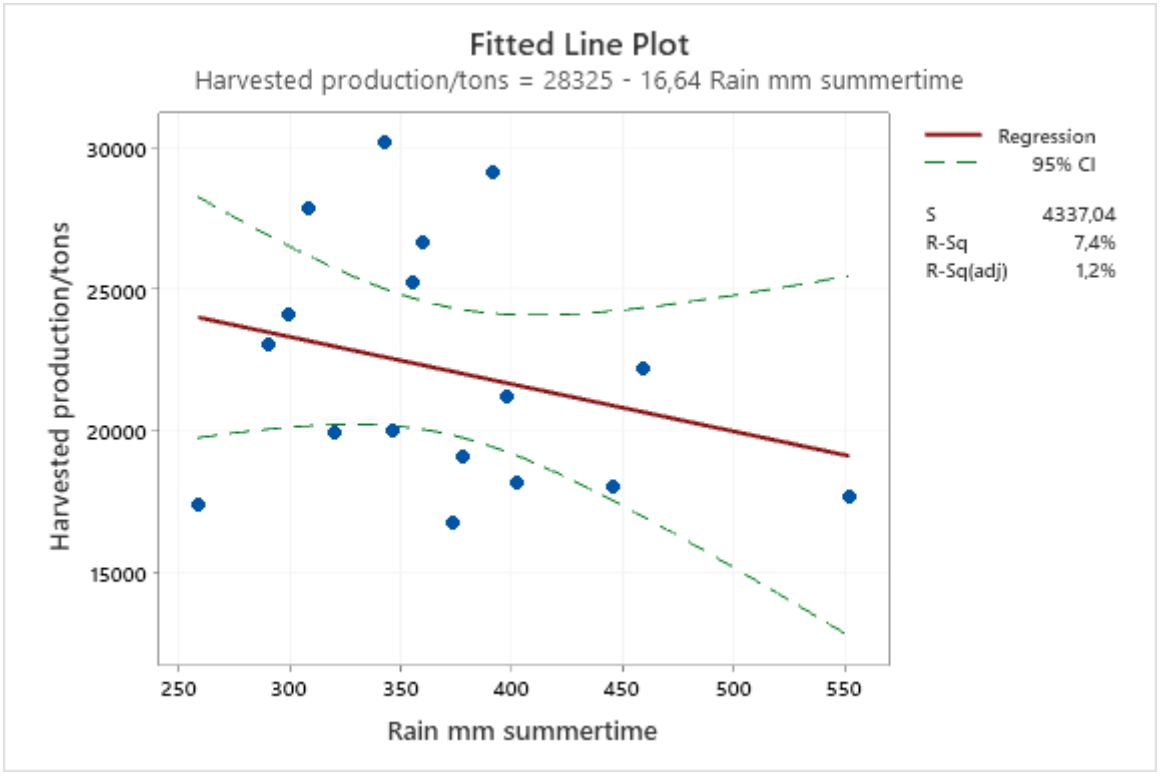
Average summer temperature (C) in Romania vs. honey production tons has a positive correlation as assumed.



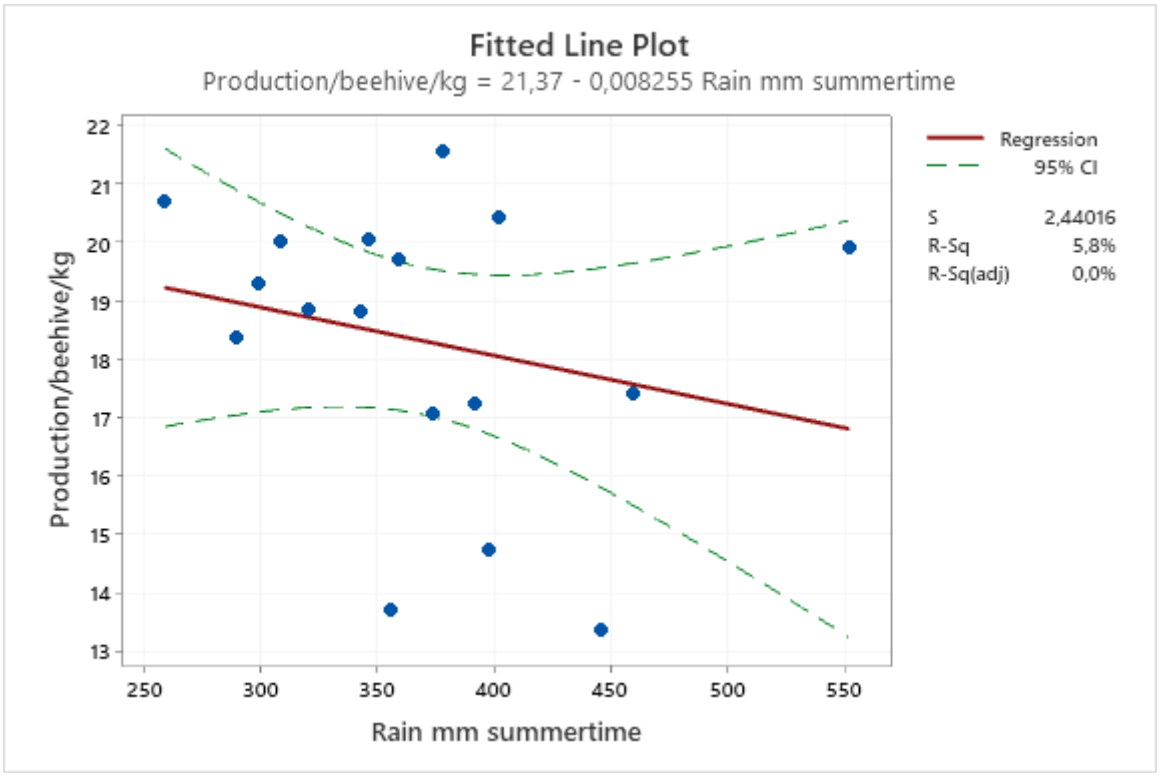
The ratio between the average summer temperature (C`) in Romania vs. Production/beehive/kg doesn’t seem to be as assumed. The assumption is the warmer the more production/beehive. This data and visualisation don't confirm the assumption.



Regression analysis on Harvested production/tons versus Rain mm summertime show the negative ratio, although the variation in data causes uncertainty.



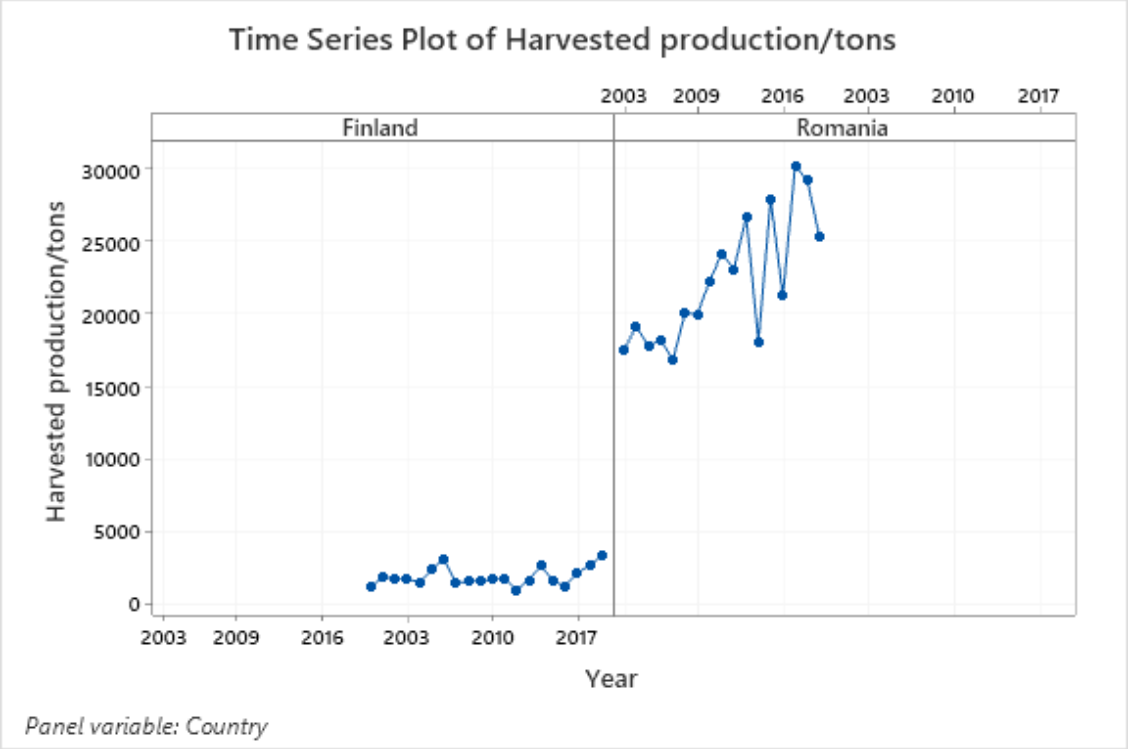
The regression analysis on the Production/beehive/kg versus Rain mm summertime gives a result, but I wouldn't trust this.



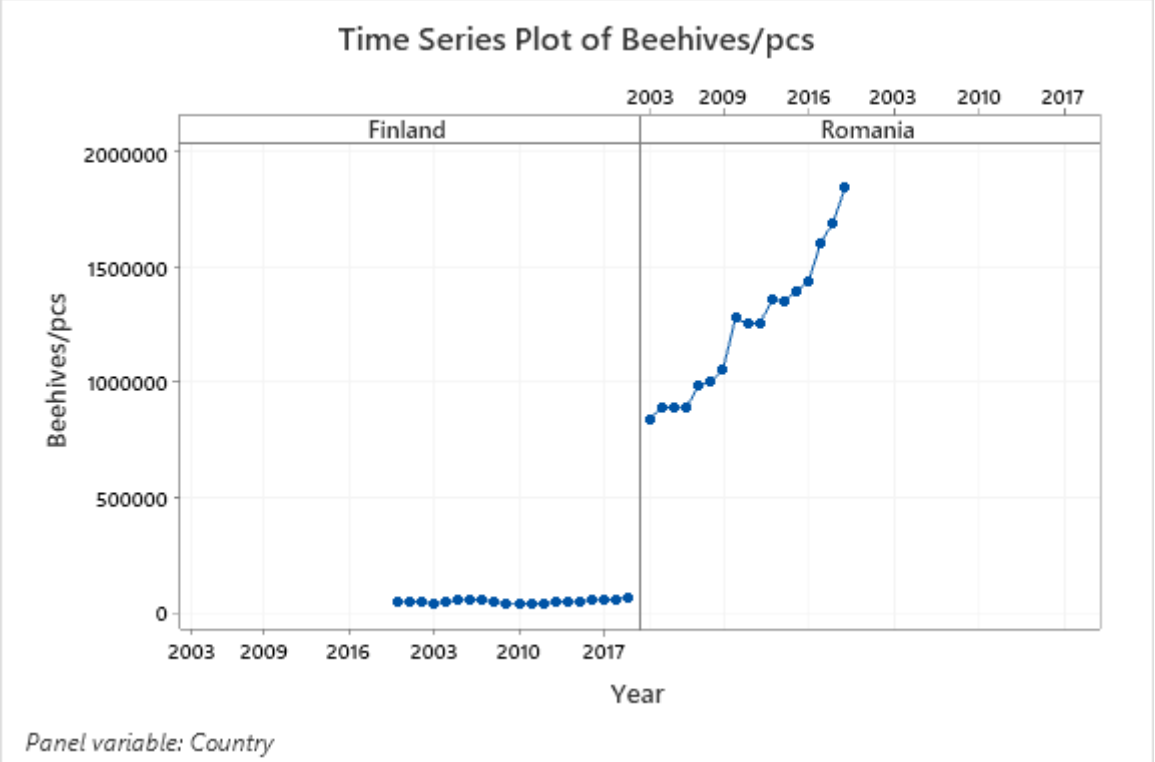
5. Comparisons Romania/Suomi

5.1 Production process

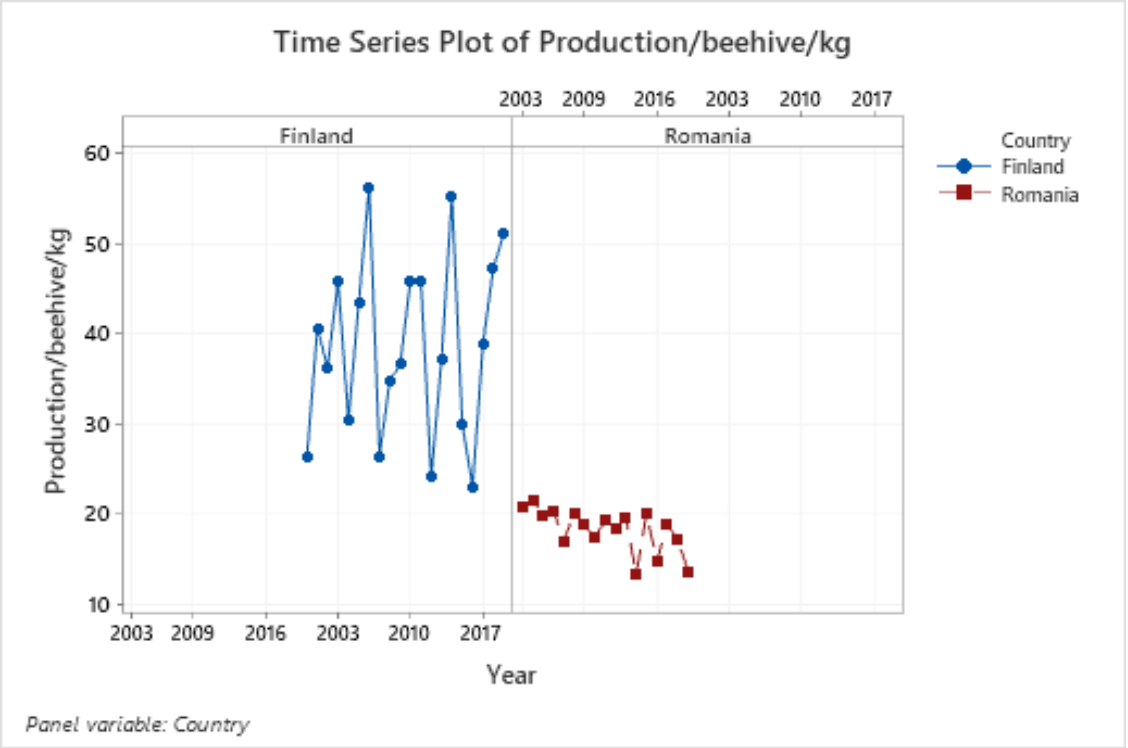
Comparison between harvested production quantity in tons. Finland is a small player compared to Romania.

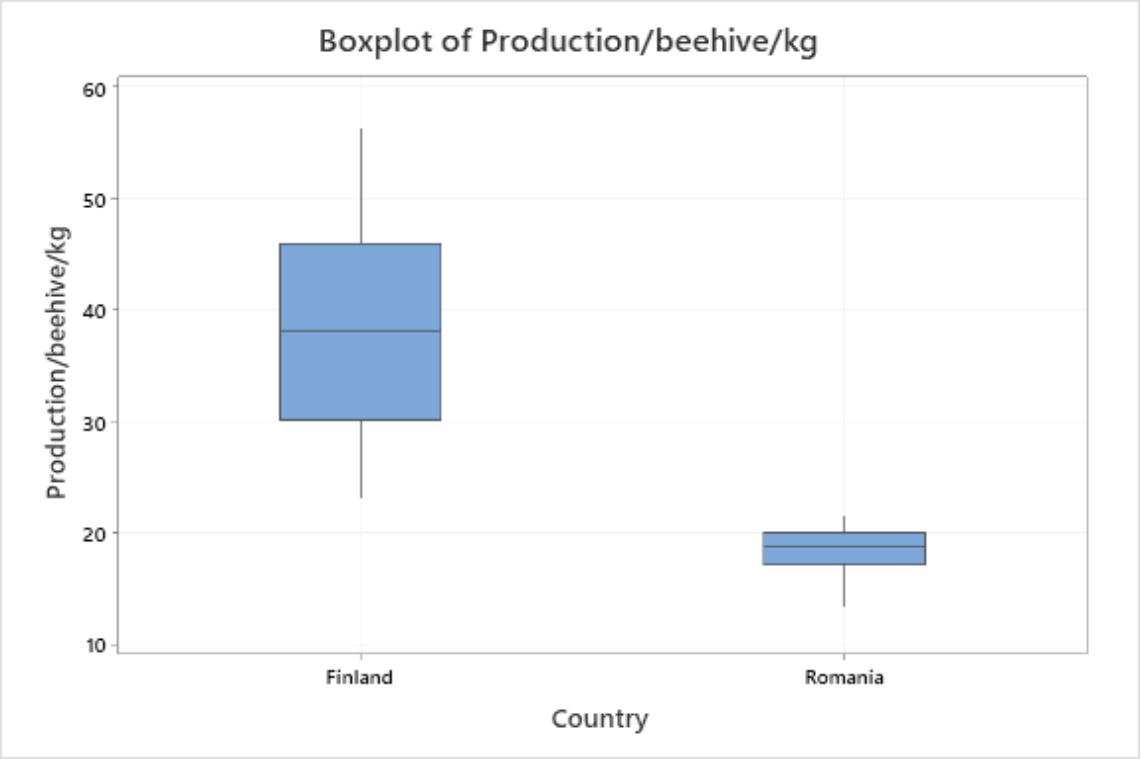


Comparison between quantity of beehives. Finland is a small player compared to Romania. Finland's situation has been the same for a long time, but Romania has increased the number of beehives.



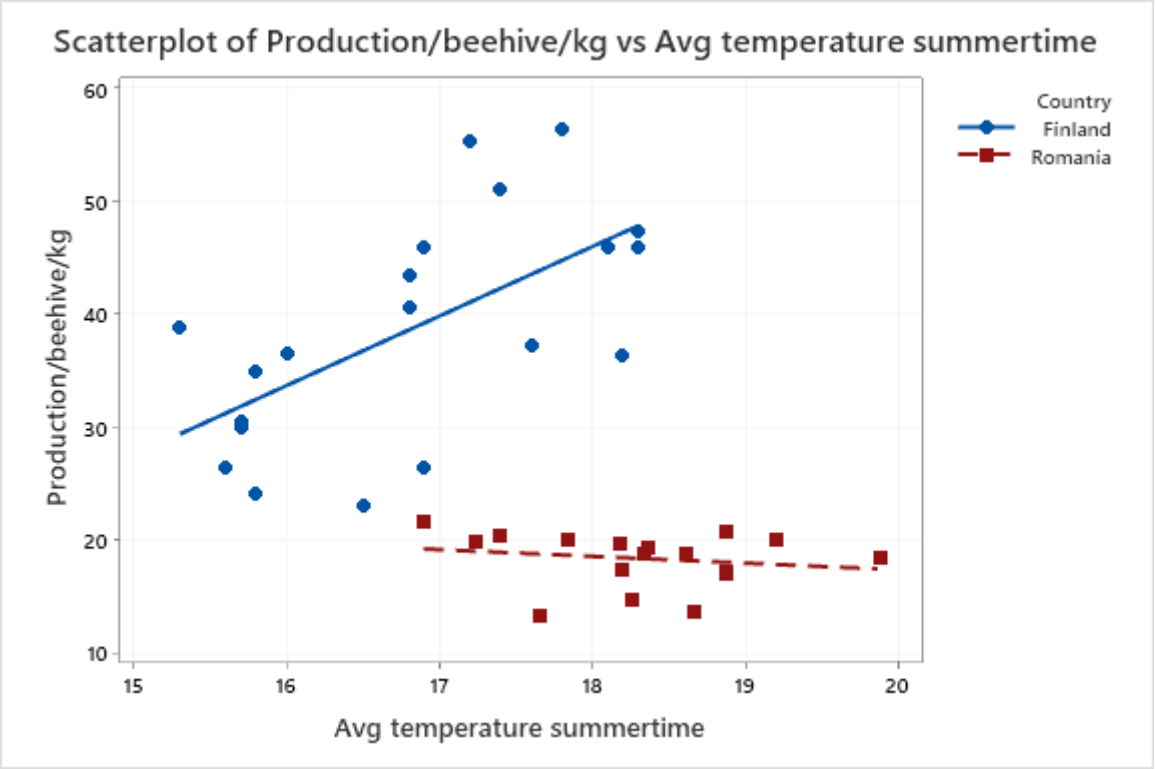
Comparison between production/beehive in kg. According to the data the production of a beehive is bigger in Finland and there is more deviation over years. Romania's production per beehive is stable but it's very low compared to Finland, although for example the temperature is higher in Romania. There is something which needs more studies.





The comparison between production/beehive and temperature is outlined below.

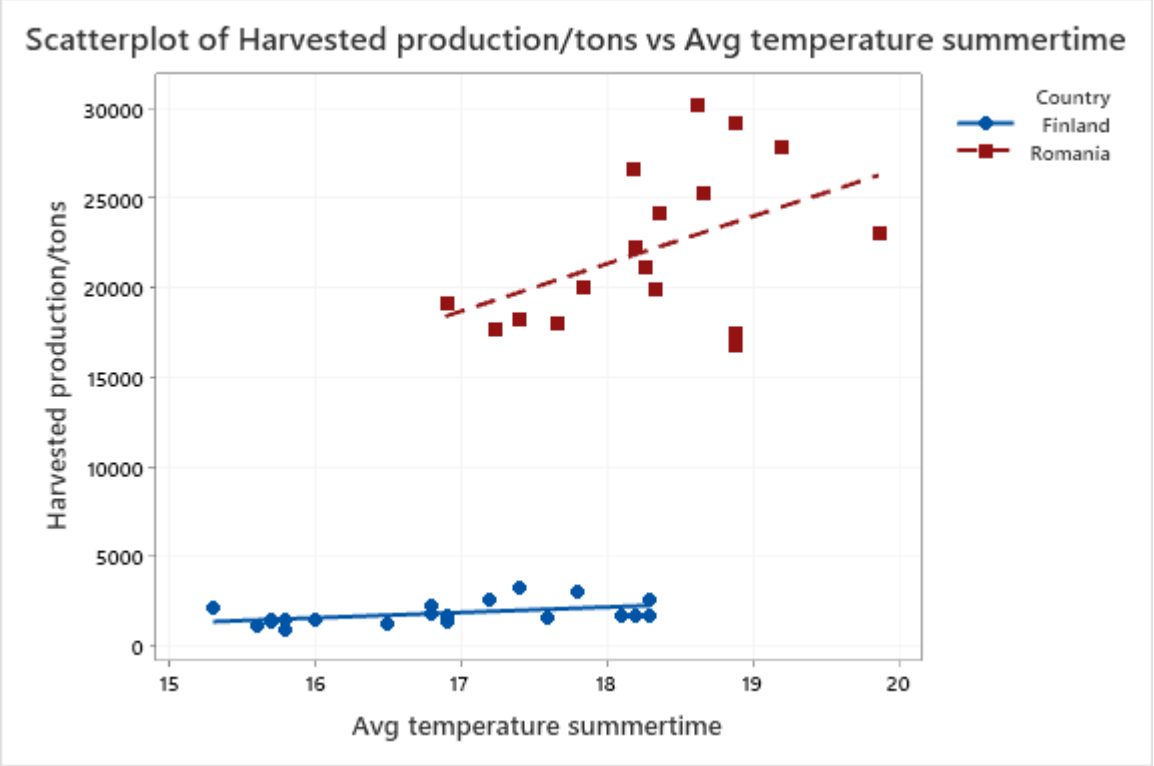
Romania: the production/beehive is at the same level, although the temperature rises. Why is that? Finland: The production/beehive varies a lot but there seems to be a positive correlation between production and temperature.



The comparison between production and temperature is outlined below.

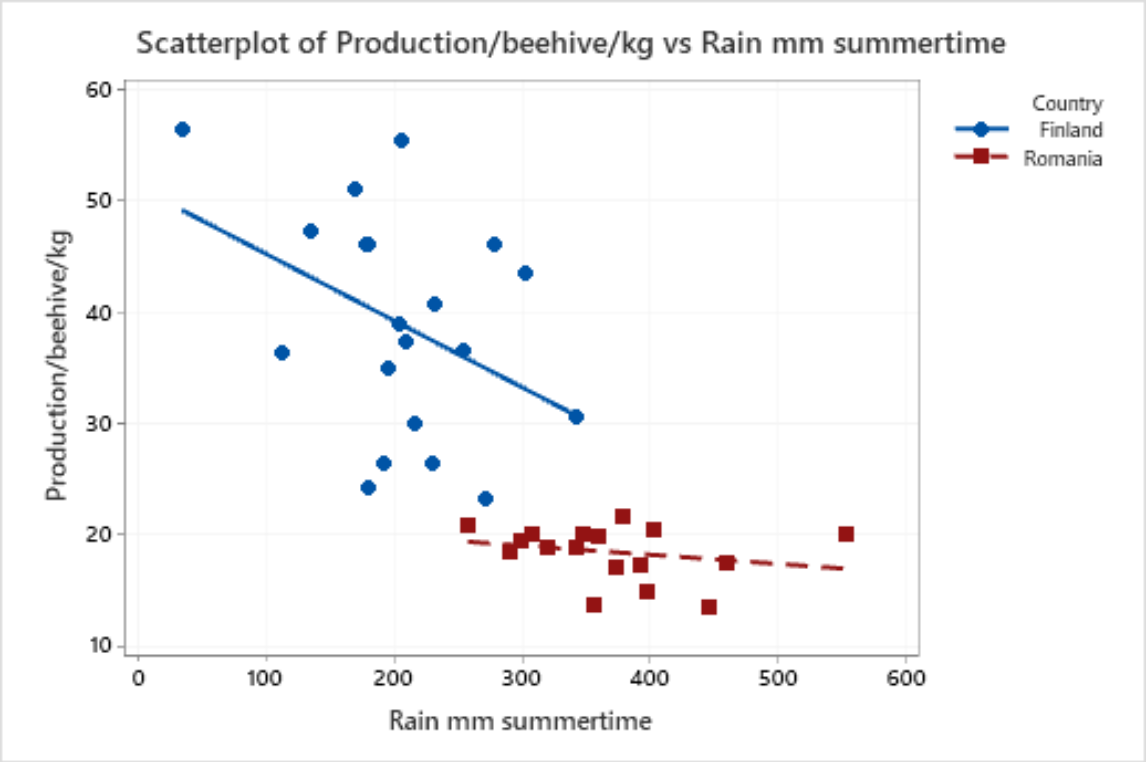
Romania: the production and temperature has a positive correlation

Finland: Compared to Romania, there doesn't seem to be a remarkable correlation between production and temperature.



The comparison between production/beehive and rain is outlined below.

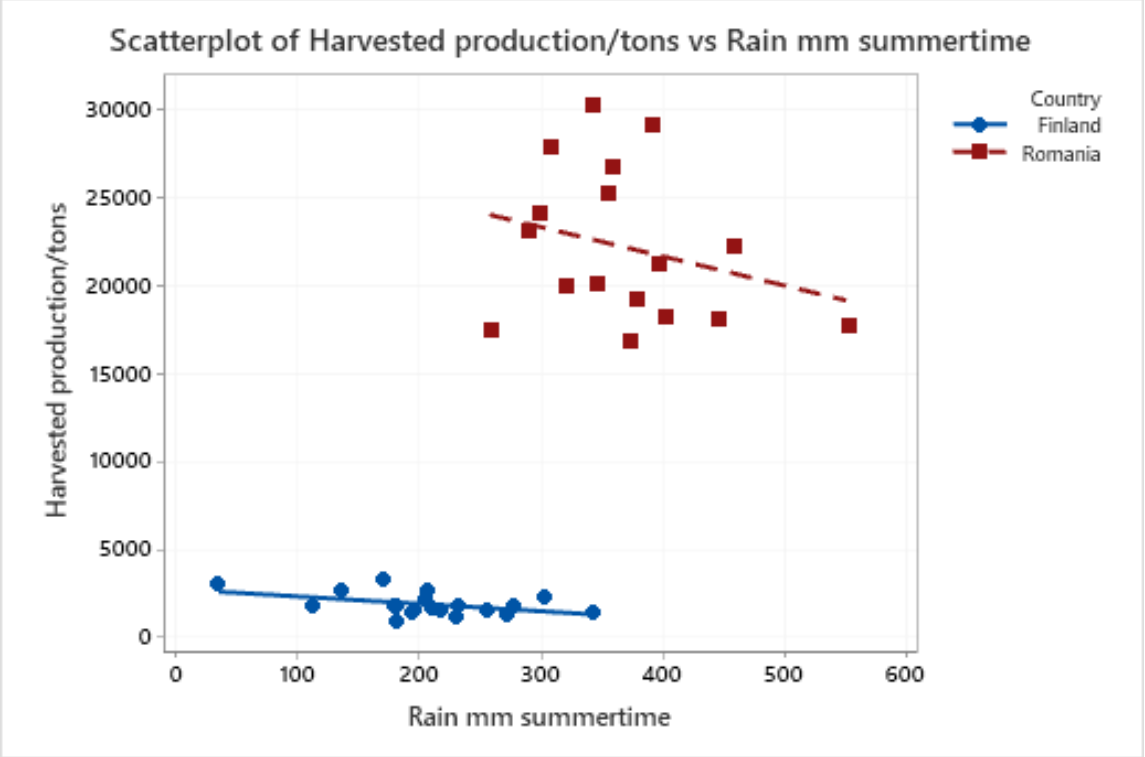
The production/beehive and rain has no clear negative correlation. The variation is particularly big in Finnish data.



The comparison between production and rain is outlined below.

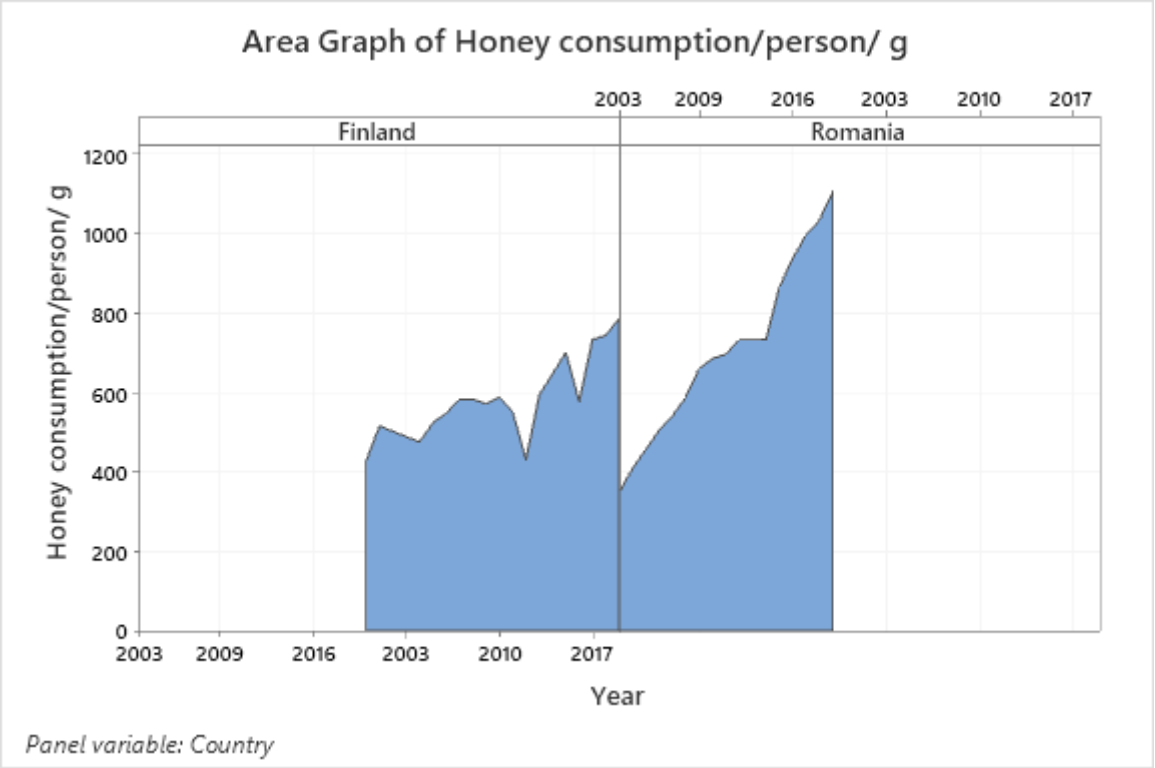
Romania: the production and rain has a negative correlation - TRUE

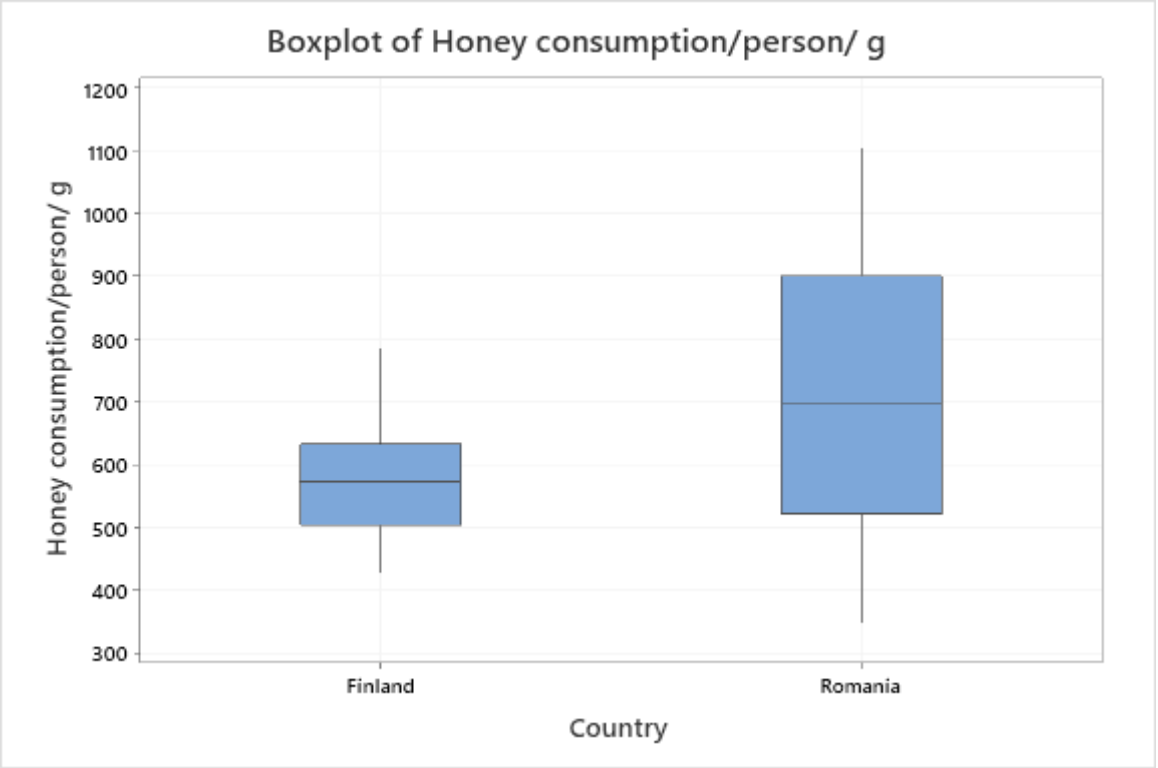
Finland: Compared to Romania, there doesn't seem to be a remarkable negative correlation between production and rain.



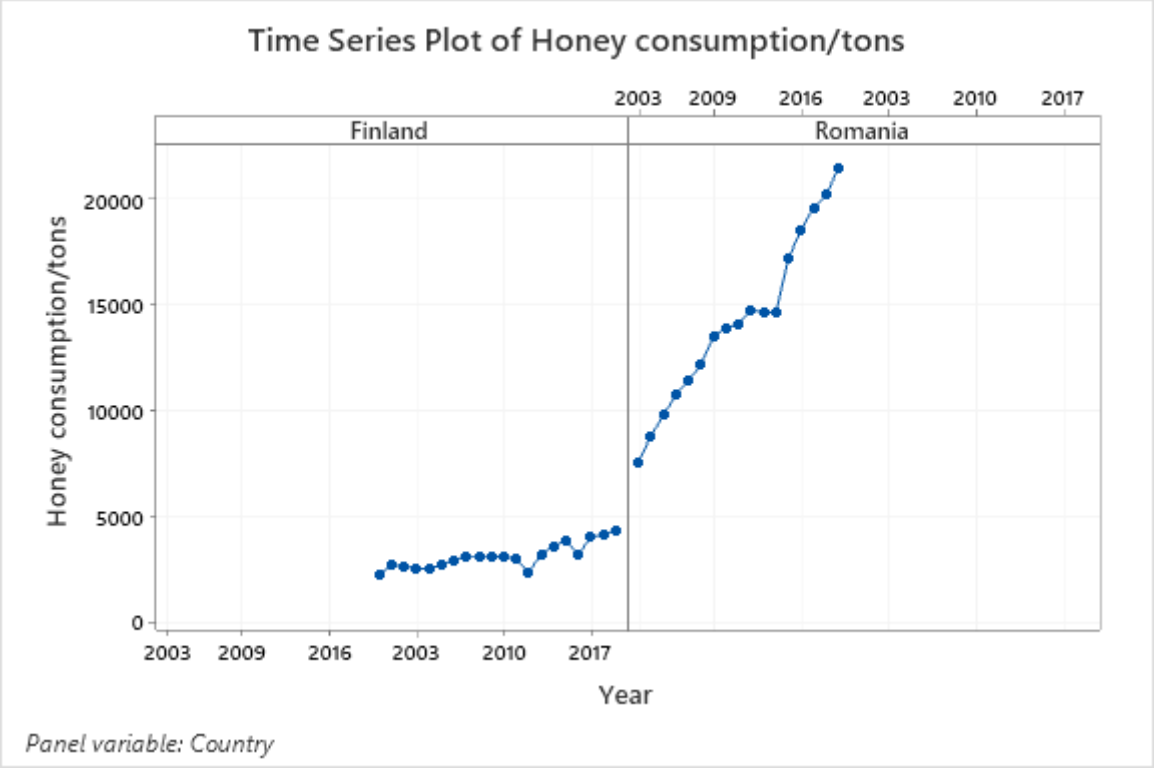
5.2 Consumption

The domestic honey consumption per person trend in both countries is rising and the amount of used honey/person is at the same level. Based on the calculated index of consumption/person, the variation in consumption is bigger in Romania (see the lower chart - Boxplot).





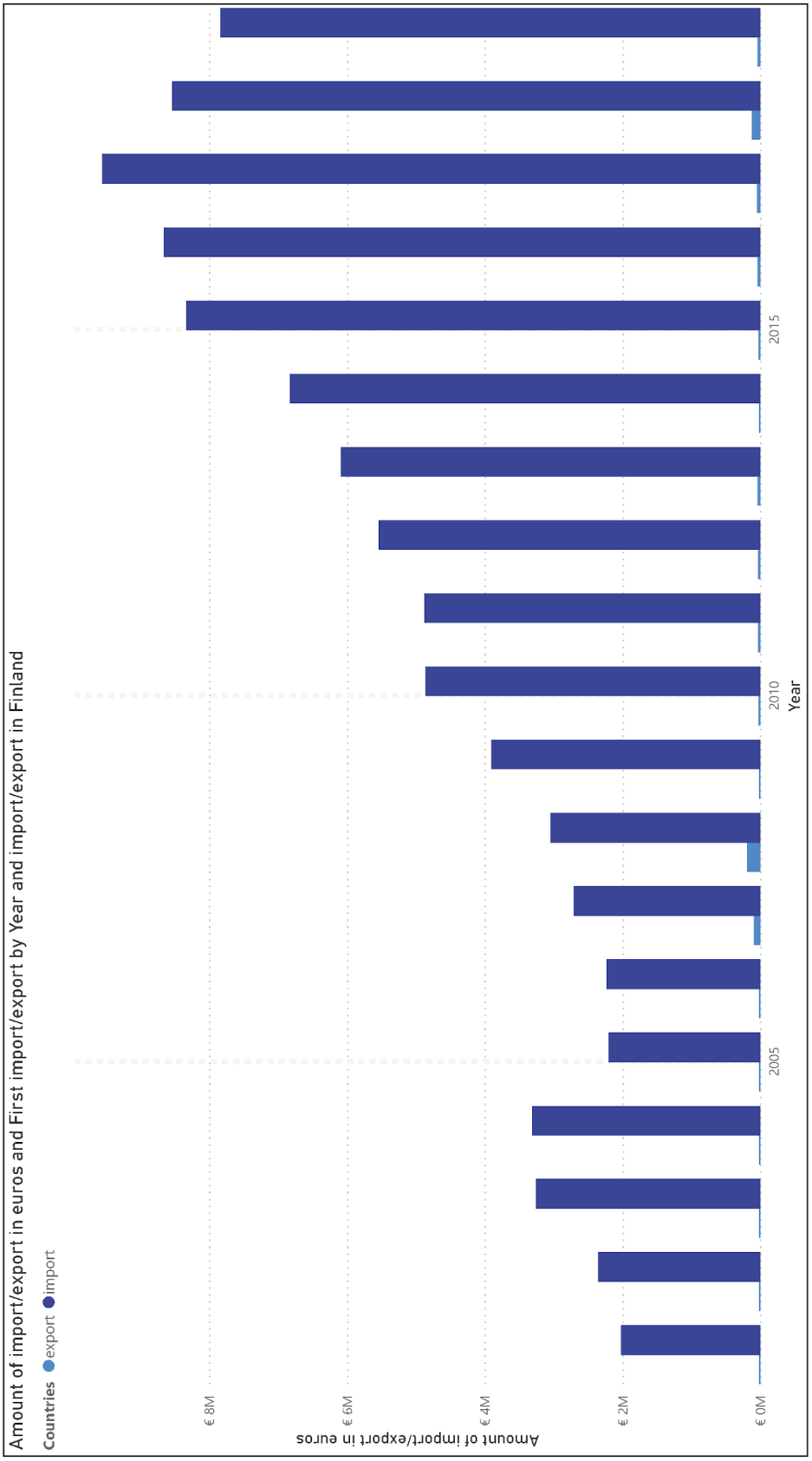
The total consumption in Romania is increasing aggressively. Why is that? Is the reason for improved availability or for the improved economical situation or something else?



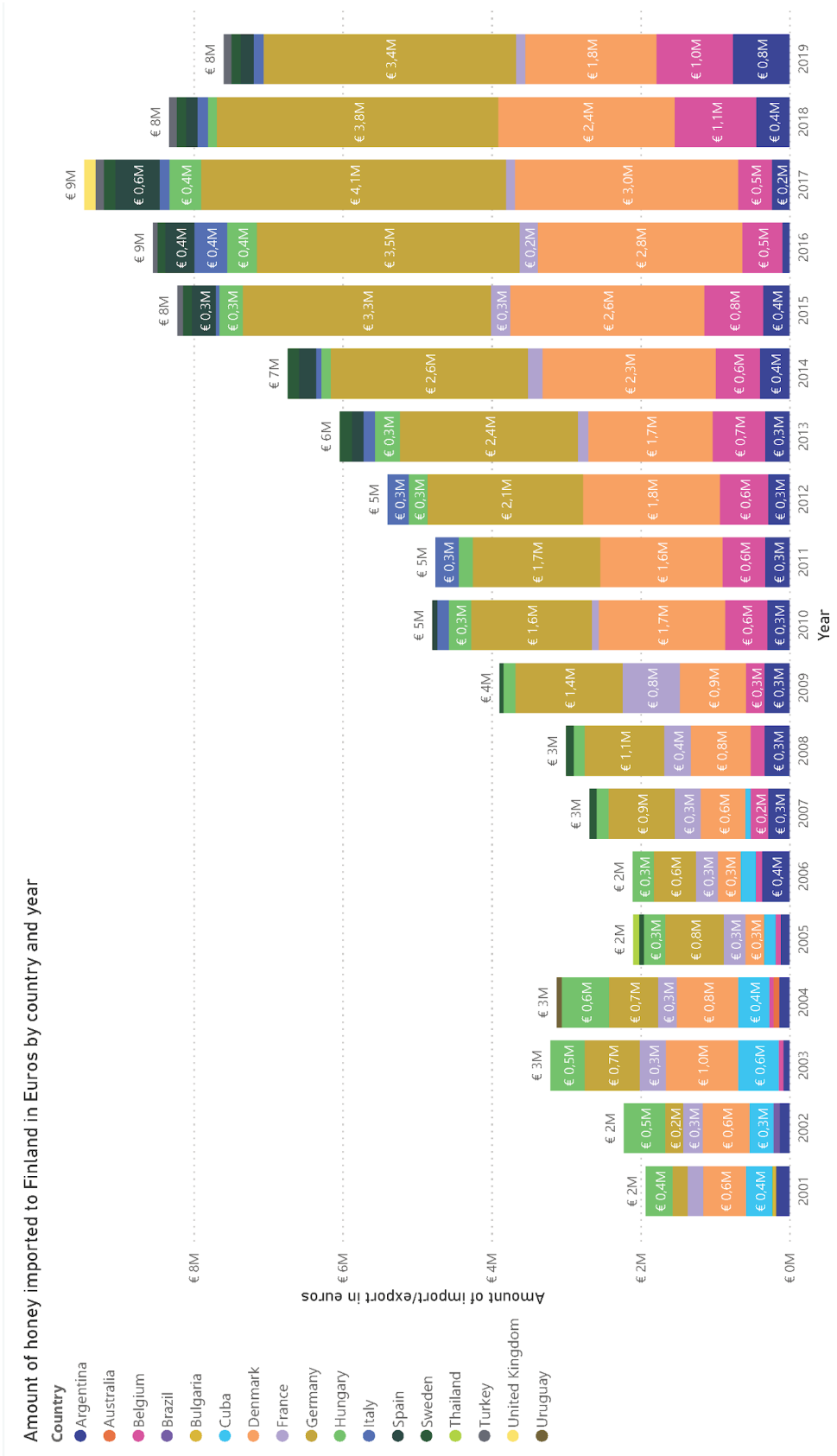
6. Honey import and export

6.1 Honey import and export in Finland

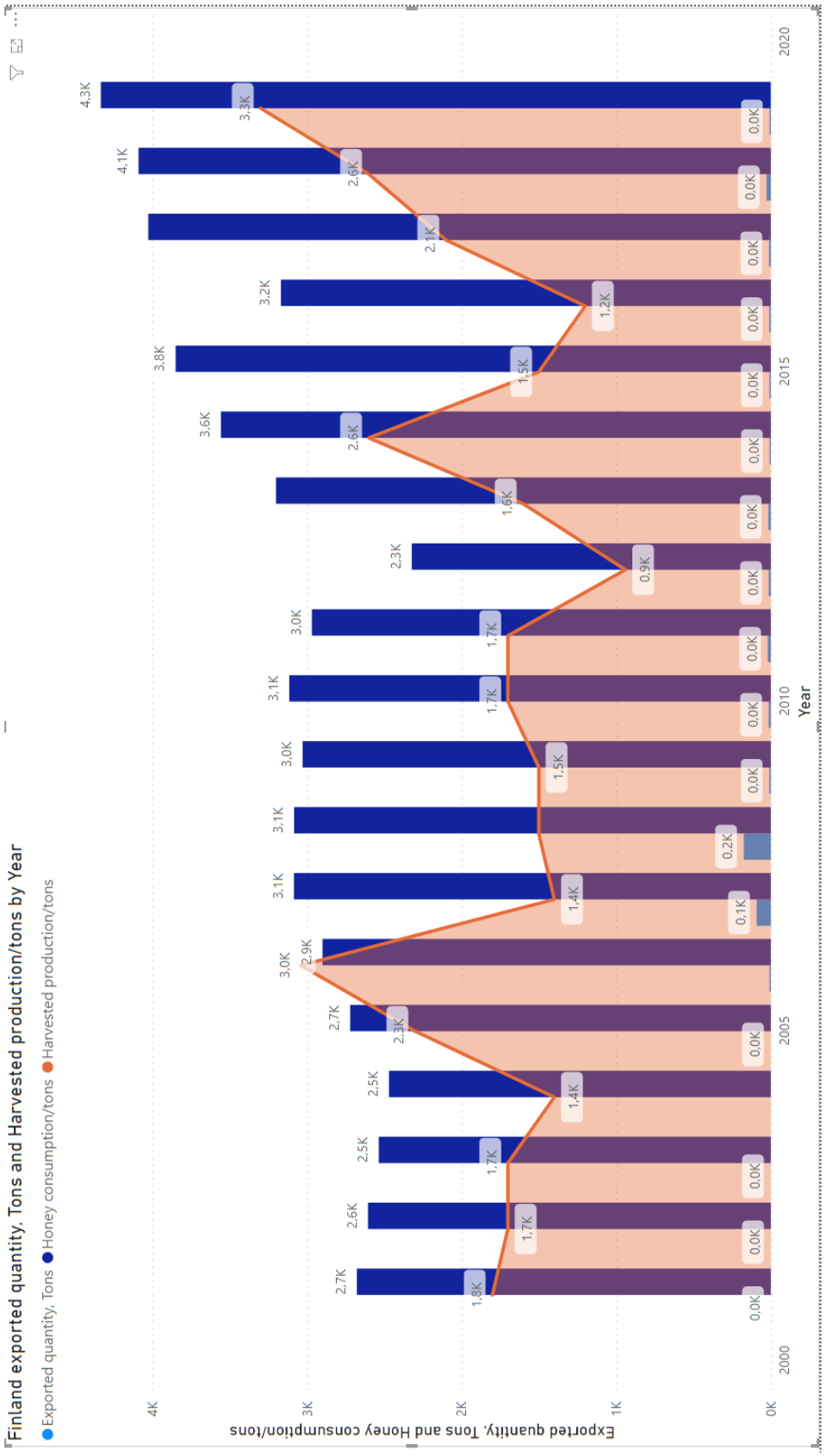
There is no export, but a rising trend of import.



The main countries of which Finland buys honey are Germany and Denmark.

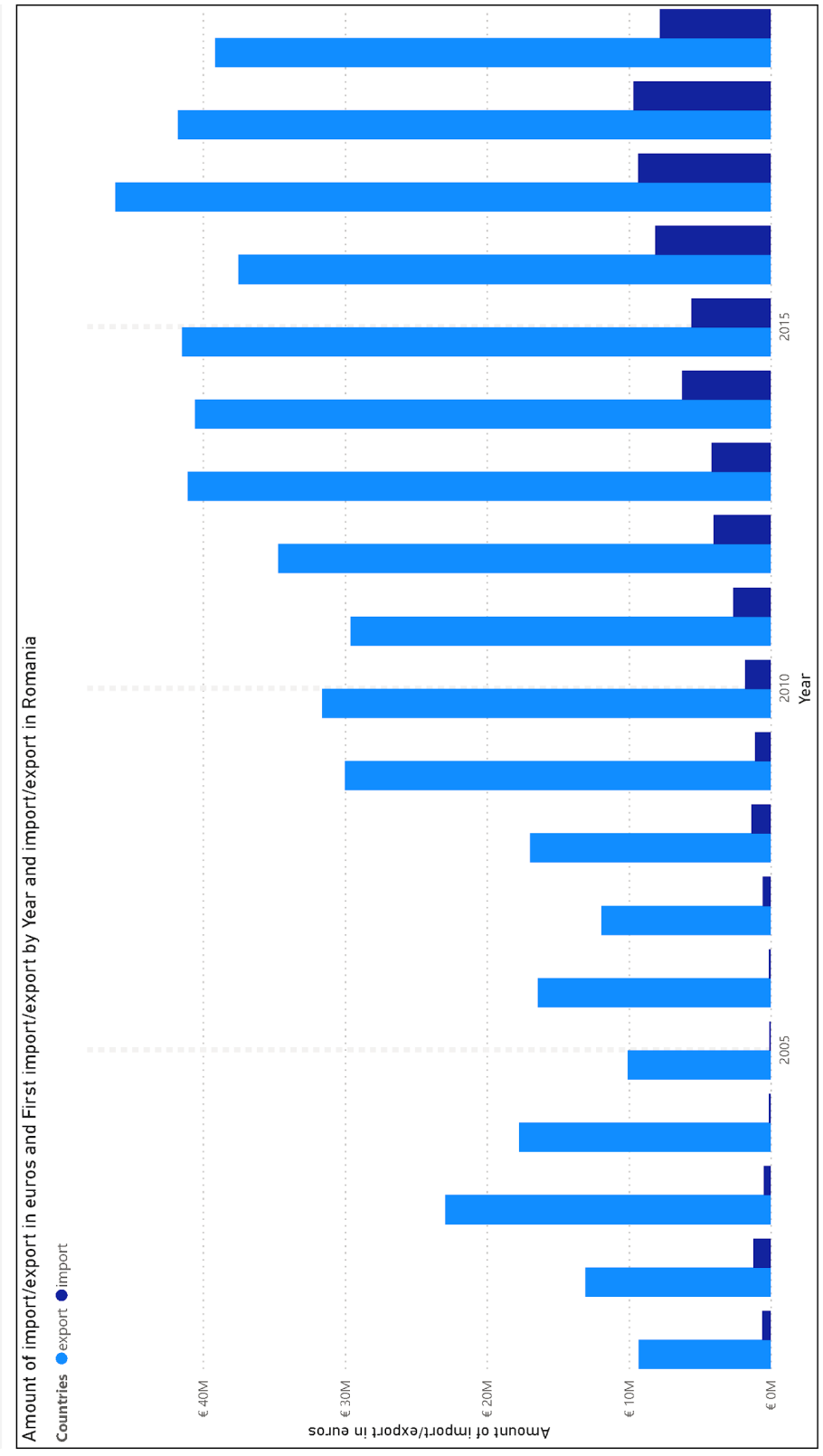


Honey consumption in Finland requires import.

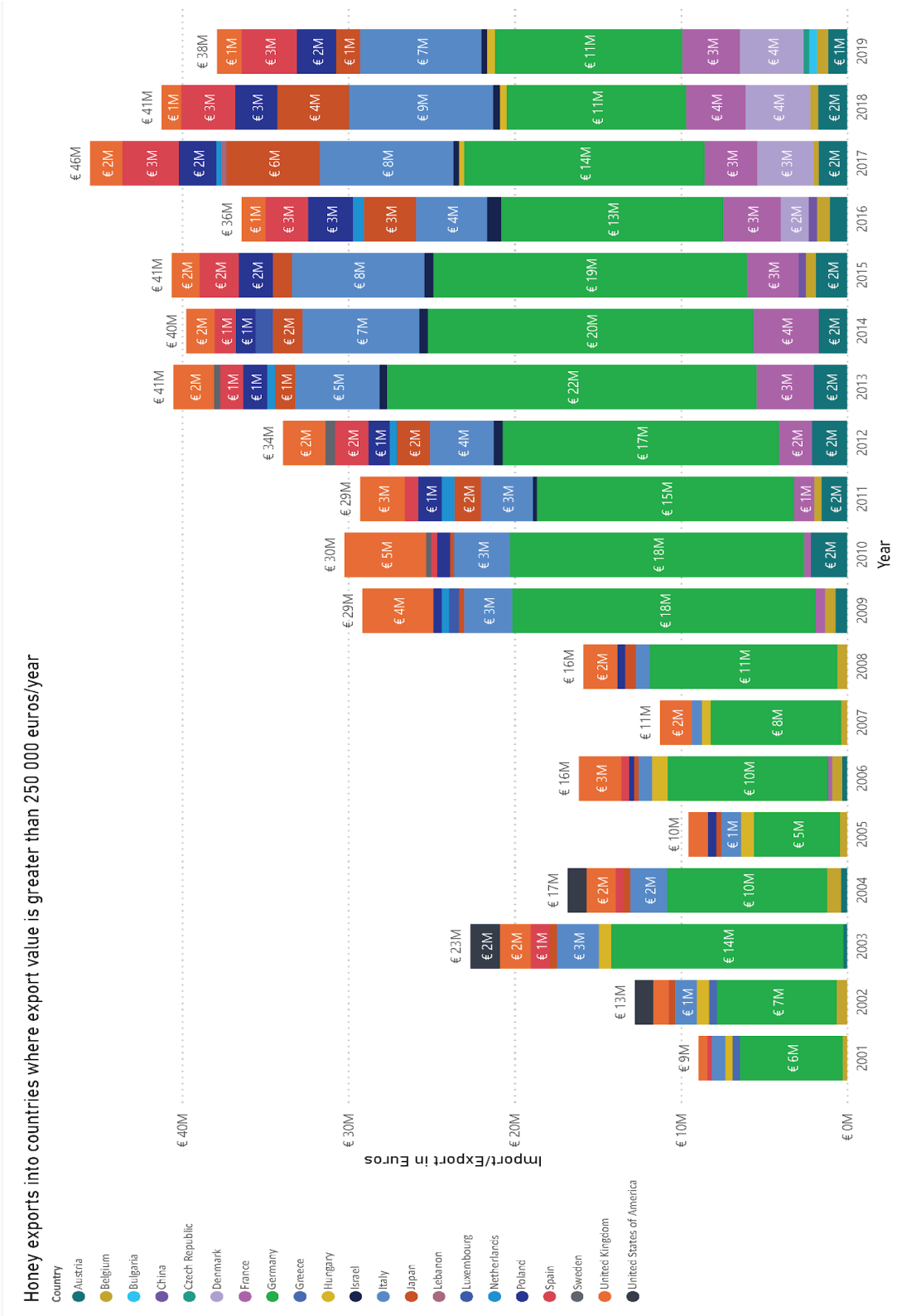


6.2 Honey import and export in Romania

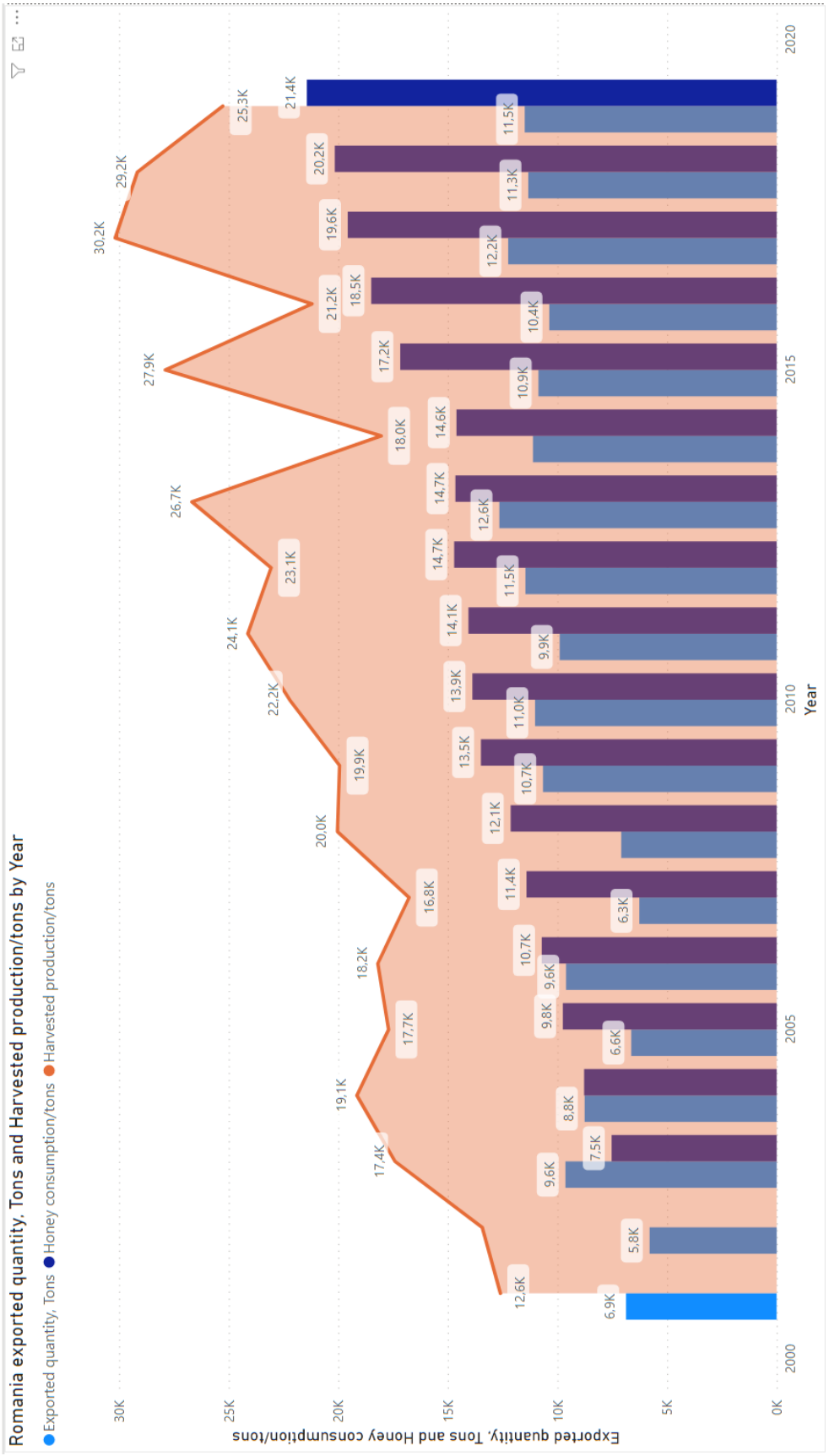
There is a remarkable amount of export, but the import is minor.



Romania exports mainly to Germany and Italy. Does it mean that Germany and Italy pack the honey and distribute it? Is it possible that when Finland buys from Germany, we get honey from Romania?



Romania honey production exceeds its own consumption. There is room for export.



References

(1) Suomen Mehiläishoitajain Liitto. *Mehiläisalan Tilastoja*; 2021, available at https://www.slideshare.net/hunajanet/sml-tilastot-2020, accessed 23.3.2021

(2) Karlsson, K. *A Telephone Interview with Maritta Martikkala Senior Adviser at Finnish Association of Beekeepers (Suomen Mehiläishoitajain Liitto)*; 2021.

(3) National Institute of Statistics Romania. AGR202A - Animal agricultural production by ownership form, macroregions, development regions and counties, available at http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table, accessed 15.4.2021.

(4) Finnish Meteorological Institute. Temperature and rain data, available at https://www.ilmatieteenlaitos.fi/kuukausitilastot, accessed 30.4.2021.

(5) National Meteorological Administration of Romania. Temperature and rain data http://www.meteoromania.ro.

(6) Pocol, C. B.; Šedík, P.; Brumă, I. S.; Amuza, A.; Chirsanova, A. Organic Beekeeping Practices in Romania: Status and Perspectives towards a Sustainable Development. *Agriculture* . 2021. https://doi.org/10.3390/agriculture11040281.

(7) International Trade Centre. TradeMap, available at https://www.trademap.org/Index.aspx, accessed 15.4.2021.

Text mining to explore Food Systems

13.5.2021

Tuula Löytty, Smart & Lean Hub Oy, Finland

Introduction

Semantic Explorer (SemEx) is one of the technical and innovative outputs of the PoliRural[1] research project financed by the Horizon2020 Program of the EU [1]. SemEx's ambitious vision is to provide support to researchers and facilitators by reducing the cognitive load related to tasks that are essential to research, development, and innovation actions.

CITIES2030 partner P14 SLEAN[2] is also a PoliRural consortium partner. SLEAN exploits SemEx in the CITIES2030 work package 3 and task 3.4 which is about systems thinking, system modelling and food systems.

This document demonstrates the results of the experiment. The aim of the experiment is to test the power, features, and outputs of SemEx, and also limitations, to assess its usability and usefulness.

The main chapters of the document are:

- Main Library: added sources
- Curated Reading List (CRL): Food Systems
- Three tools for analytics: Topic Explorer, Polarity Scores and Social Media (incl. KIBANA)

Main Library

The Main Library is built of sources related to needs of knowledge. Sources include online news articles, discussion forums, academic papers and blogs.

For this experiment, about 800 new digital sources were added to the Main Library. They were sources that were addressed on **food, food system, urban food system, food value chain, system thinking and system modelling.** The sources were found by using the above keywords in Google search. The human operator selected the best sources (technical and content quality) and she/he manually added the source links into the Main Library.

Curated Reading List (CRL)

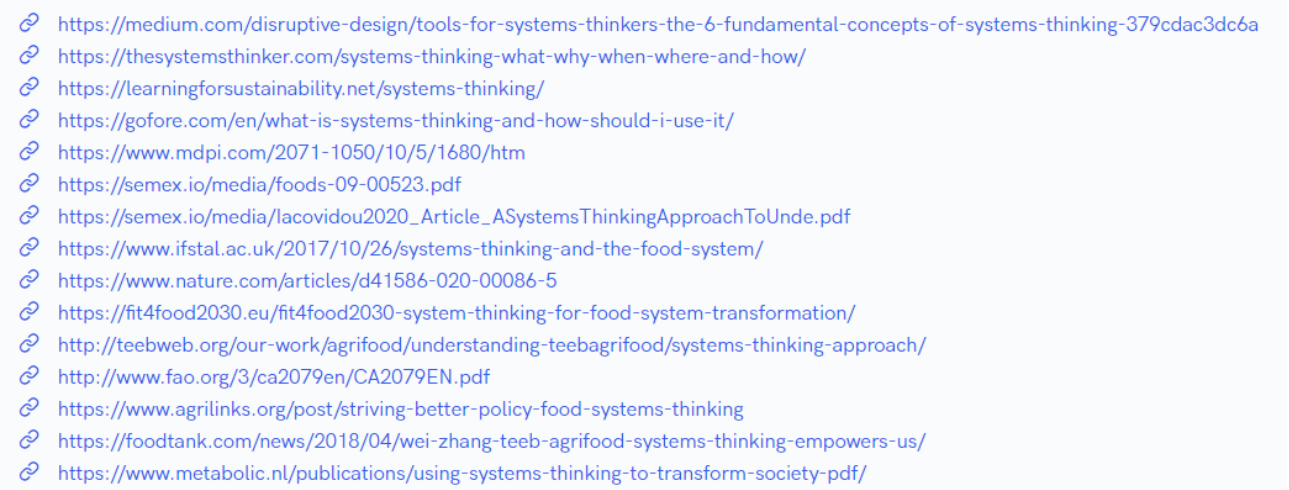
Curated Reading List

A second section of the repository is the Curated Reading Lists, containing collections of sources created by solution users. The results are Topics, Keywords, Named Entities and Word Count which are aggregated from multiple sources. The additional information of the Curated Reading List is in the SemEx Hand-on-Manual Chapter 5 [2].

Curated Reading Lists are collections of sources that are connected to the specific area of interest. In this experiment, the specific area of interest is linked to the following keywords: **food, food system, urban food system, food value chain, system thinking and system modelling**. The name of the aggregated Curated Reading List is "**Food Systems**".

In this experiment, Food Systems CRL was created semi-automatically based on the added circa 800 new sources. It means that ICT experts' intervention is needed. Because there were diverse technical reasons, all 800 new sources were not available. The reading list for "Food Systems" also contains only 547 sources. Nevertheless, the created reading list is an impressive collection of sources relevant to the specific area of interest, that is Food Systems. The screenshot 1 shows an example of the sources.

[1] PoliRural H2020 project web-page: www.PoliRural.eu
[2] Smart & Lean Hub Oy, Finland, www.smartlean.fi



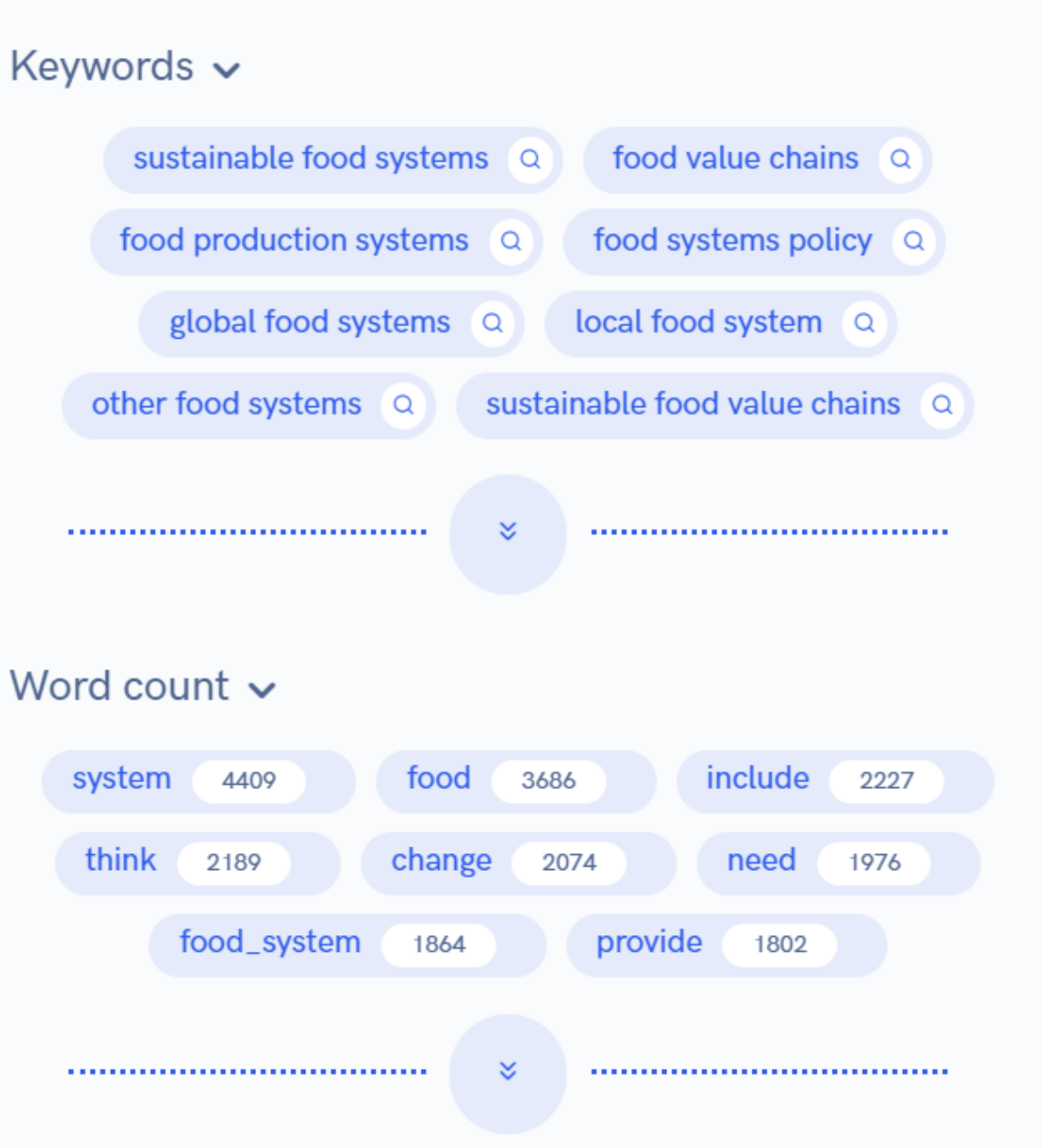
Screenshot 1: The slice of the automatically created Curated Reading List for Food Systems

The SemEx provides, not only the possibility of storing sources in a determined repository accessible whenever, but also the aggregated analysis such as summary, Topics, NER, Keywords, Wordcount and extracted URLs.

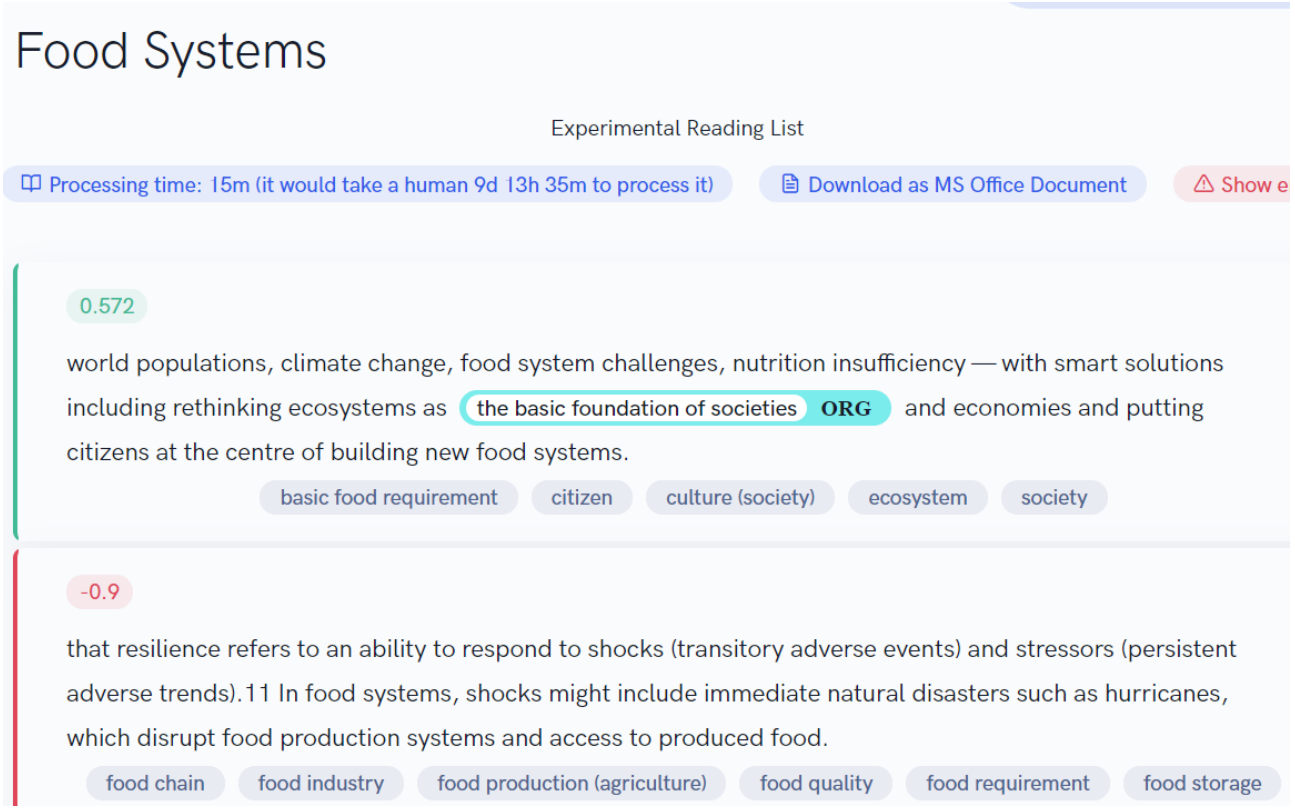
Curated Reading List - Result page

The CRL result page aggregates e.g. extracted TOPICS, NAMED ENTITIES, KEYWORDS and WORDCOUNT from sources of Curated Reading List. The result page also presents the summary of each source. See the screenshots 2-5.

Screenshot 2: Topics and Named entities of the Food System CRL



Screenshot 3: The Keywords and Word count of the Food Systems CRL



Screenshot 4: The brief summaries of the Food System sources

Analytics

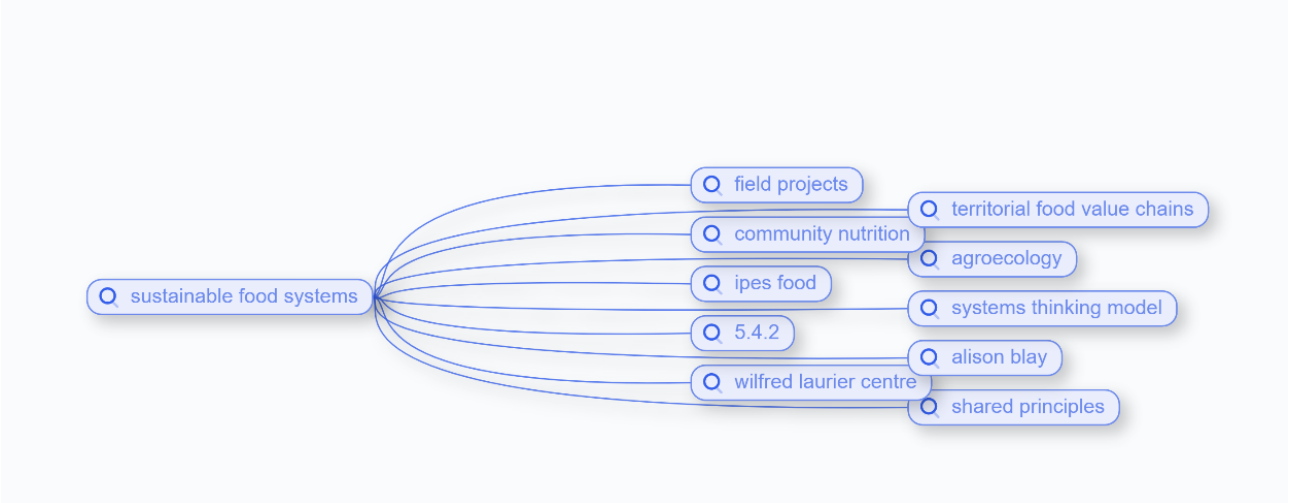
Analytics tools visualize various results from the system such as Topic Explorer and Polarity Scores, and to access Kibana for further analytical functions. SemEx Hand-on-Manual's chapters 6 and 7 respectively provide explanations about Polarity Score and Topic Explorer [2].

Topic Explorer

Topic Explorer is a semantic tree representing nodes labelled with relations, topics and subtopics.

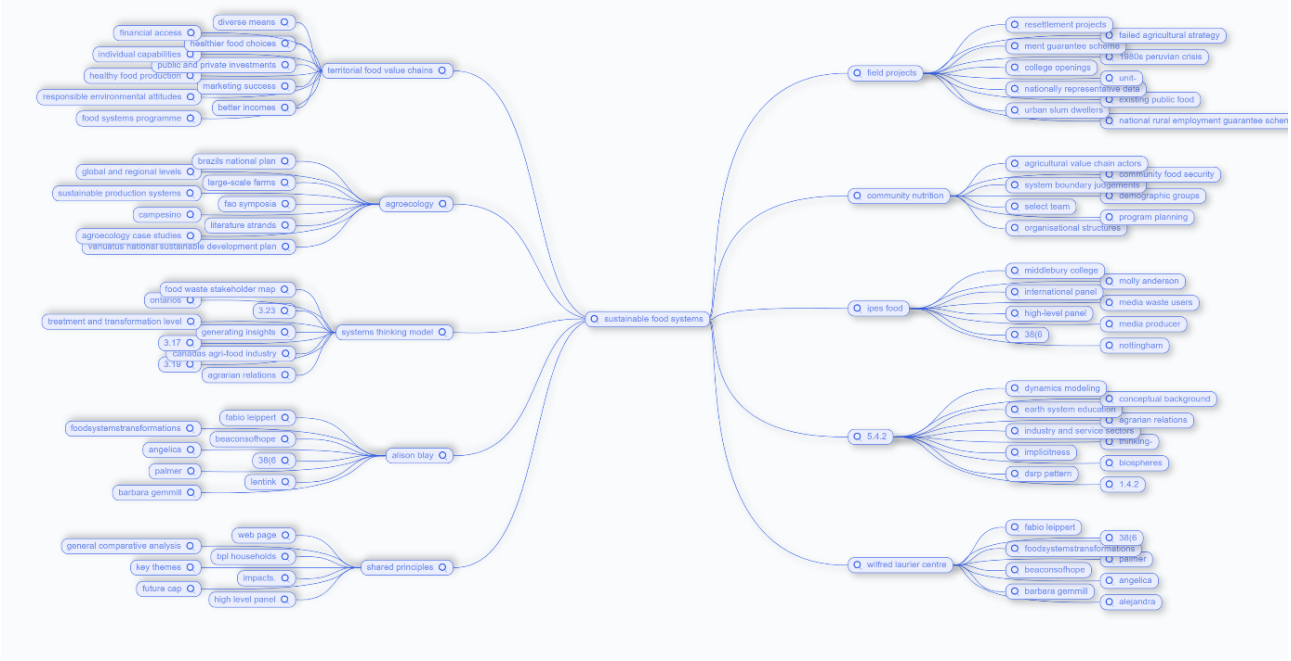
In this experiment and analysis the semantic tree is generated from a large dataset of sources listed into the Curated Reading List for Food Systems. Based on the text contained in the sources the system creates a specific semantic tree model (see screenshots 5-7).

The results at screenshot 5-7 are **before "cleaning" the model**. The screenshots 5-7 show that the semantic tree includes strange topics and subtopics e.g. number and non relevant sub-topics. The model will require trimming and cleaning which is manual work made by PoliRural ICT-expert. The work will be executed at time which will be dependent on the expert's other tasks.



Screenshot 5: The first level branches for “Sustainable Food Systems”

Screenshot 6: The second level branches for “Sustainable Food Systems” and “Systems thinking model”



Screenshot 7: The full semantic tree based on CRL for Food Systems sources

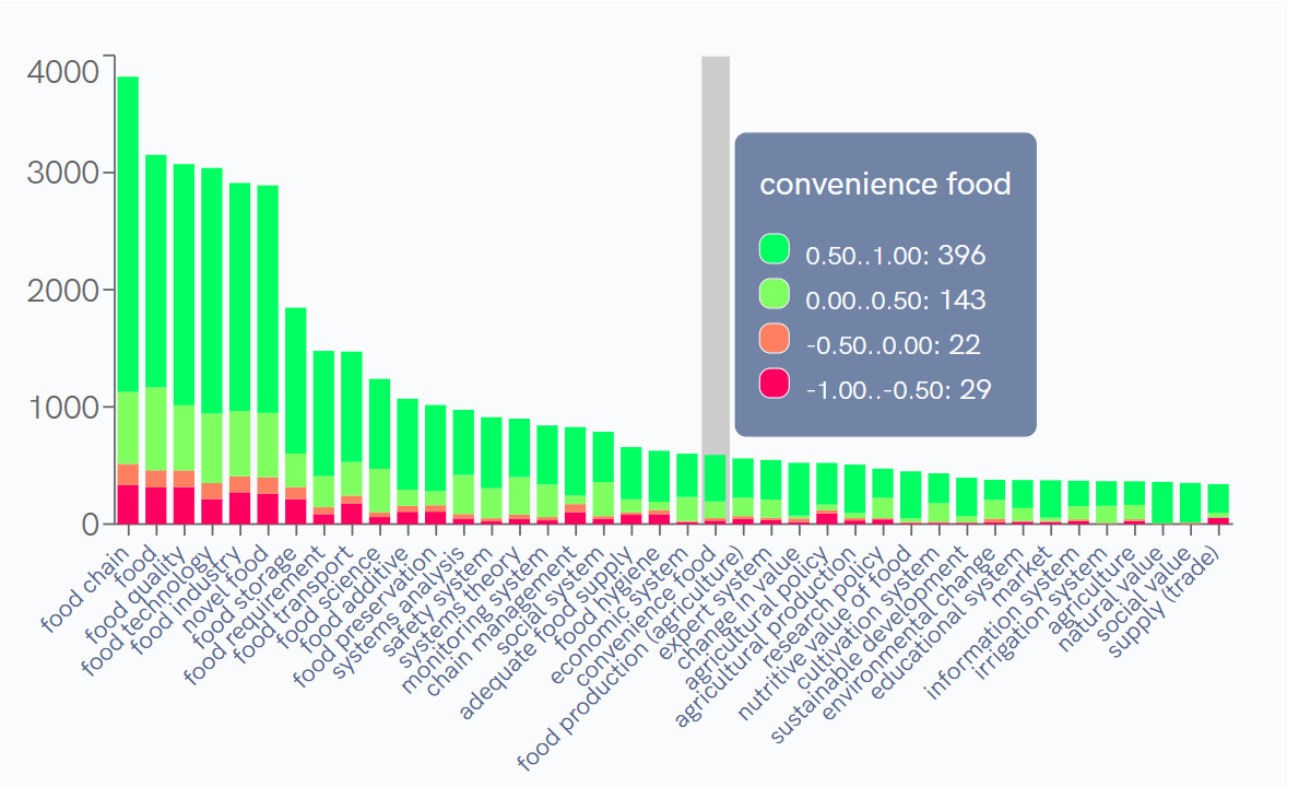
Polarity Scores

The polarity score section is a visual representation of the contents of semex.io based on the Curated Reading List for Food Systems (screenshot 8). The panel displays a histogram with 40 bars, which are the most recurrent topics. The various colours represent the sentiment of the text with the red colours indicating negative polarity and green colours suggesting positive sentiment.

Keywords are the most important words extracted from the text through the Graph-based TextRank algorithm, while to get Topics the system compares the above said Keywords to a set of topics defined in GEMET thesaurus and determines the most appropriate. Semex.io uses a predefined thesaurus called GEMET[3]. It contains more than 5000 topics in 37 languages. The topics of GEMET are closely limited to the PoliRural main topic, that is rural development.

Thus, keywords are words present in the text while Topics are mostly not present. Moreover, a limit of using a specified thesaurus is that it might miss some new words and topics. For example, GEMET does not include emerging topics such as COVID, 'Green Deal' and other recent concepts which were not in use when the last update of GEMET was done. GEMET topics seem to cover the scope of Food Systems i.e. the topics in the image (screenshot 8) are mostly well understandable in the context of Food Systems.

Topics

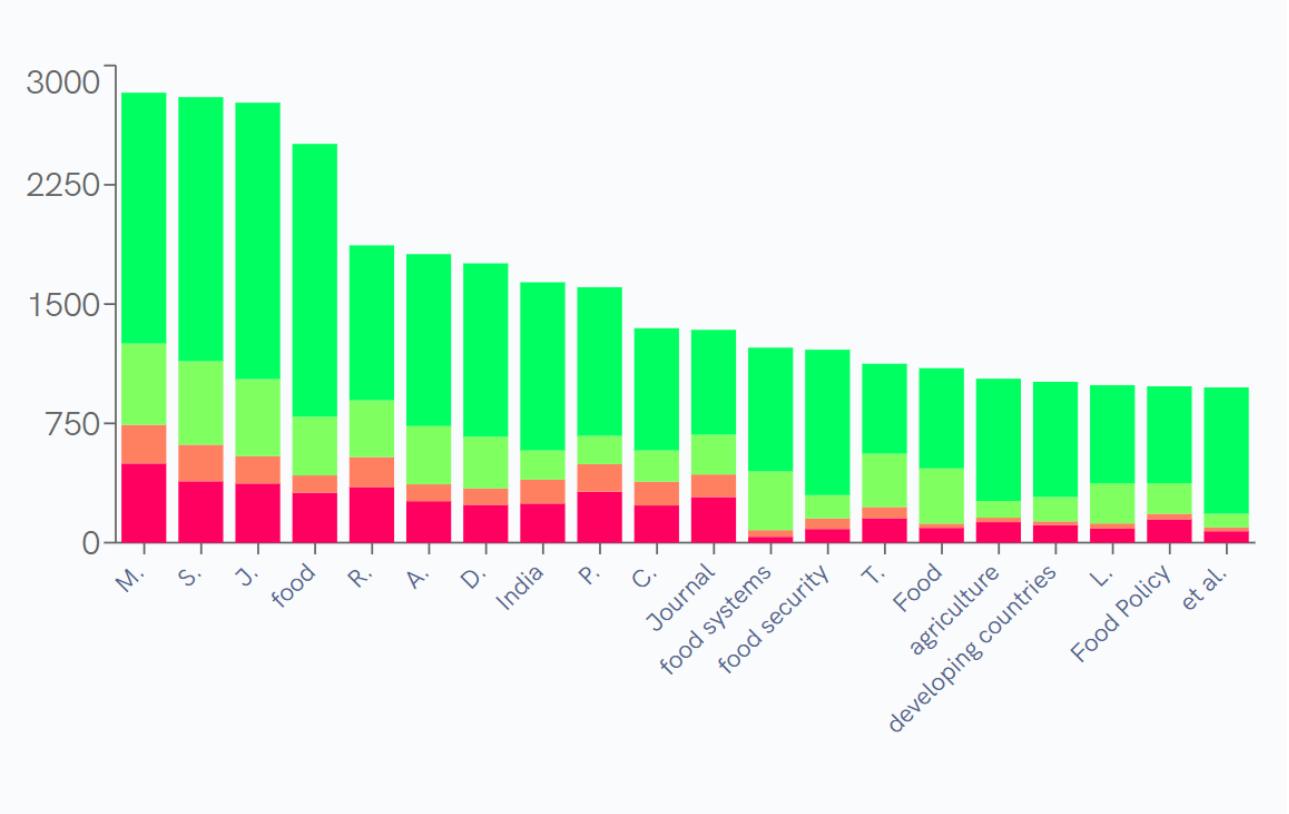


Screenshot 8: The polarity Score of the Curated Reading List sources for Food Systems

[3] GEneral Multilingual Environmental Thesaurus, https://www.eionet.europa.eu/gemet/en/about/

Keywords

As noted from screenshot 9, the keywords are strange and meaningless and do not reflect the Food System. Screenshot 9 is taken before “cleaning” the model. The model will require trimming and cleaning which is partly manual work made by PoliRural ICT- expert. The work will be executed at time which will be dependent on the expert's other tasks.

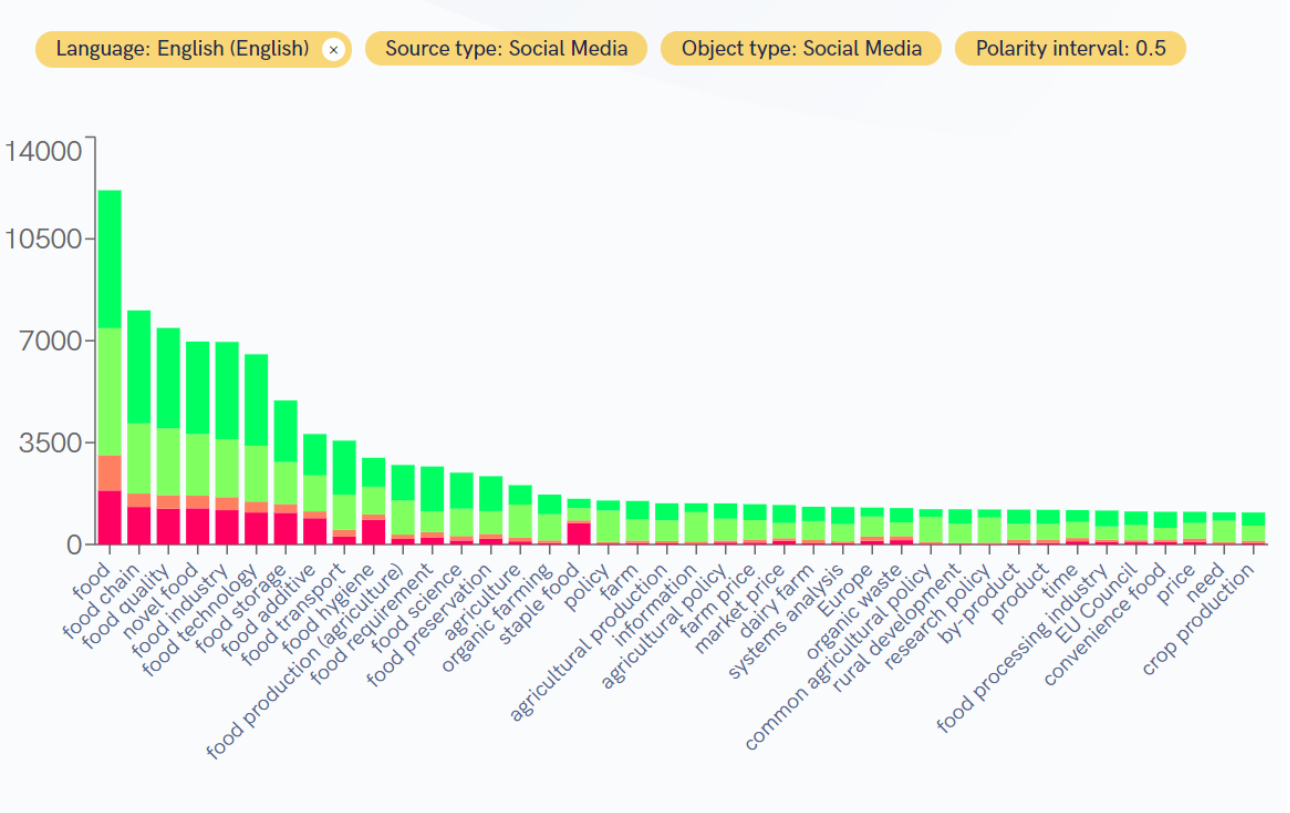


Screenshot 9: Keyword based polarity score

Social Media analysis and Kibana

The Social Media section displays the results of continuous streaming of messages from Twitter with information related to topics. More details about the Social Media section are presented in SemEx Hand-on-Manual, Chapter 8 [2].

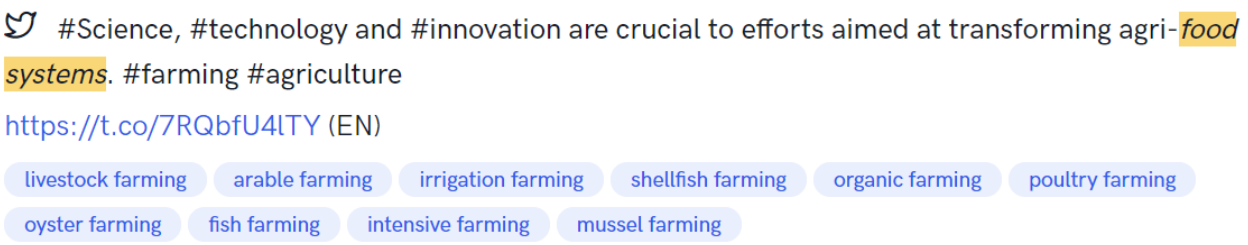
The below screenshots 10-12 are the result of the search made by using following terms: the search word - food system, time period - last 1 year, language - English



Screenshot 10: A polarity ranges based on search at Social Media: food systems, all, english

When comparing Polarity Scores from added sources (screenshot 8) to Polarity Scores from Tweets (screenshot 10) we can notice that certain topics are the same, but there are also differences which originate from the used different sources. Also, the semantic analysis result (positive/negative issues) is different because of the used source.

By clicking one bar you can review the sources i.e. Tweets and the topics which are linked to the tweet. The result is in the screenshot 11.



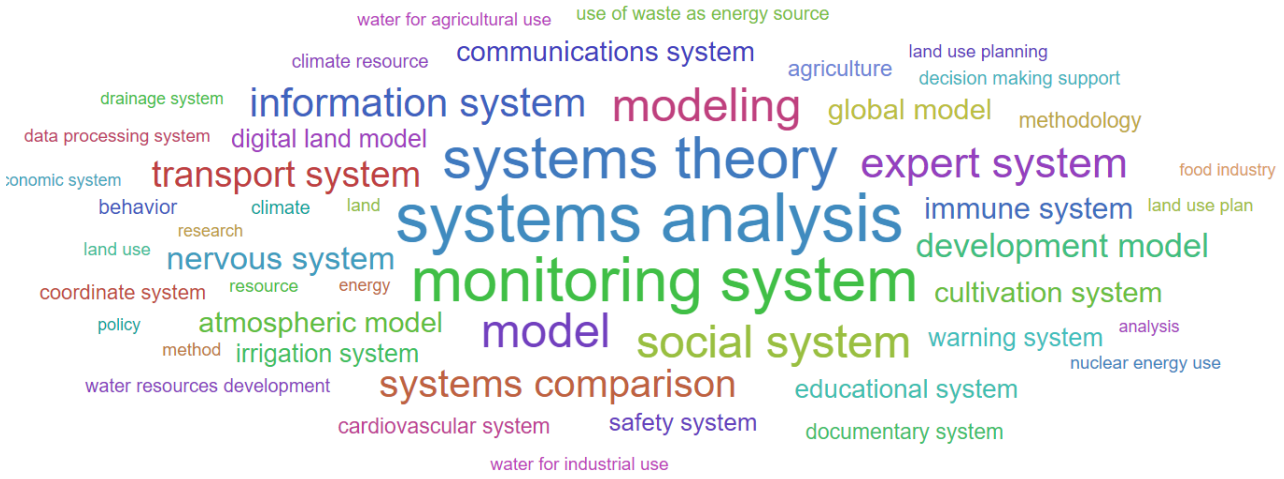
Screenshot 11: One example of a tweet that is counted into bar “organic farming”.

The screenshot 12 is a word cloud from KIBANA. It demonstrates the search term i.e food systems with 67469 documents which covers both tweets and paragraphs of the sources.

Screenshot 12: Word Cloud at KIBANA: food systems, last 1 year, english - 67469 sources.

The next two word clouds are also a visualization made at Kibana. The word cloud for the exact term "Systems Thinking" was structured from only 2891 sources, which were sources that had been added manually into the library (screenshot 13). For Kibana the sources are split into several paragraphs and that's why the number differs from the SemEx analysis that was nearly 600 sources. The latter world cloud (screenshot 14) prints visualization of the "System modelling" based only on 146 sources. Despite the limited number of sources, it's still interesting to test different keywords and topics and assess the results, which include oddities like "cardiovascular system".

Screenshot 13: Word Cloud at KIBANA: "Systems thinking", last 1 year, english - 2891 sources



Screenshot 14: Word Cloud at KIBANA: “System modelling”, last 1 year, english - 146 sources

Observations and conclusions

SemEx is a pilot application, the purpose of which is to demonstrate possibilities to analyze unstructured data that is in text format.

The application uses sources that are manually added to the library. The manual adding of sources is one limitation that may direct the usage of SemEx towards narrowly scoped topics.

The approach to create a Curated Reading List (CRL) for the new sources addressed on Food Systems was technically easy for the user, but it required extra manual work from the ICT experts. This mandatory intervention of the ICT expert is also a limitation.

The Twitter tweets as a source is a technically interesting application. It shows how an interesting topic can produce tweets and comments in the social media community. The knowledge value and reliability of the tweets may be so low that the usage of tweets is not possible. However, tweets surely tell something about our time.

The user’s minimum goal was to get visual images of the Food System: the elements and their connections. The analysis of Topic Explorer, Polarity Scores, and Social Media (incl. KIBANA) provided the main images. However, the images are only the tip of the iceberg. The more important result of the experiment is the Curated Reading List and the possibilities that it provides e.g. drill down into one source, group sources that touch the same issue. The Curated Reading List can provide the tools for the researchers and facilitators who are seeking and collecting knowledge on a certain topic. The continuous update and expansion of the Curated Reading List will rule its usability and usefulness.

The main output of the experiment was the learning. It forced the user and experimenter to concentrate on the topics of Food Systems, seek new sources and above all to play with SemEx to understand how the new sources operate in the application.

References

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