FoodE

D2.5

Life cycle assessment, life cycle costing and social LCA of 100+ CRFSI

This project has received funding form the European Union's *Horizon 2020 Research and Innovation Programme*, under Grant Agreement n°862663

Project Acronym and Name	FoodE – Food Systems in European Cities
Type of action	IA – Innovation Action
Grant Agreement No.	862663
Work package	WP2 Methodological framework development and case studies sustainability assessment
Dissemination level	Public
Document type	Report
Lead partner	UniBO
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Planned delivery date	M24
Actual delivery date	M25
Project website	FoodE
Project start date	01/02/2020
Duration	48 months
Version	3

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Document Control Sheet

Version	Date	Summary of changes	Author(s)
3	February 2022	Final	UNIBO, UAB, WR
2	November 2021	Second draft	UNIBO, UAB, WR
1	October 2021	First draft reviewed by WP2 leaders	UNIBO, UAB, WR

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Glossary

App	Application
Business Model	BM
CRFS	City Region Food System
CRFSI	City Region Food System Initiative
D	Deliverable
EcoKPI	Economic Key Performance Indicator
EcoIC	Economic Impact Category
E-LCC	Environmental Life Cycle Costing
EnvKPI	Environmental Key Performance Indicator
FU	Functional Unit
IC	Impact Category
KPI	Key Performance Indicator
LCA	Life Cycle Assessment
LCC	Life Cycle Costing
LCT	Life Cycle Thinking
SD	Standard Deviation
SLCA	Social Life Cycle Assessment
SocKPI	Social Key Performance Indicator
SocIC	Social Impact Category
ST	SubTask
Task	T
Working Package	WP

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Executive Summary

The current deliverable describes the developments and outputs of the FoodE (Food Systems in European Cities) European research project in relation with the activities carried out in Task 2.3 (T2.3). More specifically, T2.3 resulted in two deliverables, namely D2.4 and the present one (D2.5).

FoodE, funded by the Horizon 2020, was launched in 2020 and will last for 4 years. The consortium involves 24 organisations from 8 European countries (France, Germany, Italy, Netherlands, Norway, Romania, Slovenia, and Spain) and aims at accelerating the growth of citizen-led food system initiatives and creating related innovative and inclusive job opportunities at local level.

Based on the simplified layer of the methodological framework and the related data collection protocol developed in T2.2 and T2.3, the present work collects, processes, and analyses primary and secondary data from City Region Food System Initiatives (CRFSI) across Europe, adopting a Life Cycle Thinking (LCT) approach, for assessing and scoring their social, economic, and environmental sustainability performances.
To this scope a survey with a quali-quantitative perspective and limited data requirements was circulated to more than 260 CRFSI, obtaining 100 CRFSI answers. As described in previous project reports in relation with the methodological framework, namely Deliverables D2.2 and D2.3, the core survey part was composed by scorable questions, while an additional optional appendix was designed to collect quantitative data on the environmental sphere and gather further CRFSI insights for subsequent project tasks.
The resulting inventory of collected primary and secondary data has been developed in D2.4 and is complemented by the data analysis and scoring carried out in the present deliverable, to generate a synthetic sustainability assessment of the European CRFSI and a rapid appraisal of generic hotspots of impact.
The presented simplified assessment provides a first-of-a-kind scoring mechanism of evaluation of more than 100 CRFSI that can be adopted and replicated both by LCT practitioners and the general public. Results of the analysis are first presented in a single sustainability average score and then on individual Impact Categories (IC) and Key Performance Indicators (KPIs) score across the three pillars of sustainability. Such results allow to identify strengths and weaknesses of CRFSI in relation to their sustainability performances.
The outcome and related activities will pave the way for the extensive sustainability assessment of FoodE Pilots case studies that will be conducted in future phases of the project and for the deployment of an online tool to survey the sustainability of other CRFSI.

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1. Background

1.1 Project objective: FoodE – Food Systems in European Cities

The main objective of FoodE is to involve European Union local initiatives in the design, implementation, and monitoring of environmentally, economically, and socially sustainable CRFS. The key challenge of the project is to improve food and nutrition security of European citizens by shaping a sustainable environment able to increase accessibility and availability of affordable, safe, and nutritious food. This challenge will be tackled by setting a co-created mechanism, based on Citizen Science and Responsible Research & Innovation principles, where public authorities, citizens, SMEs, and non-profit organisations can share ideas, tools, best practices, and new models, supporting cities and regions in developing innovative and sustainable food systems.

1.2 WP2 objective

Considering and integrating all the recent advancements on sustainability assessment of CRFS, WP2 aims at developing a methodological framework and an analytical decision support tool for the development of innovative BMs and initiatives to enhance CRFS. More specifically, the WP2 roadmap (Figure 1) aims to:

- Create an inventory of innovative CRFSI.
- Develop an integrated methodology for the interpretation and analysis of innovative BMs and their suitability to apply in specific contexts.
- Apply, validate, and refine the integrated methodology on case studies, including a sustainability assessment, also integrating revisions proposed by stakeholders during cross-pollination.
- Develop business case reports and carry out comparative analyses to identify barriers and key drivers of change.
- Develop an analytical decision support tool, based on the FoodE integrated methodology, to support decision-making of innovative BMs and improve their performances and sustainability.

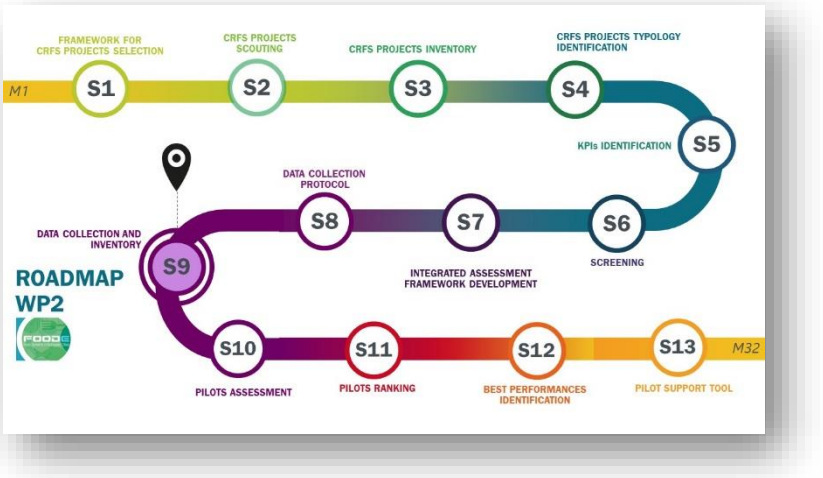

Figure 1 - Roadmap WP2

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1.3 Task and Deliverable objective

An LCT approach has been adopted to assess the environmental (e.g.: carbon footprint, land use, etc.), economic (costs, net present value, value added, etc.), and social (labour, health, vitality of regions, innovation, etc.) impacts, in a cradle (biomass supply) to grave (final use) to cradle (re-use/recycle) perspective. T2.3 aimed to collect information according to the methodological framework (D2.2) and the data collection protocol (D2.3) developed in T2.2 for the simplified layer. Primary data on technical, environmental, technological, and costing aspects have been collected and data gaps have been covered by secondary data analysis collected through several literature reviews in specific areas of CRFSI conducted in T2.3.1-T2.3.4. The task outputs consist of D2.4 and D2.5.

This project report, D2.5, builds on the data inventory and processes the results, obtaining a scored sustainability performance of CRFSI based on a LCT approach. More specifically, the present deliverable focuses on presenting results from the simplified sustainability assessment scoring of 100+ CRFSI, whose data was collected in the exploratory and detailed online survey. To this end, standardised data was retrieved at an adequate level of detail for each assessment. The process follows the methodology defined in D2.2 in relation with the simplified layer of assessment and the data collection protocol set in D2.3 to enable a comparative evaluation, standardise the data to be collected for the assessment, and select the appropriate indicators. The present deliverable is also built on D2.4 data inventory, presenting the primary data and reviews on technical, environmental, technological, and financial aspects, including information on material flows, materials, energy and costs, emission, waste, health.

1.4 Linkages with other project activities

Within the FoodE development, the present work is expected to provide fertile ground for several activities.

First, it represents the basis for the extensive LCT analysis to be conducted on the FoodE pilots case studies of WP2 (D2.6). More specifically, the analysis described here aimed at delivering a simplified sustainability assessment to be further elaborated on individual pilots.

Second, it will serve for the design of the FoodE App, aimed at improving the interaction between CRFSI and citizens. In fact, the App developed in WP3 is integrated with the sustainability assessment of CRFSI here developed.

Third, it will support the participatory pilot monitoring on sustainability performances developed in WP4.

Finally, it will feed the methodology for CRFSI BMs, and validation conducted in WP5**.** In particular, the data analysis on specific environmental, social and economic sustainability will be integrated within the BMs of CRFSI to allow for a greater understanding of their sustainability impacts. This integration will allow the development of BMs in line with the LCT methodology.

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2. Methodology

2.1 Methodology for primary data processing of the simplified assessment

2.1.1 Background summary

The survey collecting primary data to analyze the sustainability (economic, social, and environmental) of CRFSI was designed in a co-creation process (detailed in D2.2 and D2.3).

The survey stands to represent a simplified assessment of CRFSI based on the division of the three sustainability pillars, Impact Categories (IC) and Key Performance Indicators (KPIs) and turn them into a simplified CRFSI sustainability scoring. Particularly the survey is built on 10 KPIs for the social dimension, 11 for the economic one, and 15 for the environmental one (Table 1). Each KPI is composed by one or more questions, with answers scored from 1-5 depending on the sustainability degree (see D2.2 for additional details). Points of each KPI are then weighted accordingly to the number of KPIs in the relative sustainability pillar to obtain a final single sustainability score going from 1 to 5 (see D2.2 for additional details). The specific process that yielded the survey and the data collection protocol can be found in D2.2 and D2.3.

A second optional appendix of the survey on technical details was designed in a co-creation process as described in D2.2 to quantify with more accuracy the LCA sustainability of CRFSI, and without an attached sustainability scoring. This section entails a simplified LCA assessment based on quantitative and qualitative information provided by CRFSI. Due to its optional nature, only a set of CRFSI provided the data requested. This data was more time-intensive to collect than the one asked for in the simplified survey. The specific process that yielded this part of the survey and the data collection protocol can be found in D2.2 and D2.3.

Finally, an additional blank space was included in the survey to allow CRFSI respondents in discussing additional points recognized important or needing clarifications and helping the contextualization of results. These spaces and the resulting statements have been used to inform the discussion of results.

Table 1 - Pillars, Impact Categories (ICs), Key Performance Indicators (KPIs) and relative codes

Pillar	Impact category	Code	KPI	Code
Social	Job (quantity, quality, diversity)	SocIC1	Waged jobs	SocKPI1
			Contract typology	SocKPI2
			Aver. gross monthly salary	SocKPI3
			Workplace Trainings	SocKPI4
			Gender balance	SocKPI5
	Community outreach, engagement & education	SocIC2	Frequency of events	SocKPI6
			Disadvantaged people	SocKPI7
			Connection with local producers	SocKPI8
			Volunteering activities	SocKPI9
	Food quality	SocIC3	Product characteristics	SocKPI10
Economic	Organization profitability and outlook	EcoIC1	Annual net profit margin	EcoKPI1
			Income diversification	EcoKPI2
			Business future	EcoKPI3
	Local economic development	EcoIC2	Provenance of employees	EcoKPI4

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			Locally sourced supply	EcoKPI5
			Suppliers' practices	EcoKPI6
	Customer and users	EcoIC3	Customers/users acquisition	EcoKPI7
			Customers/users return	EcoKPI8
			Customer/user expenditure	EcoKPI9
			Customers/users return reason	EcoKPI10
			Online selling	EcoKPI11
Environmental	Food production/supply	EnvIC1	Technology used for crops	EnvKPI1
			Animal fed provenance	EnvKPI2
			Fishing Gear types	EnvKPI3
			Ancient cultivar or local breed	EnvKPI4
			Characteristics of the products	EnvKPI5
	Resource use efficiency	EnvIC2	Water saving practices	EnvKPI6
			Electricity sources	EnvKPI7
			Heating sources	EnvKPI8
	Waste management and circularity	EnvIC3	Waste recycling	EnvKPI9
			Sustainability commitment	EnvKPI10
			Packaging and materials recyclability and compostability	EnvKPI11
			Packaging and materials reusability	EnvKPI12
	Transport	EnvIC4	Distance from clients/ customers	EnvKPI13
			Type of transport to clients/ customers	EnvKPI14
			Type of transport of supplies	EnvKPI15

2.1.2 Data processing protocol for the scoring

The data processing protocol was designed based on the potential inclusion of additional answers in the future. Hence, the data processing was designed to avoid repetitive work through programming. Additionally, the data collection and processing beyond this deliverable in further steps of the project will be done by through the FoodE App in a completely automatized way. The software used in the data processing is described below:

- Qualtrics®: tool used to disseminate the online survey and collect the data from CRFSI.
- Any XLSX Spreadsheet Editor: tool used to process collected data from the survey in a spreadsheet. Any spreadsheets editor that works or converts to XLSX format can be used. To get the results presented in this deliverable, Microsoft Excel has been used.
- R: programming language for statistical computing and graphical representation.
- RStudio®: most used Integrated Development Environment (IDE) for R. It allows to create a script with functions included in the core R package. Additional R packages required for the script created for the data processing (e.g., Tidyverse, writexl, scales, pacman, etc.) are automatically installed and loaded when running the code.

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The data processing was divided in two steps. The first step encompassed the processing done with Qualtrics and Excel, while for the second step we used R and its IDE. The Qualtrics-Excel files are available under request to guarantee full transparency of data processing.

Step 1: Qualtrics – Excel

1. By using the XLSX file of survey answers downloaded directly from Qualtrics (tab where all the countries are included), an additional tab that copies (through cross-reference) the content of the original tab was created. It was highly important to cross-reference all cells to avoid additional work every time a new answer is added.
2. Additional columns were added to assign the "Score" of the CRFSI based on the set scoring mechanism (D2.2). At the right of every question important for the scoring (e.g. we excluded the ones asking for data consent), one column named 'Normalized value column' was added. The title of this column is the question code + "_V" (e.g. for column "Q.7.13_3", the column for the value is "Q.7.13_3_V"). The values for this column have a range based on the Likert scale (1 to 5).
3. At the end of the entire dataset, additional comments were added. These columns refer to the value for each KPI, sustainability pillar (social, economic, environmental) and Single Sustainability Score. A total of 55 columns were added at the end of the entire dataset. The explanation for the number of columns can be found below and is summarized in Table 1:
    a. 10 columns for social KPIs. These columns have the following titles: "SocKPI1", "SocKPI2", […] "SocKPI10".
    b. 11 columns for economic KPIs. These columns have the following titles: "EcoKPI1", "EcoKPI2", […] "EcoKPI11".
    c. 15 columns for environmental KPIs. These columns have the following titles: "EnvKPI1", "EnvKPI2", […] "EnvKPI15".
    d. 10 columns for Impact Categories (3 Social, 3 Economic, 4 Environmental). These columns have the following titles: "SocIC1", "SocIC2", "SocIC3", "EcoIC1", "EcoIC2", "EcoIC3", "EnvIC1", "EnvIC2", "EnvIC3", "EnvIC4"
    e. 3 columns for every sustainability pillar (social, economic, environmental). These columns will have the following titles: "Social", "Economic", "Environmental".
    f. 1 column for the final Sustainability Score. This column will have the following title: "SingleScore".

The columns for the KPI values (10 + 11 + 15 columns) were calculated based on the mean (average) of each "_V" column value for every specific question relevant to that KPI, since the weighting factors are the same for each question. As explained in D2.2, the choice to provide same weighting to each question was acknowledged as an approximation required in order to avoid arbitrary assignment of different weight to the different topics targeted.
As an example, if questions "Q7.13_3" and "Q7.13_4" are the only ones that contribute to KPI1, the value for KPI1 were calculated based on the mean value of columns "Q7.13_3_V" and "Q7.13_4_V". Thus, KPI scores are also on a Likert scale range (from 1 to 5).
The columns for the IC values (3 + 3 + 4 columns) were calculated based on the mean (average) of each KPI column value for every specific KPI relevant to that Impact Category, since the weighting factors are the same for each question. As an example, if KPIs "EnvKPI1" and "EnvKPI2" are the only ones that contribute to a specific Impact Category, the value for "Environmental" was

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calculated based on the mean value of columns "EnvKPI1" and "EnvKPI2". Thus, KPI scores ended up being on a Likert scale range (from 1 to 5).
The columns for the sustainability pillar value (1 + 1 + 1 columns) were calculated based on the mean (average) of each Impact Category column value for every specific Impact Category relevant to that sustainability pillar, since the weighting factors are the same for each question. For example, "EnvIC1", "EnvIC2", "EnvIC3" and "EnvIC4", are the only ones that contribute to the environmental pillar, then the value for "Environmental" were calculated based on the mean value of columns "EnvIC1", "EnvIC2", "EnvIC3" and "EnvIC4". Thus, IC scores end up being on a Likert scale range (from 1 to 5).
The value for "SingleScore" was then calculated based on the mean value of columns "Environmental", "Economic" and "Social". Thus, "SingleScore" also ends up being on a Likert scale range (from 1 to 5).

Step 2: R and RStudio

By using the cross-reference modified tab with additional columns obtained at the end of the previous phase, data were processed with RStudio (R Foundation, Vienna, Austria). The aim of this data processing with R was to obtain a script which core code may not be modified when new CRFSI were added to the database. Part of such work was already assigned to the previous phase by adding specific columns with predefined labels.

Although the code is static (with the need of additional graphs as the only exception) and already written, a summary of the steps is defined below:

1. The spreadsheet was imported specifying the column types
2. Columns for the optional appendix of the survey (not linked with the simplified assessment) were omitted.
3. Subsets of data per country were created.
4. Statistics summaries were created: average single score, average score for pillars, etc.
5. Different sections with relevant graphs were created.

2.1.3 Data processing protocol for the optional appendix

The data processing protocol was designed based on the potential addition of new answers in the future. If a new survey answer was added, the setting of the data processing avoided repetitive work through programming. The software used in the data processing was the same as in section 2.1.2.

The data processing was divided into two steps. The first step encompassed the processing done with Qualtrics and Excel, while the second step used R and its IDE and Simapro by PRé Consultants (Amersfoort, The Netherlands).

Step 1: Qualtrics – Excel

1. By using the XLSX file of survey answers downloaded directly from Qualtrics (tab where all the countries are included), an additional tab that copied (through cross-reference) the content of the original tab was created. It was highly important to cross-reference all cells to avoid additional work every time a new answer was added.

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2. The original tabs were tidied manually to avoid potential minor mistakes such as using dots for both thousands and decimals. A copy of the original tab without modifications was stored as a back-up.

Step 2: R and RStudio

By using the cross-reference modified tab obtained at the end of the previous phase, data were processed with RStudio in a similar way as for Section 2.1.2 and with the same aim. A summary of the steps is defined below since there are relevant changes compared to how data was treated in the previous section:

1. The spreadsheet was imported specifying the column types.
2. Columns for the simplified part of the survey were omitted.
3. Subsets of data per category (Livestock Farming, Fisheries or Crops Growing) were created.
4. Functional unit (FU) for each category was defined based on available data from the survey: head-based for Livestock Farming and mass-based for Fisheries and Crops Growing.
5. A spreadsheet with impact data (for 1 unit i.e., kg, m^3 or kWh) was imported to RStudio including all IC in Recipe 2016 (H) and EF 2.0 methods.
6. Inventory data was integrated with impact data to obtain the final impact results for each CRFSI and considering the defined IC.
7. Statistics summaries was created such as average impact scores.
8. Different sections with relevant graphs were created.
9. Data and scores obtained from this assessment serve as a basis to approach the extensive assessment of pilots (see Section 4.3.1).

2.1.3.1 Data limitations and assumptions

Based on the intention of increasing the response rate of the optional appendix of the survey, the questions asked to CRFSI were narrowed to the minimum possible. Therefore, the data collected in this optional part is used to perform an environmental assessment from an operational perspective and with the use of different assumptions, defined and justified in Table 2.

Table 2 - Assumptions made during the Life Cycle Inventory and Life Cycle Impact Assessment phases

Assumption	Justification
Background environmental data based on European or Global context	Given the objective of identifying trends rather than perform multiple individual analysis, the same average processes were used for all CRFSI
Use of secondary data for livestock feed intake	The survey asked for feed composition in percentage and number of animals per species. Asking the CRFSI for feed intake per species would have been a time-demanding request, so we proceeded by using secondary data on this variable.
Use of global emission factors for air emissions from fertilizers, manure and enteric fermentation.	The quantification of specific emission factors per country or facility would have required a visit to each CRFSI with adequate equipment. Given the objective of identifying trends rather than perform multiple individual analysis, a decision was made to use already standardized emission factors.

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Omission of emissions to water caused by leachates	Due to lack of data on overfertilization and type of soils
Choice of FU based on questions asked	Different FU were used in "Livestock Farming", "Fisheries" and "Crops Growing" based on available data from the survey, avoiding additional uncertainty.
Use of same fuel for all boats in "Fisheries"	Heavy fuel oil was assumed to be used in all boats in the "Fisheries" category. Type of fuel per type of boat will be considered in the pilots' assessment.
Questions asked but not used in the assessment	Some of the questions included in the survey were finally not used for various reasons: "Antibiotic" was not included in the assessment of livestock farming because there is no general process for this input in the background environmental database and not enough data was provided for it in the survey; the use of greenhouse or open-field cultivation was not included in the assessment of crops growing because there was not a certain way to determine the section of the CRFSI dedicated to each type of cultivation.
Omission of various inputs for "Fisheries"	Some inputs for "Fisheries" such as "Chains", "Nets" or "Diving Suits" were omitted from the assessment due to lack of responses in the survey.

Considering the above-mentioned limitations, the final data considered to perform the simplified LCA is defined below, divided by CRFSI categories:

- Livestock farming: N fertilizer (for feed production), P fertilizer (for feed production), K fertilizer (for feed production), manure used (for feed production), Feed Production (Maize, Triticale and Concentrates), Electricity, Water, Oil, Natural Gas, Disinfectant and Emissions to Air (N_2O from N fertilizers, N_2O from manure application and CH_4 from livestock enteric fermentation).
- Fisheries: Fuel, Water, Ice, Electricity, Natural Gas and Disinfectant.
- Crops Growing: N fertilizer, P fertilizer, K fertilizer, Electricity, Water, Oil, Natural Gas, Disinfectant and Emissions to Air (N_2O from N fertilizers).

2.2 Use of secondary data from the literature

The survey focused on the collection of numerous data points and was designed to cover a wide variety of disciplines, and aspects. In parallel, literature reviews (D2.4) were conducted to identify indicators and metrics for measuring the sustainability impacts of CRFSI and streamline data collection process. Nevertheless, it was inevitable that certain gaps in the collected data would remain. To this end, the literature studies were also conducted to supplement our primary data with secondary data. The literature reviews correspond with the following subtasks (ST) of T2.3:

ST2.3.1 - Food quality sampling and analyses;
ST2.3.2 - Growing systems;
ST2.3.3 - Social impacts;
ST2.3.4 - Consumer preferences and market potential.

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Specifically, only papers that report on an empirical analysis of impacts and that use clear metrics were included in the final analyses. The results of these literature reviews were used in earlier stages to inspire the development of methodology and to formulate KPIs for the survey. These secondary data from the literature reviews have paved the ground in setting the survey on the different pillars. Secondary data was only used to offer additional background and is identified as such. That was because the collection of supplemental, secondary data in literature reviews proved challenging since studies often presented some limitations, such as conflicting metrics, incongruent scales and incomplete datasets, resulting in non-transferable data. In D2.4, an extensive discussion of secondary data is conducted, and findings are expanded upon with additional studies, to optimise these indicators for future analyses of CRFSI (see D2.4).

3. Sustainability scores

As reported in D2.4, data on 100 CRFSI were collected from 10 countries across Europe. Answers from these initiatives were evaluated adopting the simplified methodological framework described in D2.2 specifically in relation with the scoring mechanism described in Section 2.1. While the extensive description of the sample is provided in D2.4, the following sections present the results of such elaboration, starting with the analysis of the total sustainability single score for the 100 CRFSI and moving forward discussing the score in each pillar, impact category, and specific KPIs. Finally non-scorable results from the optional appendix section to collect technical details on the environmental sphere only are also detailed.

The geographical spread of respondent is not equally balanced across EU member states due to several reasons. First, as a way to keep in consideration the spread inherent to the initial set of investigated CRFSI in previous steps of WP2. Secondly to reflect the spread of the consortium partners, and finally due to the Covid-19 pandemic which limited contact with respondents in some countries. The spread of CRFSI across Europe is shown in Figure 2.

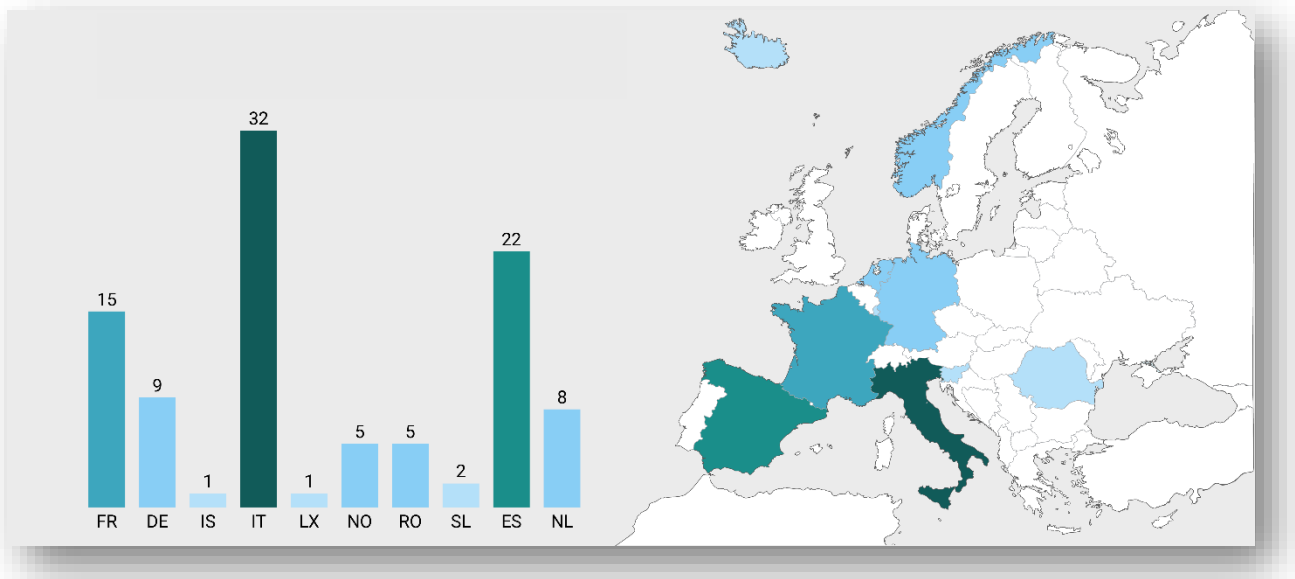

Figure 2 - Spread of the 100 surveyed CRFSI across Europe

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3.1 Single sustainability score

Figure 3 and Figure 4 shows the total sustainability score and the score per pillar of the 100 CRFSI, on average and in different countries. The single average score among the three sustainability pillars is 3.30 (±0.36 confidence interval 95%). Considering the 1-5 scale, this means that the

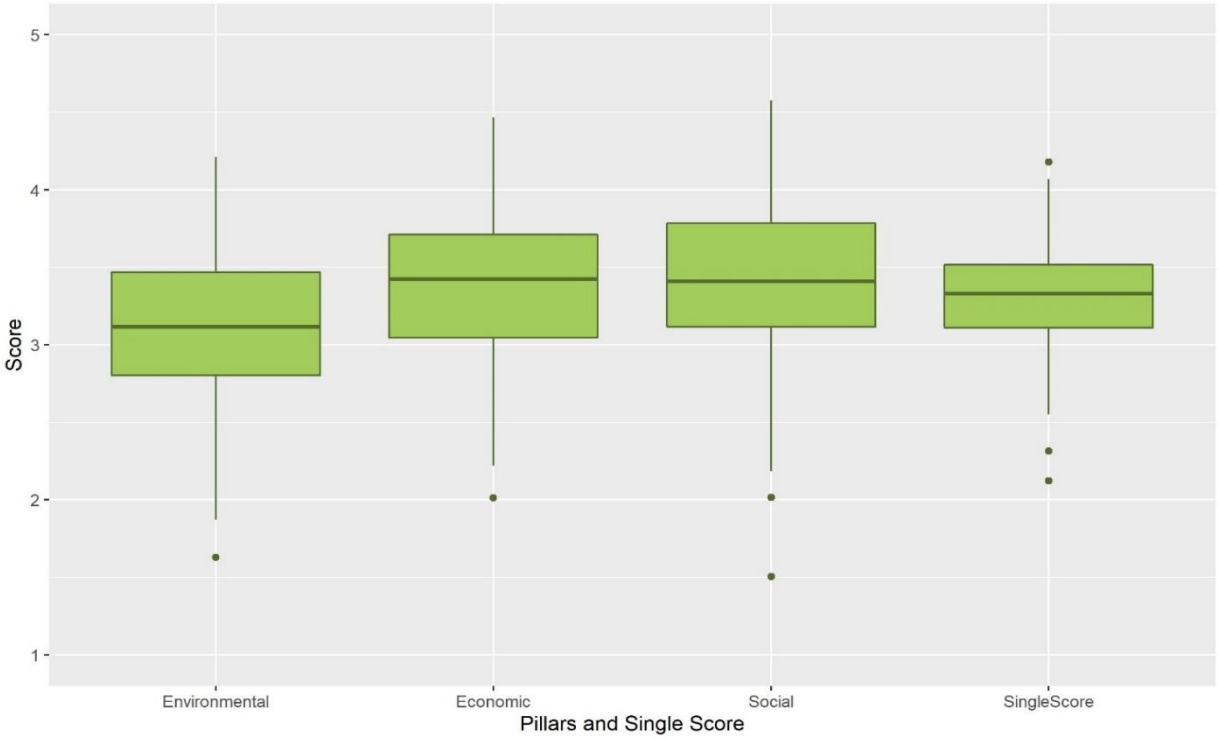

Figure 3 - Pillars and Single score for the surveyed CRFSI (n=100)

sustainability of CRFSI is on average above the medium level, with only few outliers having low performances (e.g., 2.18 and 2.31). The scoring must be contextualized also taking into account the underlying methodological choices of the survey (see D2.2), such as the choice of scoring 3 some of the "N/A" or "I don't know" answers. Such figure is quite consistent across different countries, with Germany, Romania, and Norway having a slightly higher than average score.

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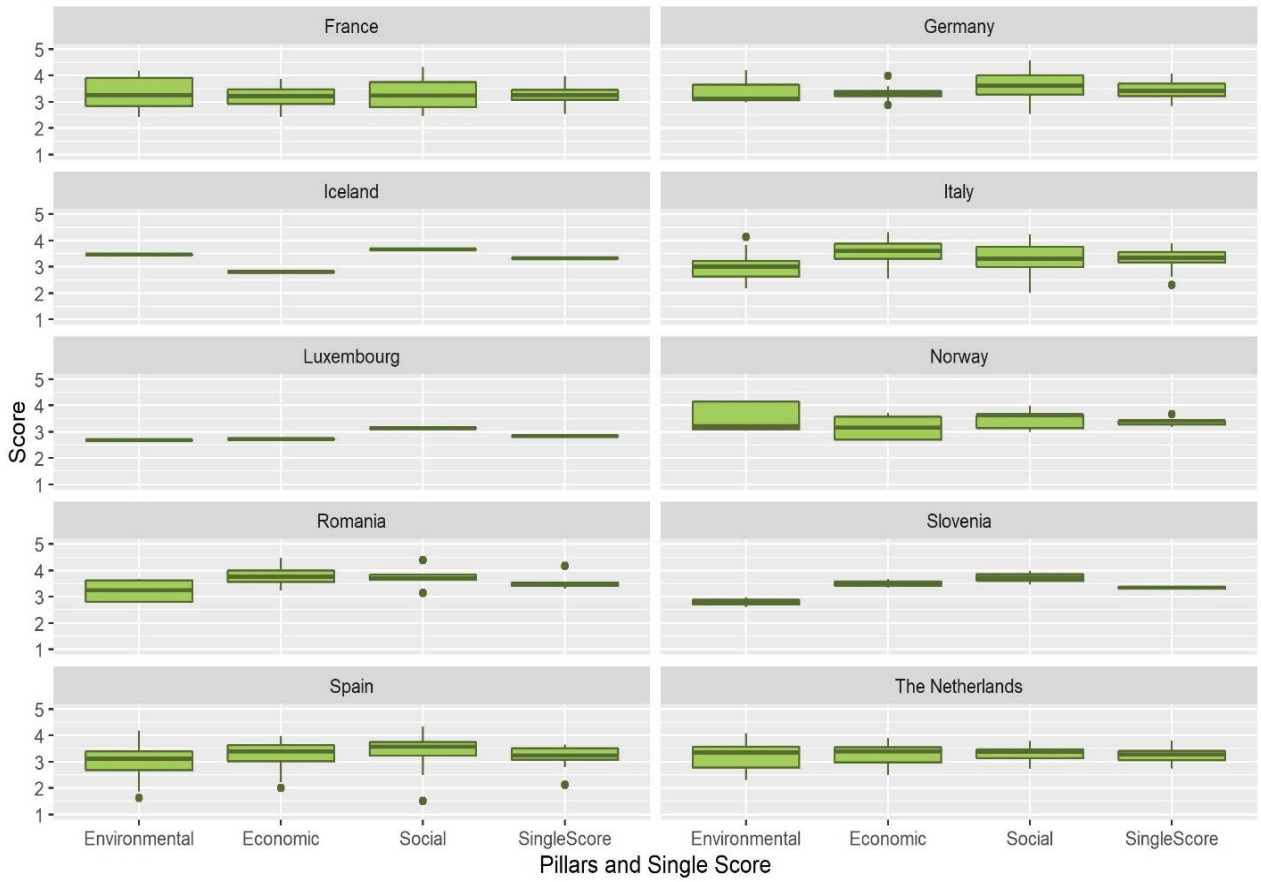

Figure 4 - Pillars and Single score for the surveyed CRFSI accordingly to Countries (n=100)

On average, the social and economic pillars show higher scores (3.39±0.11 and 3.37±0.09) than the environmental one (3.15±0.10). In this case, differences among countries are more evident, probably due to the diverse typologies of CRFSI involved in the different areas and also for the number of CRFSI respondents for each EU countries.

The fact that all three pillars have a score near 3 (the middle value of the Likert scale) confirms the consistency of the methodology: there is room for improvement in the values for the initiatives. This tendency is also observed when looking at individual indicators (see the following sections). Additionally, we can assume that the initiatives that replied the survey are "motivated" and have sustainability concerns. This would explain the mean values slightly above 3.

3.2 Social pillar

Figure 5 shows the average scores for the 3 Impact Categories (IC) of the social pillar. The highest score is related to the *"food quality"* (socIC3) having a value 4.10±0.15. This is followed by the social category *"job"* (quantity, quality, and diversity) (socIC1) (3.07±0.15), and the by the *"Community outreach, engagement & education"* (socIC2) (3.00±0.21) even though the values are quite close.

The comparison of three IC (Figure 5) in the box plot shows that IC "*job*" (socIC1) and "*Community outreach, engagement & education*" (socIC2) are similar on average even though the latter presents

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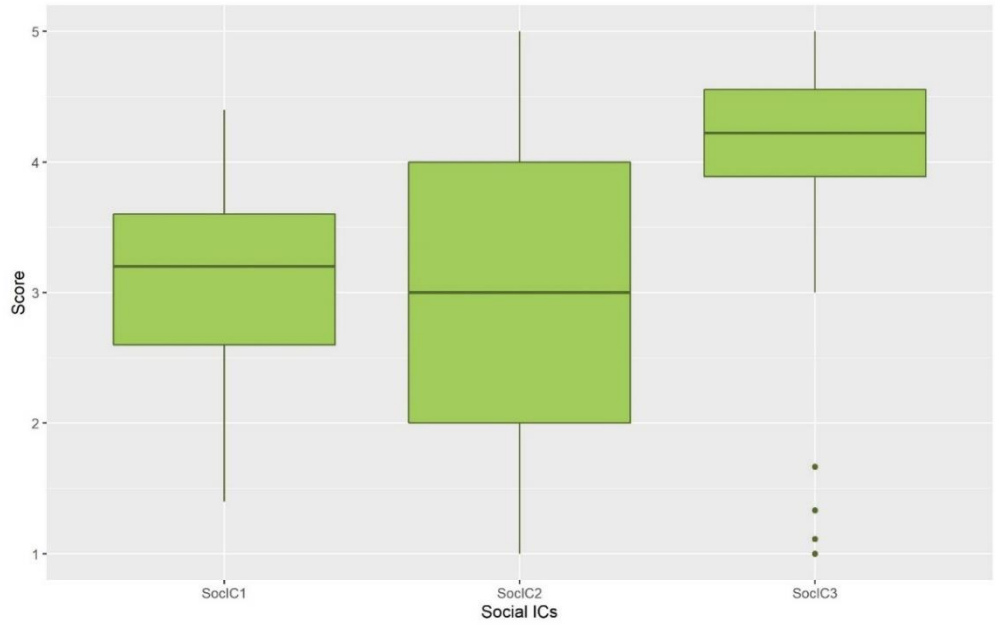

Figure 5 - Social Impact Categories (IC) scoring for the surveyed CRFSI (n=100)

a higher level of diversity on the answers. While, as stated before, the impact category "*food quality*" (socIC3) registers the highest average level with also the lowest level of diversity in answers. However, in general for the social IC, as the Standard Deviation (SD) shows (0.57) in relation to its average (3.39), it can be observed that the answers do not present a high level of variability.

When analyzing scores related to social KPIs (Figure 6) it is possible to get a more detailed understanding of the specific drivers of impact in each category. The highest average score is related to SocKPI10 ("*Product characteristics*" – 4.10±0.15), which is the only KPI in the "*food*

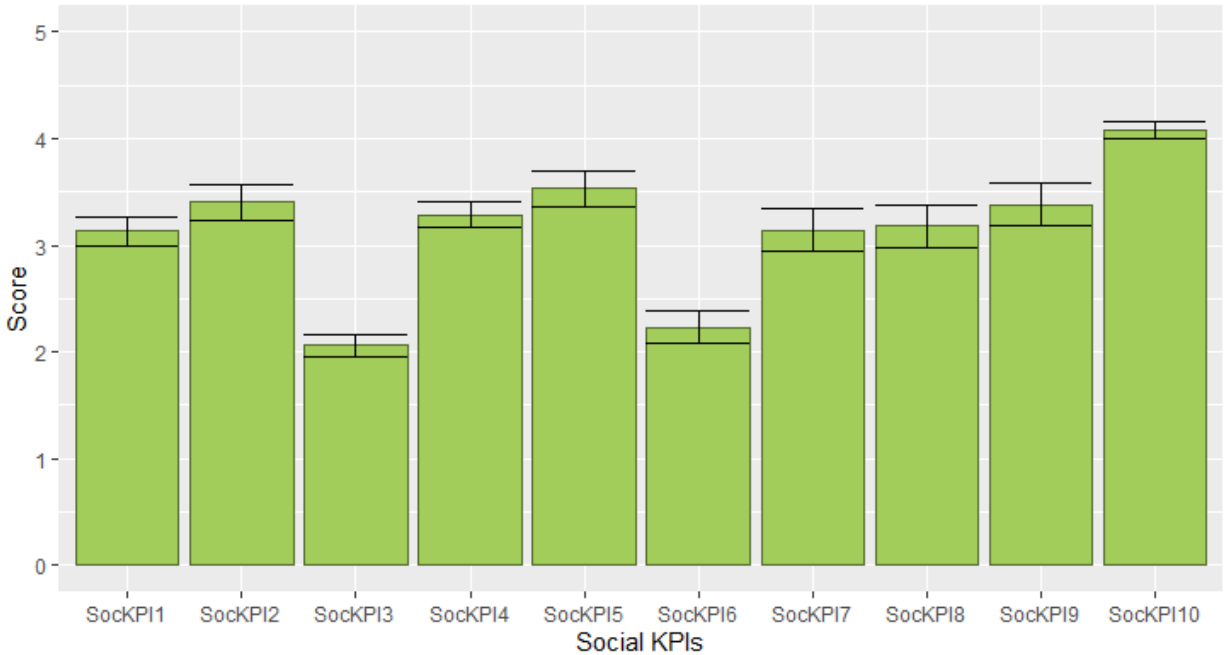

Figure 6 - Social Key Performance Indicators (KPIs) scoring for the surveyed CRFSI (n=100)

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quality" impact category (socIC3). A deeper overview of this social KPI, which is composed in turn by several questions (see D2.2 and D2.3) highlights that for CRFSI owners the most important characteristic of their products is the item of "*Taste and freshness*" with an average score of 4.56±0.18. Furthermore, it is important to highlight that "*local*" and "*environmental sustainability*" items are the second most important information that CRFSI owners want to communicate to their customer segment with the same average score of 4.40±0.15.

While the second most important is SocKPI5 ("*Gender balance"* – 3.57±0.33), related with the social impact category of "*job quality* (socIC1)". Such value can be an indication on how CRFSI have a proactive approach to the management of gender diversity on the workplace. It must be noted however that gender balance is proxied by the share of women in the workplace, without considering nonbinary individuals as well as qualitative or income-related aspects of gender balance.
The other social KPIs linked with the same socIC1 are quite close to the average of IC "*job quality*" (3.07±0.15), and have a positive score, with the only exception of SocKPI3 ("*Average gross monthly salary"* – 2.05±0.20). This means that CRFSI provide a relatively consistent number of jobs to both women and men, with permanent positions, trainings, but they also provide a relatively low salary.
While in relation with the "*community outreach, engagement & education"* IC (socIC2), it is possible to argue that higher scores are deriving from "*volunteers' activities"* (SocKPI9 – 3.42±0.38) and "*disadvantaged people"* (SocKPI7 – 3.18±0.39), and the "*connection with local producers"* (SocKPI8 – 3.18±0.39), rather than to the "*organization of outreach events"* (SocKPI6 – 2.22±0.28). However, the latter score could also be a result of the spread of Covid-19.

3.3 Economic pillar

Figure 7 shows the average scores for the 3 IC of the economic pillar. The highest score is related to the '*local economic development*' (EcoIC2) having a value of 3.51±0.19. This is followed by the

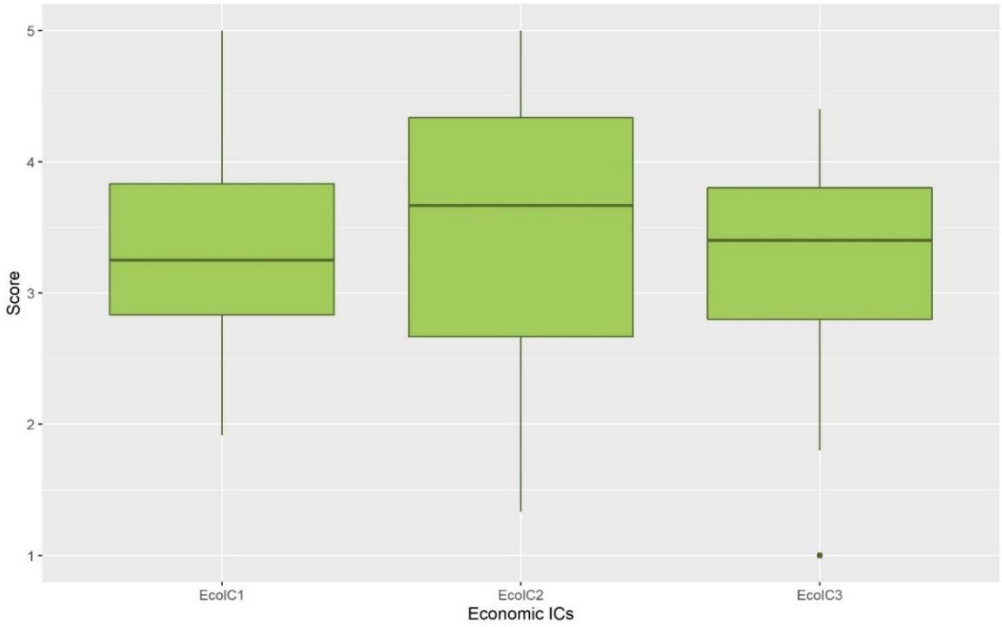

Figure 7 - Economic Impact Categories (IC) scoring for the surveyed CRFSI (n=100)

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'*organization profitability and outlook*' (EcoIC1) (3.31±0.14), and then by the '*customers and users*' (EcoIC3) (3.29±0.12).
The comparison of three IC (Figure 7) in the box plot shows all three IC are similar on average even though EcoIC2 presents a higher level of diversity on the answers.
However, it can be noted that in general, for the economic IC, the answers do not present a high level of variability (3.37 ±0.47).

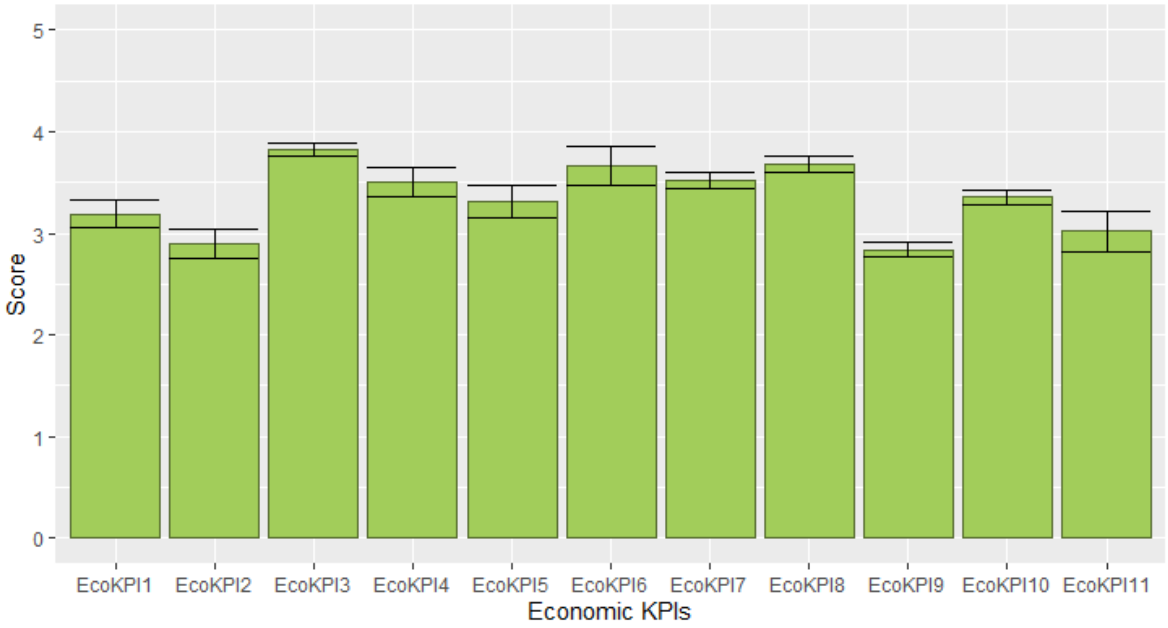

Figure 8 - Economic Key Performance Indicators (KPIs) scoring for the surveyed CRFSI (n=100)

When analyzing scores related to economic KPIs (Figure 8), it is possible to get a deeper understanding of the specific drivers of impact in each category. The highest average score is related to EcoKPI3 ("*Business future*" – 3.82±0.13) that is one of the three KPIs for "Organization profitability and outlook" IC (EcoIC1). A deeper overview of this economic KPI highlights that for CRFSI owners the most important change in their Business in the next three years will be "*Number of customers/clients/users*" with an average score of 4.04±0.16. In addition, also the other items "*product sales*", "*other revenues*", and "*profits*" have a high average score (3.90±0,18; 3.65±0,16; 3.67 ±0,16). It means that most of the CRFSI owners are quite optimistic about the future even with the spread of the COVID-19 pandemic.

Most CRFSI assessed their outlook quite positively in terms of sales, revenues, profits, and customers. A medium "*annual net profit margin*" (EcoKPI1 – 3.21±0.25) is reported, while a slightly lower than average "*diversification of income*" (EcoKPI2 – 2.92±0.29) is registered.

As mentioned, ties to local economies are demonstrated by the consistently high scores in all EcoKPI4-6 ("*provenance of employees*", "*locally sourced supply*", "*suppliers' practices*") for the EcoIC2, in particular when it comes to the adoption of fair practices towards suppliers.

The positive outlook in terms of customers is also confirmed by the scores related to EcoKPI7 and EcoKPI8, namely "*customers/users' acquisition*" and "*return rates*" (3.53±0.15 and 3.67±0.15 respectively) in EcoIC3, probably thanks to the positive effect of the word of mouth (EcoKPI10

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"*Customers/users return reason*"). However, their expenditure does not tend to increase (EcoKPI9 "*Customer/user expenditure*"). Finally, as far as online selling is regarded, the average score suggests that such a channel typology is adopted only by 50% of CRFSI.

3.4 Environmental pillar

Figure 9 shows the average scores for the 4 IC of the environmental pillar. The highest score is related to the *"waste management and circularity"* (EnvIC3) having a value 3.76±0.68. This is followed by the environmental category *"resource use effi*ciency" (EnvIC1) (3.21±1.01), with the two IC with a value below 3 being "*Food production/supply*" (EnvIC2) (2.99±0.62) and "*Transport*" (2.63±1.22) (EnvIC4), having the lowest score with the greatest SD.

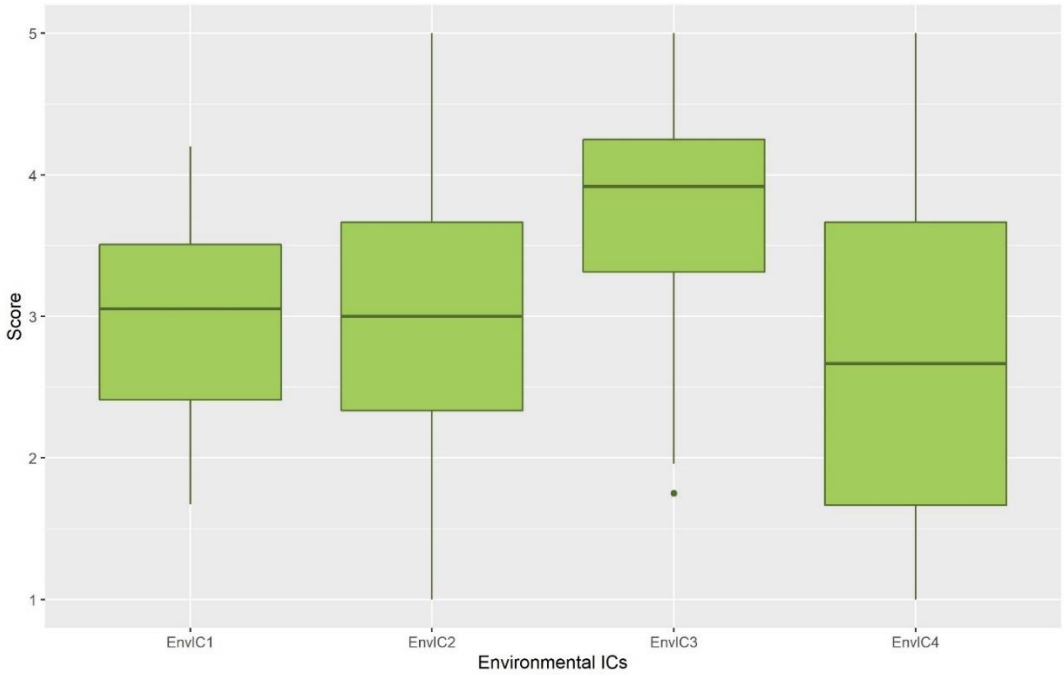

Figure 9 - Environmental Impact Categories (IC) scoring for the surveyed CRFSI (n=100)

The comparison of the four environmental IC (Figure 9) in the box plot shows that "*resource use efficiency*" (EnvIC1) and "*Food production/supply*" (EnvIC2) are similar on average even though the latter presents a higher level of diversity on the answers (1.01 compared to 0.62). When we look at the environmental pillar score (3.15±0.53), generated as a mean of the four IC, we can see that the SD is lower the one obtained in the four environmental IC.

When analyzing scores related to environmental KPIs (Figure 10), it is possible to get a deeper understanding of the specific drivers of impact in each category. The highest average score is related to EnvKPI6 ("*water saving practices"* – 4.11±1.16). This score is more than 1 point above the other two KPIs included in the IC *"resource use efficiency*", EnvKPI7 "*Electricity sources*" (2.67±1.40) and EnvKPI8 "*Heating sources*" (2.85±1.63). The other environmental KPIs with a score above 4 are "*characteristics of the products* – EnvKPI5" (4.07±1.07) and "*waste recycling* - EnvKPI9" (4.07±1.07).

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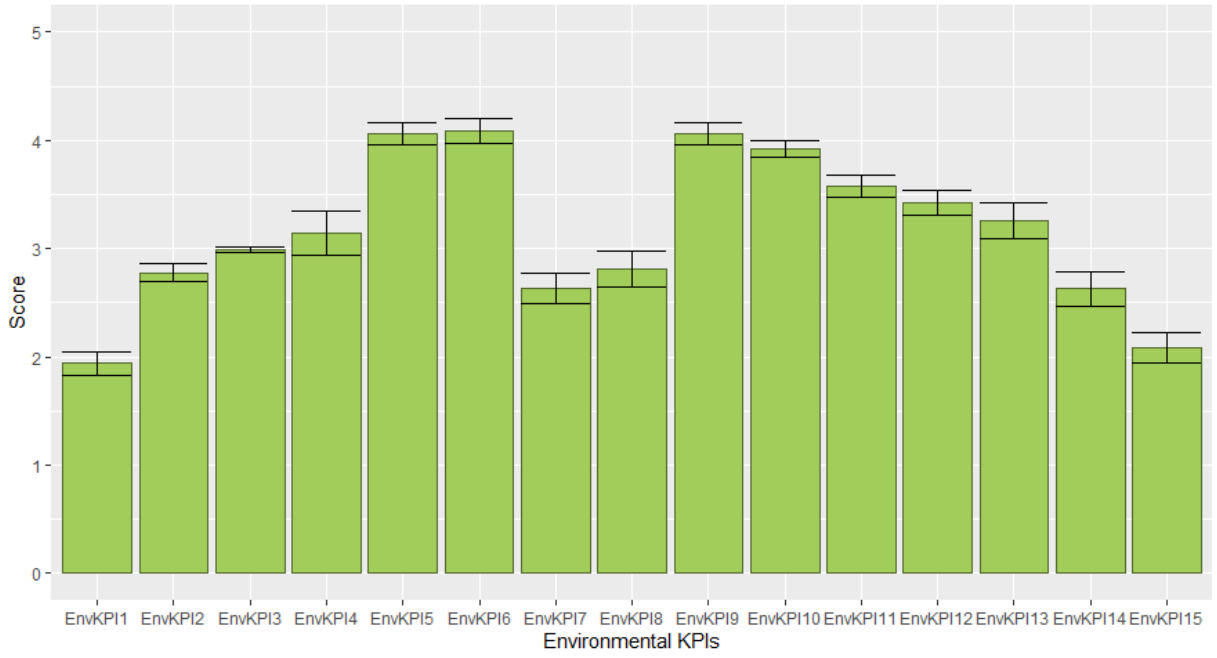

Figure 10 - Environmental Key Performance Indicators (KPIs) scoring for the surveyed CRFSI (n=100)

On the other hand, two environmental KPIs are included among the 3 worst-scoring KPIs: "*Type of transport of supplies* – EnvKPI15)" (2.06±1.37) and "*Technology used for crops* – EnvKPI1" (1.98±1.16), being the KPI with the worst scoring. "*Technology used for crops*" is included in the IC "*Food production/supply*", jointly with "*Characteristics of the products*" and 3 other KPIs with a similar score but very different variabilities: "*Animal fed provenance* – EnvKPI2" (2.78±0.84), "*Fishing gear types*", EnvKPI3 (2.99±0.26) and "*Ancient cultivar or local breed*", EnvKPI4 (3.14±2.01). The close value of "*Animal fed provenance*" to 3 is due to the frequency of "*I do not produce manage or sell any dairy and/or eggs and/or fish*" answers in the survey sample. However, more than 20% of the CRFSI replied with a specific distance to the question, thus yielding a SD close to 0.80. In the case of "*Fishing gear types*", the value is extremely close to 3 due to the fact that almost all answers in the sample were "*I do not produce, manage or sell any fish*" or "*I don't know*", with only 4 answers with specific gear types. This is related to the low representativity of fisheries in the sample, and thus yields a value close to 3 and a low variability of answers.

The best-scoring KPI in the "*Transport*" IC is "*Distance from clients/customers* - EnvKPI13" (3.23±1.64), understandable given that the survey was focused on initiatives included in the City/Region Food System. However, there is still room for improvement in the EnvKPI14 "*Type of transport to clients/customers*" (2.59±1.62).

Finally, the relatively good score of the impact category "*Waste management and circularity*" is also seen in the KPIs that represent it: with values close to 4 in "*Waste recycling* – EnvKPI9" (4.07±1.07), and "*Sustainability Commitment* – EnvKPI10" (3.94±0.79), and values close to 3.5 in "*Packaging and materials recyclability and compostability* – EnvKPI11" (3.58±1.03) and "*Packaging and materials reusability* – EnvKPI12" (3.44±1.15).

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3.4.1 Optional appendix

Overall, around 45 CRFSI responded to the optional questions on the environmental dimensions. Results are presented below.

Average results for countries with CRFSI classified as Livestock Farming and Crops Growing are presented in Figure 12 and Figure 11 respectively.

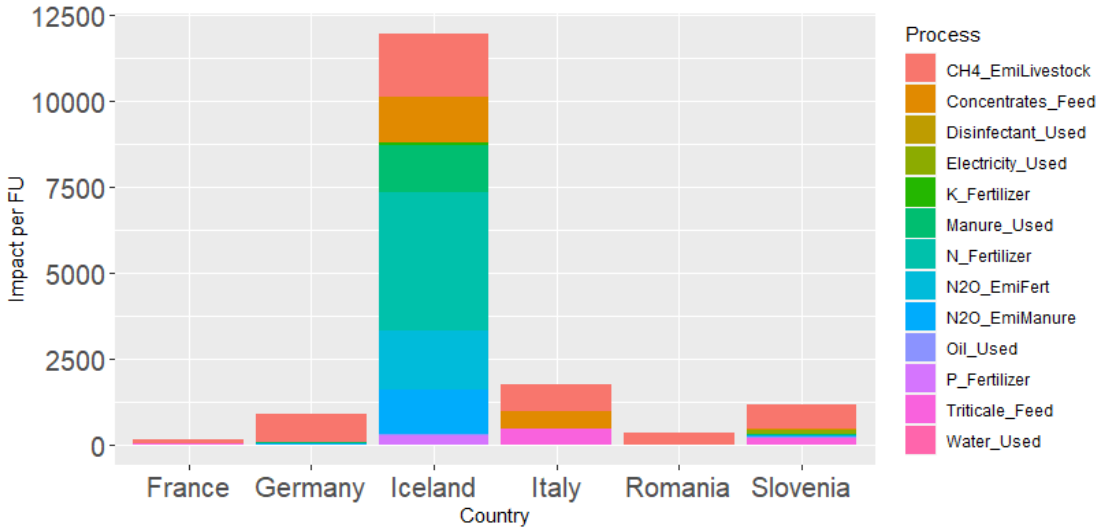

Figure 12 – Average Global Warming Potential (kg CO2 eq) per Functional Unit (FU) of the livestock farming CRSFI accordingly to the country (n=13)

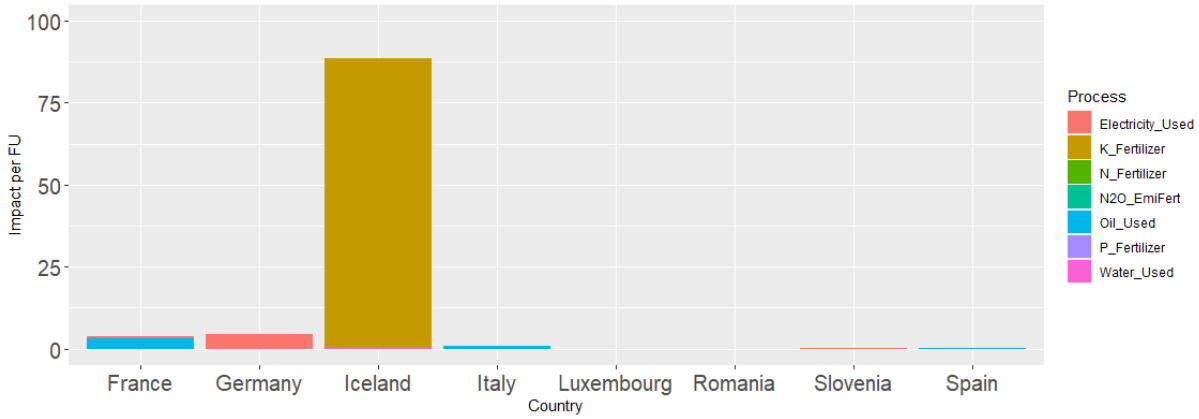

Figure 11 – Average Global Warming Potential (kg CO2 eq) Functional Unit (FU) of the crops growing CRSFI accordingly to the country (n=32)

Fisheries are not included since there were limited data available from CRFSI classified under this class. Data related to fisheries was provided for a CRFSI linked a pilot and will therefore be extensively analyzed during the pilot's assessment phase.

The high impacts of Iceland average, especially for crop farming, are related to a mistake in the data for the only CRFSI from Iceland included in the survey. Although the main inputs and outputs

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were introduced correctly, this CRFSI reported that only 30 kg of vegetables were produced during an entire year, which doesn't align with the amount of resources filled in the survey.

To illustrate the variability of scores in the climate change impact category (unit being Kg CO_2 eq), livestock and crop farming initiatives are divided in Figure 13 and Figure 14, attributing a numeric code to each initiative in the survey (I1, I2, etc).

In Figure 13, showing the carbon footprint of livestock farming initiatives per country, we can see that the impact is normally higher than 1t of CO_2 eq per animal, with the CRFSI in Iceland representing the highest impacts among the CRFSI presented. The difference between the CRFSI in Iceland and the other ones may be related to the completeness of the data for this CRFSI and the fact that it has a combined number of 280 cattle and dairy cows, known to be two types of livestock with a high-impact profile. Thus, the use of a FU based on animal count may harm this CRFSI environmental performance.

In terms of agricultural crops, the difference between the minimum and the maximum impact are several magnitude orders. These differences can be attributed to the completeness/lack of the data provided by the initiatives while filling the survey. A clear example can be seen for the two initiatives in Luxembourg and Romania. The fact that these two initiatives have only an impact around 10^{-5} iKg CO_2 eq related to the fact that only data related to the water consumption was provided. An initiative in Slovenia reached an impact of around 0.08 kg CO_2 eq per kg of vegetables (4000 times higher than those in Luxembourg and Romania) by providing data on oil and electricity consumption, although initiatives in Spain, Italy, France, or Germany reached values between 4 and 30 kg CO_2 eq per kg of vegetables by providing data for the same elements in the inventory.

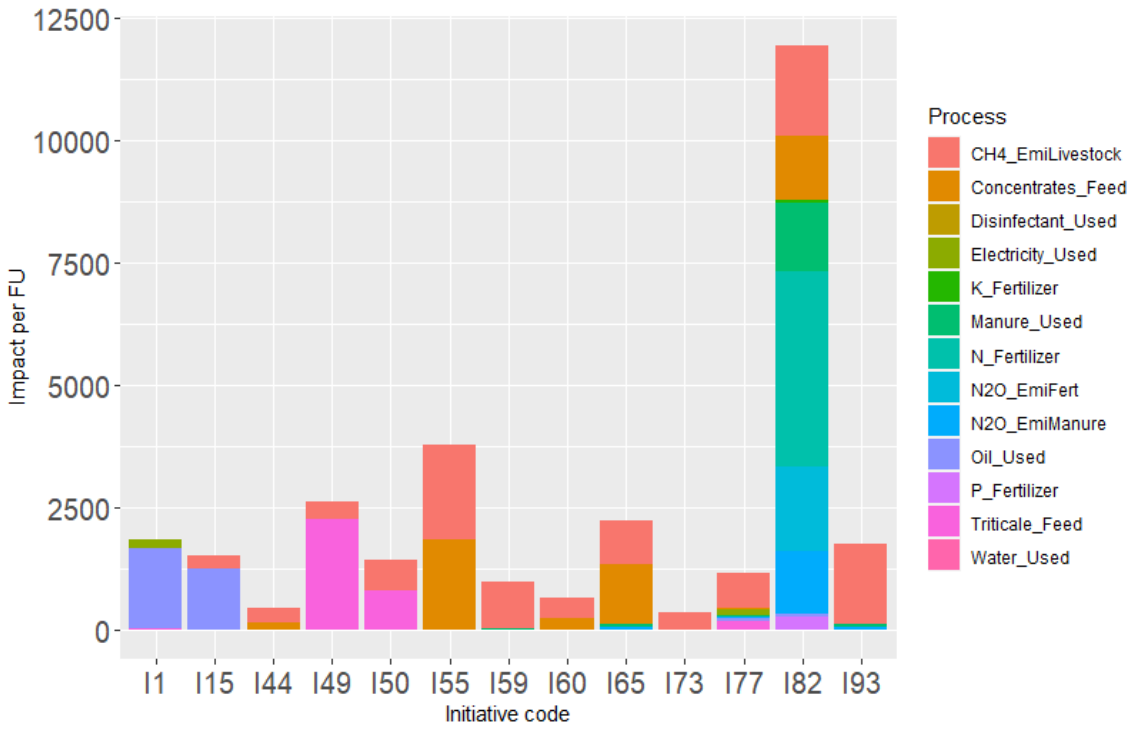

Figure 13 - Global Warming Potential (kg CO2 eq) per Functional Unit (FU) of the livestock farming CRFSI

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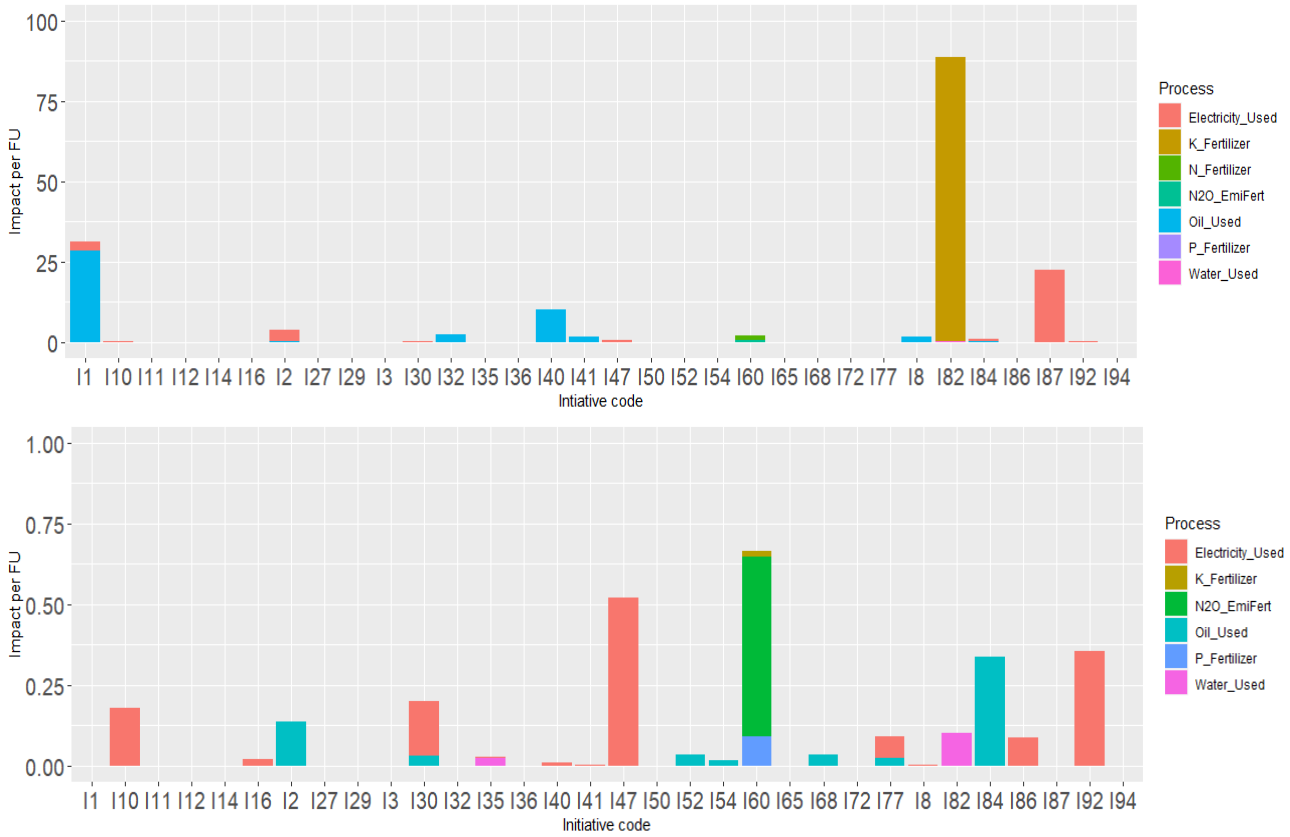

Figure 14 - Global Warming Potential (kg CO2 eq) per Functional Unit (FU) of the crops growing CRFSI

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3.5 Sustainability postcard

To encourage the survey dissemination and provide CRFSI with a concrete output, for each CRFSI participating in the survey and giving the consent to be contacted back from the FoodE project[1] a sustainability postcard was designed and delivered. For CRFSI, this is intended as a way to understand potential improvement opportunities and to communicate the CRFSI performance and advancements to the surrounding community.

A template of the Sustainability postcard is depicted in Figure 15. This includes the single sustainability scoring of the CRFSI, and the scoring of the three pillars of sustainability (i.e., the social one, the economic one and the environmental one). Additionally, for those CRFSI having answered the optional part and specifically requiring more detailed information on their LCA performance, a simple processing of the relative results was produced and shared.

The postcard has been sent in digital format, high resolution, for printing purpose. CRFSI were first contacted through the email address they provided in the survey compilation. In case this process was not successful they were contacted through the phone number they provided.

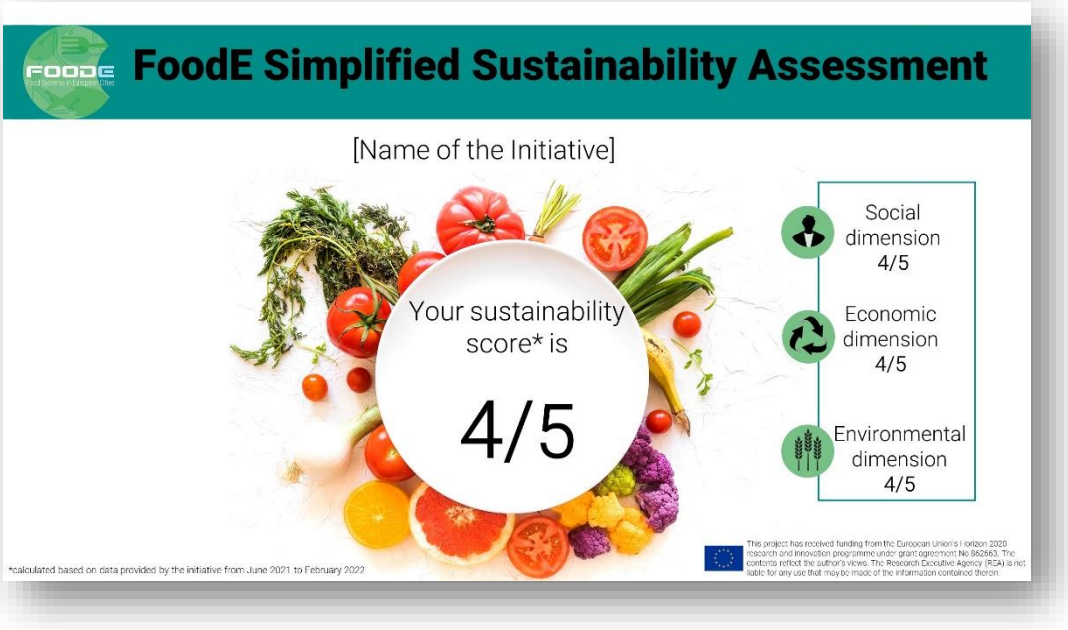

Figure 15 - FoodE Sustainability postcard for CRFSI

[1] *'I give consent to the storage and further use - NOT NECESSARY for the purposes of participating in the study in question - of my personal data for the purposes and in the manner set forth in point (B) of the 'Data protection information notice'.*

4. Additional remarks and discussion

4.1 Social pillar

To support the discussion of results, the most relevant additional remarks collected in the blank box of the online survey for the social pillar are provided in Table 3 - Social pillar additional remarksTable 3.

A first point of attention refers to the fact that the survey was designed to be as inclusive as possible for different CRFSI dealing with different steps of the food chain (e.g., food production, transportation, distribution, services) and different food typologies. This inevitably led to shortcomings for some CRFSI in answering to one or more questions. Specific examples are provided by additional remarks (see remark 1,2,3 in Table 3, highlighting how research or educational CRFSI might have encountered some difficulties in answering to a set of questions.

An additional point of interest is towards family-owned initiatives. In fact, some of them obtained lower scoring value for the '*Job*' IC given the fact they don't employ anyone outside of their family members. In some cases, they also work for self-sufficiency only (see additional remarks 4,5,6 in Table 3). This issue represents a key point of attention for the future extensive assessment of case studies on the social dimension.

It is also worth noticing that some terms used for the sustainability assessment might have been interpreted differently by each CRFSI. Such a concern suggests that providing the respondents with standardized vocabulary explanation might have helped in standardising the answers meaning. However, this is a quite critical step given that these terms do not necessarily have a commonly agreed on significance either from a scientific perspective, or from a civil society one. Hence the survey designers preferred to let respondents tailor each term to its specific local condition. Some examples of how this might have influenced the CRFSI answers are provided in Table 3 (remarks 7-10).

Finally, the lifespan of each CRFSI could have also influenced the final sustainability scoring. Examples refer to the workplace trainings or frequency of events which might be harder to organize in newly settled CRFSI. This is also suggested in remark (14). Hence, for the future assessment of case studies, a standardization factor for this element might help in better interpreting results and highlighting important hotspots of intervention.

Table 3 - Social pillar additional remarks

Social pillar additional remarks
(1) We are a research institute, so we are providing a service (perform research) rather than selling a product. This is why in the last question of this section we replied (neither important or unimportant)
(2) animal welfare and fairness in food chain are not really applicable to our company. So I can't say anything about this
(3) We are a plant-based restaurant; so, the animal welfare question is N/A. By the way, it is very important to us and that is why we made the choice. Not only for animal welfare, but also for other sustainability principles.
(4) We don't have employees since we are a family farm counting on family members only
(5) We are a small family initiative with only family members involved and no employee

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(6) My work is rather a subsistence work for family self-sufficiency, without any employee
(7) The meaning of 'our community' was a bit vague. We intended it a farm participating in our network and project stakeholders.
(8) Affordability and fair price are different things. Affordability is cheap. Fair price it should be more expensive
(9) I think affordability and fair price are two different things: My products are not in the affordable category, and my customers are not interested in my products and services because they are affordable, but rather for the fact that it pays "me" fairly. This is the reason that I ticked that box. Fair pay for the farmer/beekeeper is an important principle of our organization.
(10) Given that our activity takes place in a region with limited economic resources and it is our organization's policy that all employees are members of the local community (they live in the towns closest to the farm), it can be said that we carry out activities for disadvantaged people; In other words, we employ them and we are a motor for the local economy, although we do not necessarily encourage any strict volunteer work.
(11) Most of our clients are tourists who are enjoying their holidays and are not very interested in the local eating and poorly interested in the environmental sustainability of the food they eat.
(12) As for the workplace trainings, we provide continuous day-to-day informal training to our employees, but we don't foresee any official/certified courses for them.
(13) We are all owners of the company we therefore don't have official employees. We buy sometimes potatoes from another farmer or a few kilos of fruit that we sell, but it's very little
(14) As we have just finished our first season focusing on building a food forest, there has been relatively little food produced yet.

4.2. Economic Pillar

To support the discussion of results, the most relevant additional remarks collected in the blank box of the online survey for the economic pillar are provided in Table 4.

Foremost, specifically when dealing with financial issues and precise data requirement, the people answering the survey and/or collecting the data can influence the final results. In particular, as also highlighted in the additional remarks (1,2), when the individual is not fully aware of the CRFSI functioning he or she might risk including biased data. Hence, making sure to address the adequate CRFSI stakeholder is a key preliminary issue for the quality of the assessment.

As mentioned for the social pillar, also in this case the different CRFSI encountered difficulties since one or more questions might not fully apply to the scope of their activities. Examples of this are provided in Additional Remarks 3, 4, 5, 6. A specific case is represented by non-profit initiatives since they tend to adopt different financial mechanisms than normal businesses, hence resulting in potential lower scores in this pillar. They might not consider the profit margin or the business change of their profit as relevant categories.
Relatively to other specific models of production, such as for example, Community Supported Agriculture or Solidarity Purchased Groups, they might entail fixed subscription for members or customers and a constant money collection from this financial source (see additional remarks 7,8,9).

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Finally, as previously indicated, the time span of the activity is something that should be more broadly considered when analysing results since new initiatives might have limited data (see additional remarks 11, 12). As an example, very young initiatives might have obtained lower sustainability scores in '*Organisation profitability and outlook*' IC because the initial years of activities can be particularly critical from a financial perspective and because it is quite hard for them to forecast the business future they expect. In parallel, the total expenditure increase of customers and their return rate might also be quite difficult to be estimated at the very early stage of an activity.

Table 4 - Economic pillar additional remarks

Economic pillar additional remarks
(1) In my position as Responsible for Quality and Sustainability, I do not handle economic data and, consequently, the answers in this section are still somewhat vague estimates of my own, or mere conjectures (such as the percentage of net profits). In the same way, it is the Commercial Department that has exact information on the recurrence or not of customers. *(2) What is your annual net profit margin (ratio of net profits to revenues)? I do not know.* *(3) Do you adopt fair business practices towards suppliers? Question in my opinion N.A. for small businesses* *(4) Issues not relevant to us: fair practices and local sourcing* *(5) There are some questions that just don't apply to me* *(6) Lastly the first question here on this page about my net profit margin does not apply to my model because the payments I collect from my members become my salary and there is nothing left. The initiative is not profit-driven, which is another point.* *(7) Our collaborative farm redistributes its products to members who work in the gardens, we do not actually sell them, they are part of a monthly subscription formula for users.* *(8) it is not possible for the customers to spend more than they already did, because there is a fixed package with a fixed payment which is prepaid at the beginning of the season.* *(9) We are a non-profit association, so we answer from a member's point of view and not from a customer's point of view* *(10) The return frequency of customers is difficult to calculate given that we are a new reality, which has only been open for just over a year.* *(11) I do not know since this is my first year of implementing this initiative.*

4.3 Environmental pillar

To support the discussion of results, the most relevant additional remarks collected in the blank box of the online survey for the environmental pillar are provided in Table 5.

A common point of attention that was also highlighted for the social and economic pillars refers to the fact that the survey was designed to be as inclusive as possible for different CRFSI dealing with different steps of the chain (e.g., food production, transportation, distribution, services) and different food typologies. As a consequence, some limitations were mentioned by CRFSI regarding the difficulties on answering specific questions. Specific examples are provided by additional remarks (1 to 4), highlighting how some of the questions regarding water use, energy use or those strictly focused on fisheries.

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Some additional remarks focused on particularities of CRFSI that couldn't fit in the established questions of the survey. Additional remark 5 highlighted the CRFSI certification through international standards but mentioned the limitations in improving aspects related to transport and packaging. Additional remark 6 underlined that the low commitment to reduce organic waste was related to high degree of circularity that this CRFSI achieves with this kind of waste.

Transport was the main topic that CRFSI wanted to add comments to. Some examples are a justification on the use of fossil fuel vehicles due to the area where the CRFSI is located (7), a detailed explanation on the use fossil fuel vehicles per activity (8) and a comment on the use of electronic bikes (9).

Finally, a CRFSI also used the additional remarks section to provide information on additional services that they provide to customers and farmers (10).

Table 5 - Environmental pillar additional remarks

Environmental pillar additional remarks
(1) We do not use water in our processes, but you force us to answer the questions without giving options not to answer them. *(2) Some answers do not fit our structure at all, such as the questions about energy or the transport of goods to the customer. We will buy electric cars in the future and set up an electric filling station.* *(3) We do manage fish- however we are doing so in an aquaponics system - therefore none of the fishing gear for boats applies* (4) *Some unclear questions that I can't answer (about fish for example)* *(5) We are a land-based aquaculture farm located in a remote environment (Doñana), so it is extremely difficult to serve only the local community. Everything requires transportation from/to long distances. On the other hand, our commitment to the environment and the reduction of impacts is absolute, insofar as we are certified with EMAS III and ISO 14001, but the reality of packaging is something that falls mainly to our commercial factory, not to us strictly. The product that leaves here does so in isothermal containers with water and ice, which are reusable. The containers with supplies are removed by an authorized waste manager, just like any other organic or inorganic waste produced.* *(6) We have no commitment to reduce organic waste because in the countryside organic waste is not waste: what little waste goes into the fertilizers and returns to the ground* *(7) our company is located in a territorially inaccessible area, not easily accessible, and therefore we need for the transport of fossil fuel vehicles* *(8) we use diesel food truck to get to the market. It only drives about 40 km a week because the market is close by. Our beans import goes with ships of a shipping company (CMA CGM) that invests in greening sea transport* *(9) For our large kitchen for 100 people who live on site plus seminar guests, we transport ours with an ebike and trailer* *(10) From the Almond Association of Gran Canaria we not only promote, educate and advise to carry out ecological productions, we carry them out with conviction and free technical advice for the farmer. From this point of view, the use of the area's resources is maximum (inputs, organic fertilizers, etc.) and sustainability and the promotion of biodiversity are a priority for the farms*

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4.3.1 Optional appendix

Lessons learned for pilots' assessment

LCA is a time-demanding methodology when performed extensively. Therefore, the environmental profile that can be obtained by collecting data from complex systems such as CRFSI through an online survey can only serve as a simplistic approach of impact characterization. Nonetheless, the data collection from this survey can be useful to determine what may be the hotspots and limitations that an LCA practitioner may encounter while assessing a system extensively. We have listed below the main ones:

- **Lesson 1: Relevant data to establish a valid FU**. Although most CRFSI completed at least part of the requested data, we found that some of them filled data regarding the resources but didn't complete data regarding number of animals (livestock farming), average catch (fisheries) or yield (crops growing). When dividing the impact of the system with its reference flow, infinite values that are meaningless are generated for those initiatives that didn't fill this type of data. Moreover, the FU based on quantity of animals for livestock farming is not strictly correct since it doesn't respond to a function. Accepted FU for livestock farming are mass of fresh weight for cattle beef, chicken or pig farming, and fat protein corrected milk for dairy cows. Therefore, the choice of the FU to use has to be incorporated before the data collection since some FU rely on them.
- **Lesson 2: Identification of relevant system-specific and indicator-specific flows**. Electricity, oil or water consumption might be inputs that are useful to collect for the broad spectrum of initiatives that compose a CRFSI. However, fertilizer or manure application might be relevant for livestock or agricultural systems, but not for fisheries, where ice for cooling might be important. In terms of on-site emissions, nitrous oxide may be relevant when nitrogen fertilizers are applied, but only if the assessment includes a calculation of a carbon footprint, since it is the only the category where this gas is harmful according to published characterization factors. Nitrogen and phosphorus emissions to water are another example of importance relative to the assessed IC. Characterization factors for the emissions of these two elements to water are only provided for eutrophication-related IC (e.g. freshwater and marine eutrophication). Therefore, their quantification may not be relevant if the assessment does not include these IC. However, if we are analyzing an agricultural system, the omission of the eutrophication effects hinders a big section of the system's environmental profile.
- **Lesson 3: Units**. We have observed that in some cases, data provided by initiatives is filled considering their units (e.g., tons or kg/m^2 of vegetables produced) instead of those predefined in the survey (e.g., kg of vegetables produced). Although sometimes the mistake seems obvious, it has to be verified through a direct contact with the initiative, which is not always easy if the data was provided through a survey. However, when there is a direct relationship with the initiative (as there will be with the pilots), these kinds of mistakes can easily be solved.
- **Lesson 4: Lack of data and how to overcome it**. As we can observe for the carbon footprint of both livestock farming and agricultural systems, lack of data does massively affect the final result for a specific initiative. After an effort has been done to collect primary data for a specific initiative but no results have been obtained for various reasons, the use of secondary data is preferred over not having data at all. Although the fact that using

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secondary data may decrease the degree of comparability between those initiative and similar ones, not having data for relevant elements in the inventory make two similar systems incomparable.

- Lesson 5: Local and case-specific practices. The survey asked for amounts of resources but left aside aspects like origin, how these resources were transported or degrees of self-sufficiency (apart from electricity). As an example, it wasn't asked how the renewable electricity was produced or how the initiatives were implementing sustainable practices like water recirculation or rainwater harvesting. Asking about these specific topics through an online survey can compromise the response rate, but it is relevant to extensively characterize the system when doing a complete LCA. For this reason, involving local knowledge (e.g., some countries may have a legislation that imposes the use of rainwater harvesting systems) as well as knowing through on-site visits the various elements of the initiatives can help obtain the bigger picture and thus the most complete environmental profile.
- Lesson 6: Territorialized background data. To develop a simple impact matrix, Europe averaged data was used to calculate the environmental impact of the initiatives that filled the optional part of the survey. To quantify the environmental impacts of initiatives as precisely as possible, the assessment of pilots in T2.4 must account for the background data as territorialized as possible, considering also its availability.

As for the previous sections, also for the optional appendix of the survey, an additional set of remarks were provided by the CRFSI (Table 6). These were mostly related to general and specific clarifications regarding the quantitative data provided, either including additional specification to better contextualize results or highlighting the non-applicability of some questions (see additional remarks 1 to 9). Similarly, other remarks refer to the availability of data, underlining how in some cases one or more data are either not collected or not accessible (see additional remarks from 10 to 14). Finally, other remarks refer to the applicability or scope of the survey in relation to the CRFSI, referring back to the existing differences across CRFSI explained in the previous sections (see additional remarks 15, 16).

Table 6 - Optional appendix additional remarks

Optional appendix additional remarks
(1) We produce vegetable garden plants so the classification by Kg is not relevant for us.
(2) Transportation is done by van within the island, in a 50km radius.
(3) We are not a fishing company but an onshore aquaculture company. We carry out our activity on a 2,500-hectare farm that takes water daily from the Guadalquivir estuary (hence the annual amount of 80 cubic Hm) and has to distribute it continuously (hence the enormous consumption of electricity).
(4) Marketing is short chain, from the producer to the local customer, or the small traditional candy stores of the producing municipalities. Energy consumption is reduced at specific moments of agricultural work or at the moment of harvesting the almond for sale. It is a crop with very little water and energy needs.
(5) They sell distributors or we serve through carriers.
(6) They are estimates, you also go to the garden and from the garden to home on foot.
(7) The main electricity we use comes from 100% renewable sources certified by TÜV.

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(8) We essentially produce dry olives. Energy consumption is low because the oil is transformed into oil. Deliveries made by van and bike in the restricted traffic areas.
(9) For this autumn we are planning to build a rain catchment basin. The amount of water is not just irrigation water, as we are a social institution with many people, we need a lot of service water
(10) I do not follow the resources used, I answered promptly, and renewable energy = sun
(11) We do not keep track of the resources we use during the year, but for sure our goal is not to waste!
(12) Most of that on this is currently not available to me.
(13) We do not produce coffee beans ourselves; the coffee farmers do that from whom we buy directly and with whom we build long-term relationships
(14) I have no idea how much water etc. we use. We take slot water, we have automatic sprinklers, it's very difficult to know that. Also, the kg of veggies, if you add this data to your collected data, I think it won't be accurate.
(15) We are a non-profit association, so we respond from a membership perspective and not a client perspective.
(16) It is not a commercial garden.

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5. Conclusions

Based on the methodology developed in D2.2 and D2.3 and taking advantage of the data inventory in D2.4, the present report analyses the sustainability simplified assessment results of 100 CRFSI selected within the project FoodE. The three sustainability pillars are investigated both individually and in combination, to provide a simplified multidisciplinary sustainability assessment. This assessment does not substitute an extensive Life Cycle Thinking assessment, but rather provides the preliminary background.

The results provide a set of interesting insights into European CRFSI. As it is shown in Figure 2 (Section 3), most of the European regions were covered by the assessment. From a general perspective, the single sustainability average score among the three pillars (3.30 out of 5 ±0.07) of the selected CRFSI highlights a superior level from the average for the sustainability dimension. However, such scoring must be analyzed taking also into account that importance of "N/A" or "I don't know" answers in the final result, as explained in the methodological reports (D2.2). Results are characterized by a large degree of comparability across scales, and food sectors confirming the key role of the present framework in offering a unique innovative step for the European CRFSI evaluation. Overall, the social dimension seems to be most high-scoring pillar for CRFSI (3.39±0.11), followed by the economic dimension (3.37±0.09) and the environmental one (3.15±0.10). However, such scores slightly vary in relation to the different geographical areas investigated. The collection of secondary data paved the ground in identifying KPIs for the survey design on the different pillars and due to some related limitations, it was used to offer additional background and is identified as such. The data from literature are being reinterpreted and published as individual reviews in scientific journals, as a clear dissemination for CRFSI, researchers and EU citizens. Results of this specific activity are extensively reported in D2.4.

Future studies may address some of the critical points discussed in Section 4 to refine the simplified sustainability assessment scoring. For instance, limiting the use of multi-interpretable terms and improving the inclusiveness of the survey, while not damaging its comparability. Additional literature studies may contribute to this refinement by investigating the relative impact of performance indicators in greater detail. The conducted literature studies elucidated that the present body of knowledge is vast, but extensive and fragmented. An in-depth, multi-disciplinary study into indicators and metrics could therefore improve the future sustainability assessment of CRFSI.

The presented results form the basis for the extensive sustainability assessment of FoodE pilots, which will serve to tackle some of the simplified assessment framework limitations and provide more detailed, tailored and analytical results. Additionally, the sustainability score and information of the initiatives from the survey will be used in the FoodE App, developed within WP3, and integrated with the customers' feedback score. As such, the developed framework will be implemented into a practical day-to-day tool for CRFSI stakeholders.

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