D1.1: Inventory of skills and competencies

WP1 – A shared inventory of skills

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Executive summary

The current European agrifood and forestry system needs to innovate towards more sustainable agriculture, forestry, food and bio-based value chains to tackle challenges such as globalization and climate change. Agrifood and forestry professionals need to develop contemporary skills in order to face the current challenges of the sector. In response to this need, Nextfood work package 1 has developed an inventory of skills that will be supportive in the transition to more resilient agrifood and forestry systems. Universities and other educational bodies in the field of sustainable agrifood systems can benefit from this in their development of curricula. In order to identify the skills and competencies needed in future practices and/or processes, the inventory reviews previous research and relevant projects, as well as analyzes empirical data produced in the Nextfood project.

This report is structured as follows. The first section provides an introduction to the aim of this inventory of skills, and introduces its main concepts. The next chapter presents the methods and results of the four datasets that together provide the data on which the report builds. In the following two chapters, the results of the four datasets are compared to each other in order to identify the skills that are emphasized across the data. This has resulted in an overall list of skills, as well as a qualitative analysis of the skills with the aim of contextualizing them, and providing an understanding of their different meanings, dilemmas and operationalization. For presenting the variety, depth and width in these complex sectors and networks seven categories structure the analysis. The final chapter presents the main conclusions and next steps within the Nextfood project: To analyse to what extent the identified skills are catered for in existing research, education and training systems.

1 Introduction

In order for the current European agrifood and forestry system to innovate towards more sustainable production and value chains, and tackle challenges such as globalization and climate change, professionals within agrifood and forestry are expected to play an important role. Previous research has found that moving towards more sustainability requires deeper and broader knowledge bases and that professionals generally are lacking the skills to tackle these current challenges of the system, and that there is a need to reorganise formal and lifelong education systems to better promote such skills (Charatsari & Lioutas, 2019; Šūmane et al., 2018).

The aim of this paper is in line with these findings to create an inventory of skills needed in the transition towards more sustainable agriculture, forestry and associated bio-value chains. In order to investigate how to educate future generations to meet the challenges of climate change and support a transition to more sustainable agrifood and forestry systems, NextFOOD work package 1 (WP1) has identified and analysed the most important skills and competencies needed.

Besides a comprehensive literature study, information about needed skills, have been gathered from a variety of stakeholders, amongst others covering farmers, advisors, teachers and other practitioners, researchers and actors in the respective sectors.

The agrifood, forestry and associated bio-value sectors are continuously changing due to advances in science/technology, consumer demands and political and economic frameworks. The main aim of the presented inventory of skills is therefore to analyse which overall categories of skills are relevant across geographies, disciplines and fields of work. The inventory thereby focusses on the overall categories of skills, rather than listing skills that are specific and concrete, as these are expected to change quickly and to differentiate between contexts. The adaptation of these categories of skills to specific contexts is thereby left to the educational institutions that run education within the scope of agrifood and forestry.

This document represents the findings of this analysis, and a follow up on further data generated in the coming project period will establish a comprehensive basis for the publishing of the overall findings in this work package. This will offer an up-to-date overview for the further development of curricula when integrating skills that universities and other educational bodies in the field of sustainable agrifood and forestry systems should consider in the transition to more resilience.

The document focusses on key skills needed to support a sustainable development, thus it does not elaborate on skills that are not particularly related to sustainability, such as basic financial management or marketing techniques, as these are not different for businesses with a sustainable profile than for those without. Only in the situations where the needed skills are different or differently applied due to a focus on sustainability, are they included.

The data gathered from this inventory is presented both in tables and in analysis of the empirical data. For presenting the variety, depth and width in these complex sectors and networks seven categories structure the analysis. Through these categories it is possible to contextualize the findings, so that also the practical and instrumental skills

and routines of the practitioners appears as concrete touchpoints for change and for the adaptation of sustainable skills and practices.

1.1 Definition of skills

Theories of knowledge have been dealing with different sorts of knowledge and tried to define them. This is an ongoing process also today. The study of the theory of knowledge - epistemology - have in historic time had the attention of the research community. To name a few, theories deriving from Aristotle differ between learning cycles, the reflection and the concrete context and the Bologna framework for higher education defining the learning outcomes as what students know and can do when graduating. In the Nextfood project these concepts are introduced through a discussion covering also circular and linear learning modes and with oscillation and abduction between theory and practice. One discussion relates to the differences between the concepts of knowledge, skills and competences, with simplifies as knowledge relating to theory whereas skills relates to practice, and what links these two is competencies. However, in the data, the terms in practice becomes blurred. We have thus decided to have a broad definition of skills in this document, and also include phenomena and concepts that some would refer to as either competences or knowledge.

Furthermore, the identified categories of skills can be taught on different levels and through different methods and thereby students can achieve both knowledge, skills and competence within the individual categories.

1.2 Definition of sustainability

The document talks about skills to support a sustainable development, yet the concept of sustainability is not easily defined. One overall definition that is often agreed to, is that sustainability consists of social, environmental and economic dimensions (Davidson et al., 2015; Brundtland, 1987). The Nextfood project was built on this broad and generally accepted definition on sustainability and therefore this definition is used in this document. However there are both explicit and implicit differences in how sustainability is interpreted and prioritized in the different sources of data upon which this analysis is built, and the document therefore works with sustainability as a flexible concept which is defined by practice, rather than trying to impose a strict definition of the term.

1.3 Target group

The information that this report builds on have been gathered from a variety of stakeholders, as well as literature that covers an equally broad spectrum of actors. Together, the empirical material represents the following stakeholders:

- Researchers, teachers and other staff from educational institutions/universities: 54
- Students: 11
- Farmers and agri-business managers: 52
- Agricultural advisors: 31
- Fisheries: 6

- Food enterprises and industry (small-scale and large-scale): 16
- Others (NGOs, policy makers, ministerial bodies, farmer's federations, consultants): 19
- Forestry officials: 2

The peer-reviewed literature represents primary producers (farming, fishing and forestry workers), agronomists, researchers, decision-makers and policy-makers, however, it is not possible to find numbers in which groups are most represented, as many articles target several groups simultaneously.

Together, the stakeholders, in their respective roles, represent different sectors: Agriculture, fisheries, food enterprises and industry (small-scale and large-scale companies) and forestry, as well as overall governance. The main emphasis, however, is on agriculture, with a clear overrepresentation of actors and research related to this sector in the focus groups and the peer-reviewed literature. The forestry sector is primarily represented through the literature, as this sector is not represented amongst the focus groups and with only two respondents in the questionnaire.

2 Methods and results

This paper builds on data produced through different research methods: A review of peer-reviewed literature, as well as a review of non peer-reviewed literature, focus group interviews with professionals, practitioners and academics in the agrifood and forestry system, and a questionnaire survey conducted by various NEXTFOOD partners in their respective regions. The methods and results of each approach are presented in the following chapters.

The results have been compared to each other in order to identify the skills that are emphasized across the data. This has resulted in an overall list of skills, that represents the skills identified through all datasets, as well as a qualitative analysis of the skills with the aim of contextualizing them, and providing an understanding of their different meanings, dilemmas and operationalization.

2.1 Review of peer-reviewed literature

2.1.1 Methods

A 3-step methodology was adopted in order to ensure a rigorous and repeatable method: (i) generation of keywords, (ii) systematic search, and (iii) extraction of skills.

21 keywords were generated by Nextfood wp1 partners. A minimum of five keywords related to education, action research and sustainable farming / food systems were provided by each partner of WP1. These were compiled into the 21 most repeated keywords and organized into three domains: 5 keywords for education, 7 for methodology features and 9 for knowledge content. Keywords related to learning methodology was left out, as this is covered in wp1 task 1.3. The keywords were developed into search strings including synonyms and related words, as well as a search string related to the overall aim of identifying skills. In addition, more keywords were developed as the initial keywords were too broad and gave too many irrelevant hits. Therefore, new search strings were developed to narrow the search, and new search words were added in existing search strings.

Sustainability: Resilien*, environment*, food security, “climate change”, food waste, food security.
Transdisciplinary: transdiscipl*, “systems thinking”, multi-actor, food chain, interactive.
Innovation: Innovati*, development, “social change”, social capacity. Added keywords: co-innovation.
Agriculture: agricultur*, agroecolog*, “agri-food system”. Added keywords: family farming, farmer, agronomist, agricultural adviser, agrifood.

Competencies: Skills, competenc*, learning, knowledge, experiential, evaluation, systems thinking, education. Added keywords: soil conservation, clean water, biodiversity, ecosystem services, multi-actor, natural resources.
Examples of added search words: Marine, fish, aqua, seafood, beverage, food processing, food policy, food administration, food transport

Table 1. Keywords and search strings, peer-reviewed literature.

Searched were carried out by three researchers within three areas; natural science; social science; and innovation between December 2018 and April 2019 in five databases striving for a broad subject coverage: Web of science, ASFA, Scopus, EBSCO and PROQUEST. The searches used different combinations of the search strings, within each of the areas, and always including keywords related to sustainability. Total number of hits within the three areas were; social science (1110), natural science (642), and innovation (1397).

If more than a hundred hits in one search, the results were sorted by most cited, most relevant, and most recent, and the 25 first articles, according to these terms, were reviewed by title and keywords. Each researcher conducted a list with the articles that they deemed relevant by abstract and this was reviewed by at least one other researcher in the team. Through this review process, a final list of 34 relevant papers was conducted, which can be seen in 'Annex 1. 34 sources from peer-reviewed literature'.

From each article, any mentioned skill or phrase which involved a skill needed, were copied into a working paper developed by four wp1 researchers. This paper was titled "Tentative categorization of identified skills, definitions and research fields" and included identified skills, and explicitly documented definitions of the concept sustainability. 164 skills where identified in this list.

A mapping session was then performed to thematize the skills into tentative themes. For example, words and phrases such as *"Ability to recognize multiple systems and feedback loops at play in an issue*", "*Understanding complexities in agricultural systems",* and "*adapt multi-criteria sustainability assessment of the food systems"*, were categorized into the theme "Systems thinking".

Through this process, the 164 identified skills were condensed to 8 overall themes, including 27 sub-themes in total. Sub-themes were made to unfold the overall theme in more specific topics. These themes, including the specific and contextual skills identified from the peer reviewed literature, are represented in the table below (table 2. List of skills identified in the peer-reviewed literature). The themes are tentatively arranged in terms of their increasing emphasis in the literature. The list does not distinguish between skills needed in the present and future, as this was not clearly expressed in the reviewed literature. However, it is emphasized in the literature that sustainability is a complex issue which requires a continuous evaluation and improvement of skills in order to move towards more sustainability in the agrifood system (Charatsari, 2019).

"The transition towards SA [sustainable agriculture] *is conceived as a continuous process, requiring consecutive adjustments on the part of farmers to the changing social and economic conditions which affect their enterprises* (Chantre and Cardona, 2014, cited in Charatsari, 2019, 233)". Therefore, the identified skills can be understood as skills increasingly becoming more relevant and needed in the future.

2.1.2 Results

The 34 articles represent primary producers (farming, fishing and forestry workers), agronomists, researchers, decision-makers and policy-makers within agriculture (14 articles), forestry (5 articles), aquaculture (8 articles), and food system (6 articles). The studies within agriculture and food systems represent all continents. Studies made within the forestry sector represent geographical areas with large areas of forest, such as Norway, Sweden, Texas, Mexico and California. Studies about sustainable aquaculture and fisheries are covering geographical areas like Australia, Brazil, Europe, Cambodia, as well as broader, international perspectives.

Overall theme	Needed skills
Systems thinking	• Skills to recognize multiple systems and feedback loops in an issue • Skills to understand the complexities involved in real life practices • Skills to understand the complexities in agrifood systems • Skills to adapt multi-criteria sustainability assessment of the food systems
Knowledge integration	• Skills to use and interpret current scientific knowledge • Capability to integrate local knowledge with scientific knowledge • Recognize farmer experience as one valid contribution to farm system design • Skill to involve social learning, innovation and knowledge processes with actors in research and other actors
Interdisciplinarity and cross-sectional learning and cooperation	• Skills in involving other knowledgeable producers, consumers and traders in knowledge development
Lifelong learning	• Critical thinking • Problem solving • Ability to obtain and integrate knowledge continuously
Building and maintaining networks	• Networking building capacities • Sharing skills in the network • Capability to solve internal conflicts

Innovative mindset	• Skills in innovation • Adaptability • Openness to novelty and change
Technical and subject specific knowledge	• Knowledge of basic ecological principles and the ability to apply ecological science to current issue • Ability to apply agricultural technologies
Facilitation and strategic management	• Ability to facilitate a sustainable change (related to agronomists or other advisers) • Ability to build and maintain cooperatives in the sector, individual companies, and farmers.

Table 2. List of skills identified in the peer-reviewed literature.

2.2 Non peer-review study

2.2.1 Methodology

A 3-stage methodology was adopted in order to ensure a rigorous and repeatable method: (i) generation of keywords, (ii) systematic search, and (iii) extraction of skills.

A minimum of five keywords related to the areas of education, action research and sustainable farming / food systems were independently provided by the 8 partners of WP1 and these were compiled into the 21 most-repeated keywords and organized into three domains: 5 keywords for "education", 7 for "methodology features" and 9 for "knowledge content" (Figure 1). Each of these 21 keywords was paired with each of four words/phrases referring to skills (technical skills, soft skills, values, knowledge) that had been previously defined by WP1 partners for a total of 21 x 4 or 84 keyword combinations.

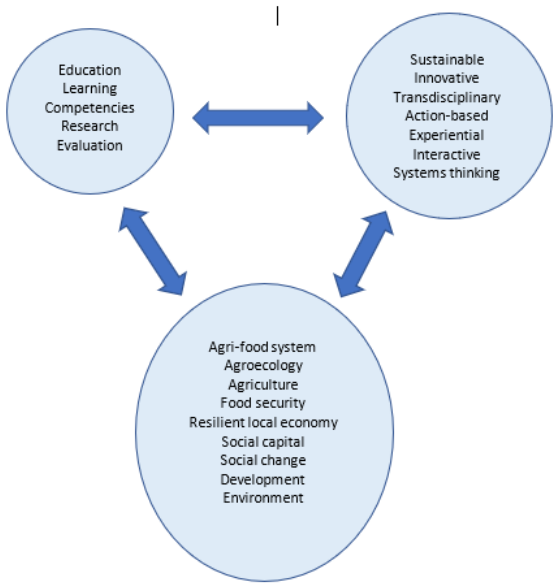

Figure 1. A graphic of 21 keywords in three domains.

Between February and March 2019, three search engines of non-peer reviewed work: Cordis, the primary source of results from EU-funded projects since 1990 (cordis.europa.eu); Erasmus+, the database of all projects in the fields of education, training, youth and sports (ec.europa.eu /programmes/erasmus-plus/projects); and Google, the primary overall online search engine were systematically researched using the 84 keyword combinations.

The number of hits for these 84 keyword combinations ranged from 0 to several thousand.

For some keyword combinations the number of hits was too high to be useful, “Education” and “Soft Skills” for example returned 2058 results in the Erasmus+ database. In these cases, an additional keyword was added to narrow the search. In the example above, “Food” was added and the number of Erasmus+ hits descended to 121.

For those keyword combinations that furnished around 50 hits, the title and teaser of each article or project was systematically reviewed and those that were clearly not related to the areas of education, action research and sustainable farming / food systems were deleted. For example, the keyword combination of “Sustainable Food” and “Technical Skills” returned a project entitled, “Diagnoses, pathogeneses and epidemiologies of salmonid alphavirus diseases”. This was deleted from the database.

The remaining projects and articles were examined in detail by at least one of the WP1 researchers and the 30 most relevant non-peer review sources were identified: 15 from research projects in the Cordis and Erasmus+ databases and 15 from Google (primarily national and international research projects). A list of the 30 sources can be found in ‘Annex 2. 30 Sources from non-peer reviewed literature’.

From each of these 30 sources, any and all phrases which mentioned skills were extracted and then the specific skill words found in each source were organized into three previously agreed categories: Ecological, Social/Economic and Food Chain/Food Production. For example, the phrase “increasing their knowledge, abilities and skills about business administration and management” from the “Totcoopi” project in Erasmus+ became “Business Administration” and “Management”, both in the Social/Economic category.

2.2.2 Results

The 30 sources identified from the search of non-peer reviewed literature represented work done in over 39 countries and/or regions (Figure 2). The largest representation was from countries that were involved in work from a single source, that is 19 countries/regions other than the 20 named in the graphic. The second largest country represented was UK, represented in 9 sources. Then France, Germany and Italy with work in 7 sources each and Global studies represented in 6 sources.

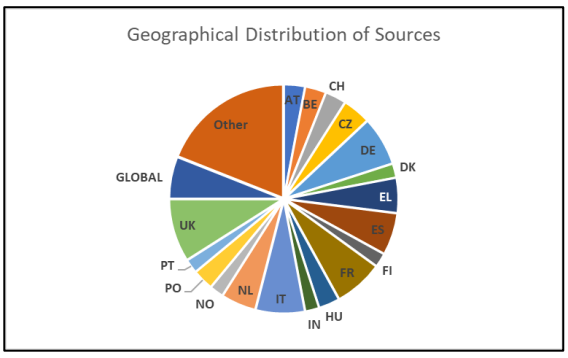

Figure 2. Geographical distribution of sources.

Most non peer-reviewed sources discussed skills in a country not shown in the graphic above, that is ”other”. Sources which discussed skills in UK and Global were also highly represented.

Skill phrases relating to education, action research and sustainable farming / food systems were identified 103 times in the 30 sources. All of these skill phrases referred to skills believed to be necessary for the immediate future. The number of skill phrases per source ranged from 1 to 7. Some skill phrases were a single word, “Agroecology” and some were a long sentence referring to more than a single easily identifiable skill, “To enlarge and enrich collective understanding and perspectives on access to land issues and

solutions for established organizations by the experience from the Czech Republic, Scotland and Greece". These 101 skill phrases were categorized as Ecological (17), Social/Economic (55) or Food Production/Food Chain (31). By eliminating repeats, combining similarities and separating multiple skills mentioned in a single skill phrase, the 101 skill phrases reduced to 52 different skills, 18 Ecological, 22 Social/Economic and 11 Food Production/Food Chain.

The skill most commonly discussed was a broad one in the Ecological category, *"Agroecological practices including relationship with healthy diet and sustainable intensification"* which was discussed in 7 sources (Table 3). The other most frequently discussed skills were, *"Land management including local and diverse production on existing land"* in 6 sources, *"Knowledge on entrepreneurship and systems management principles including business plans and management guidelines"* in 5 sources, and *"Create awareness, engage/transfer with local stakeholders, key food system actors and the wider society"* in 4 sources. No other skills were discussed in more than 3 different sources.

SKILL	SKILL CATEGORY	NO. of SOURCES
Agroecological practices including relationship with healthy diet and sustainable intensification	Ecological	7
Land management including local and diverse production on existing land	Ecological	6
Knowledge on entrepreneurship and systems management principles including business plans and management guidelines	Social/Economic	5
Create awareness, engage/transfer with local stakeholders, key food system actors and the wider society	Social/Economic	4

Table 3. Skills most commonly referred to in the non peer-reviewed sources.

2.3 Focus group interviews

2.3.1 Methodology

20 focus group interviews have been completed in 9 different countries (Norway, Sweden, Denmark, Austria, Greece, Italy, Chile, India, Czech Republic, Ethiopia) during 2018 and 2019. Together, the focus groups represent the following types of informants: Farmers (50), actors within fisheries and fish farms (6), advisors to farmers (31), food enterprises/industry (16), researchers/teachers (40), students (9), Others, such as ministerial bodies, farmers federations, consultants (12). For the analysis, the last three categories have been clustered in the professional category 'academia'. See 'Annex 3. List of conducted focus groups' for an overview of each focus group.

The purpose was to gain an insight into different experiences and thoughts on skills needed now and in the future to support a sustainable transition, and potential lack of skills in current professionals, as well as their understandings of and practical work with sustainability in a food related context. The interviews also discussed the relations between education and research and their field of practice.

The focus group interviews have followed a common outline, developed by a team of wp1 researchers. The outline describes the focus group method and includes an interview guide with four themes and interview questions for each theme.

The four overall themes were:

- Theme 1: Background information and participants' networks
- Theme 2: Skills
- Theme 3: Sustainability
- Theme 4: Education and research

The outline can be seen in 'Annex 4. NEXTFOOD Focus group outline'.

The focus group interviews were conducted by the Nextfood research teams in the respective institutions, who also adjusted the interview guide to the context of each specific focus group.

The interviews have been sound- and/or video recorded. Nine focus group interviews have been summarized in English by the research team that conducted the interview. Two interviews have been transcribed verbatim and translated to English, four is a mix of summaries and direct quotes translated to English. The results of two of the focus group interviews (done in Greece by American Farm School of Thessaloniki and Lund Univeristy) have also been published elsewhere (see Charatsari, Jönsson & Papadopoulos, 2019). Their conclusions are included in the present report.

The transcriptions and summaries have been coded in Nvivo by the Danish research team. Based on this, two lists of skills have been conducted for each of the four categories of professions (farmer, advisors, food enterprises/industry and academia): One with the skills needed in today's agrifood system, and one with skills expected to increase in importance in the future. The lists include the skills that were emphasized across several focus groups.

The codes were then collated into themes that moved beyond the individual skills, and also included data about the contexts, interpretations, dilemmas and operationalisations of the skills in practice. This part of the analysis is presented in chapter 4. Discussion and contextualisation.

The main limitations of the focus group interviews and the analysis hereof is that

- The focus group interviews have been carried out by many different researchers with different research traditions and within different fields of research. In spite of the common outline, this means that the focus group interviews have been conducted in different ways, ranging from more quantitative approaches with focus on listing and ordering skills, to more qualitative approaches with open questions for discussion among the participants.
- As each focus group interview have been summarised by the research team that conducted them, it is very different how detailed the summaries are and what the research teams have focused on. Thus, conducting the summary is implicitly to start analysing the results, since the process involves deciding which points to represent. This selection has been done implicitly and differently by the different research teams, with the consequence that the material for coding and further analysis differentiates from lists of skills in

bulletpoints, to verbatim transscriptions. This naturally leaves different opportunities for depth of analysis.

- The fact that many different actors from across the food system have taken part in the focus groups means that it is difficult to go into depth with the potential specificities of each group of actors.
- Several focus groups used a pre-written list of skills (see 'Annex 4. NEXTFOOD Focus group outline') and asked participants to rank these, as well as think about skills that were not on the list. Thereby, the list have influenced the participant's answers.

2.3.2 Results

A list of skills presently needed and divided by profession can be found in 'Annex 5. Skills presenty needed divided by profession'.

Looking across the four groups of professions, we identified the following skills which were prioritized across the different focus groups. For the future skills, it was not evident in all the focus groups which professions the identified skills applied to, and they have therefore not been divided by profession:

Present skills (needed by professionals of today)	Skills of increasing importance in the future
• Collaboration /teamwork(incl. interdisciplinary, multicultural) (F, A, E, ACA) • Adaptation, experimentation and development (F, A, E, ACA). • Providing Leadership (F, A, E) • Marketing (strategies and techniques) (F, A, E) • Communicating (F, E, ACA) • System thinking/applying holistic knowledge (F, E, A) • Business planning and strategic management (F, A) • Digital skills (F, E) • Being conscious and responsible (F, ACA) • Technical skills in general (A, E) • Build networks (A, E) • Observation (A, ACA)	1. Digital skills 1. Adopting modern technology, including robotics 2. Adaptation, experimentation and development 2. Collaboration, teamwork and interdisciplinarity 2. Adaptability and marketing in relation new (global) trends 2. System thinking/applying holistic knowledge 2. Motivation and consciousness 3. Lifelong learning 3. Applying tools for sustainable farming/replacing former practice 3. Communicate added-value of the food produced locally and/or sustainably 3. Soft skills in general 3. Innovation 3. Circular business models (less waste)

Table 4. List of skills needed now and in the future identified in the focus groups.

F = Farmers, A = advisors to farmers, E=employees in food enterprises/industry, ACA = academics

2.3.3 Gaps in today's skills

Gaps in skills have not been the prime focus of this report. The following is therefore only an indicator of gaps, as discussed in some focus groups that should be further examined in task 1.2.

Farmers	• Lack of connection between theory and practice • Lack of digital skills • Lack of knowledge about the local environment and landscape and how to apply such knowledge • Lack of holistic knowledge (too specialized knowledge) • Lack of tools for sustainable farming (e.g. reduce dependence on pesticides) and skills in how to apply them
Advisors to farmers	• Lack of skills in bringing theoretical knowledge into practice • Lack of knowledge and consciousness about transition towards sustainability
Employees in food enterprises/industry	• Lack of digital skills • Lack of systems thinking (incl. critical overview of the supply chain)
Academia	• Lack of skills in teamworking and interpersonal Skills • Lack of skills in linking theory and practice

Table 5. List of gaps in today's skills, identified in the focus groups.

A gap between theory and practice is identified in relation to three of the professions and thereby indicates that this especially should be further examined.

2.4 Questionnaire

2.4.1 Methodology

The questionnaire was prepared through online consultation between two project partners (ISEKI, WHH/UoC) involved in WP1 on the basis of Focal Group discussions that were conducted by different partners/at different project locations/in different cases. The questionnaire was a mix of open and closed choice based questions. Open-ended questions were about skills respondents find important in their present context and skills they perceive to be important in a future sustainable food system context. The questionnaire was pilot tested in Kolkata and Vienna and was

subsequently posted on an online platform whose link was shared with all NEXTFOOD partners.

2.4.2 Results

Questionnaire responses were received from 31 individuals: the majority identified themselves as Academia-Faculty and Administration (33%), followed by Researcher-Institute (17%) and NGO Activists (14%). No other group represented more than 10% of the respondents (Students and Alumni, Sustainable Agriculture Activists, Policy Makers, Municipal Authorities, Retailers/Supermarket, Agri-business Managers, Forestry Officials). Respondents could choose as many stakeholder categories as desired here, yet most chose only one as 31 individuals provided 42 stakeholder identifications. The complete dataset about the respondents and also for all the questions in the questionnaire is available as 'Annex 6. Findings Nextfood WP1 Questionnaire on Skills for the Future of Sustainable Food/Forestry'.

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When asked to briefly describe the three most important skills in their daily work, the most commonly used words were people-related including "communication", "management" and "networking". The Word Cloud analysis in Figure 3 shows all words used by respondents and, in the insert, those words used for the skill considered most important. Here, "communication" and "networking" remain and more science-related words such as "research" and "project" emerge. These analyses were performed using the free software NuagesDeMots.fr © and a list of skills provided by respondents but corrected for spelling, hyphenation and removal of words unrelated to skills.

Figure 3. A Word Cloud analysis of three most important skills in today's daily work. Insert: Word Cloud of number one most important skill

For the 7 statements about skills for the future of sustainable food / forestry, respondents agreed most with "Efficient use of resources (e.g., decrease waste, use local) will be essential" with 71% rating their agreement as 9 or 10 on a scale of 1 to 10. Following, was the statement, "Networking skills will become more and more important" with 68% rating their agreement as 9 or 10. The other 5 statements had 55% or less rating their agreement as 9 or 10. Respondents agreed least with the statement, "Interdisciplinary skills will be more important than specific technical skills" with 26% giving a rating of 9 or 10.

When asked to briefly describe the 3 skills they would most like to have for a successful future career in sustainable food / forestry, the most commonly used words included, as for skills already present, people-related skills. “Networking” and “interdisciplinary” were mentioned most often, followed by “adaptability” and “problem” (Figure 4).

Figure 4. A Word Cloud analysis of three most desired skills for future career.

3 The major differences and similarities between the datasets

Looking across the four datasets, there are both similarities and differences in which skills they emphasize. The peer-reviewed literature, questionnaires and focus groups generally point in the same directions, emphasizing soft skills, particularly skills related to aspects of collaborations and aspects of skills in actively engaging in and dealing with changes. The focus groups, however, also prioritize digital skills which are not emphasized in other datasets. Soft skills are also emphasised in the non-peer reviewed literature, however, here ecological skills (such as agroecological practices and land management) are equally prioritized.

The following skills are prioritized among two or more datasets:

- Collaboration and interdisciplinarity
- Adaptation and experimentation
- System thinking/applying holistic knowledge
- Motivation and consciousness
- Lifelong learning
- Networking

However, many of the skills that are only emphasised in one dataset, are closely related to skills in this list, which will be elaborated in the following section.

4 Discussion and contextualisation

The aim of the following qualitative analysis of the skills is to provide a contextualization and elaboration of the meanings, interpretations, dilemmas and operationalization of the lists of skills provided above, as these risk to be difficult to operationalize and leave too much room for misinterpretation if they are read in isolation.

The analysis has followed the following methodology.

The skills that were highlighted as important in the future in each dataset were clustered into some overall themes across the four datasets. The themes that were given highest priority across the datasets were chosen for further analysis, where the themes and the skills they represent were examined in relation to their definitions and meanings in the respective data. The questionnaires does not entail elaborated data about the skills, and have therefore only been included in the analysis in the first step of identifying the most relevant skills and themes across the datasets.

A draft of the themes has been reviewed by all partners of wp1.

All datasets also touch upon aspects that are not directly formulated as skills, but rather can be described as mind-set or motivation, such as awareness, responsibility, empathy, curiosity, optimism, openness or consciousness. Thus, mindset and motivation are important drivers for change and underlying most of the themes and skills in this document. Furthermore, the emphasis on these issues also imply a need for skills to spread such awareness and motivation to others. It should therefore be considered in future education how to also cater for these aspects.

4.1 Navigating in a changing world: Life-long learning, problem-solving and adaptation

Skills in navigating in a world of constant change and to deal with wicked problems stands out in the peer-reviewed literature, questionnaires and focus groups, as skills that are already needed today, but expected to become of increasing importance in the future across a wide range of professions and disciplines. The overall argument is that the agrifood- and forestry systems needs to be continuously changing to meet the future challenges. Therefore, it is urgent that all involved stakeholders are able to keep adapting to new challenges and possibilities, but also to have the skills to push such development through skills in life-long learning, problem-solving, innovation, and experimentation.

4.1.1 Life-long learning

The peer-reviewed literature, focus groups and questionnaires all point towards an increasing need for skills in lifelong learning and development that cuts across all professions. In the peer reviewed literature life-long learning is identified as an ongoing process of learning and adapting on both local and global levels (Charatsari, 2019).

One important aspect of skills within lifelong learning, which is highlighted in the focus groups, is to identify, use and produce knowledge and information, including to

navigate within the many different types of knowledge and knowledge sources that exist.

The ability to manage the information and use it accordingly is very important in this world where information is freely available. Choosing what is important with respect to one's area and how that can be applied, is a skill to be developed. (Researcher, Kerala).

This is very similar to what is identified in the peer-reviewed literature, as the ability to obtain new knowledge and/or knowledge not yet discovered, identified by farmers, retailers, and crop advisers (Davidson et al., 2015). A few focus groups also pointed towards skills and willingness of professionals to participate in the production of new knowledge (e.g. through participation in research projects), with the argument that many challenges related to sustainability is not yet well examined or documented.

Continuing training outside one's own specialization, is also highlighted as an important aspect of life-long learning, especially in the focus groups, in order to support skills for interdisciplinary collaboration.

The need for continuing professional education was widely agreed to. Needed skills change and people educated in a specialty can become more rounded by additional training after graduation. The example of food marketing experts learning some food production skills was given. (Focus group resume, ISEKI)

Other aspects of life-long learning, which was identified in the peer-reviewed literature and focus groups are skills within critical thinking, including the ability to reflect on and challenge one's own understandings and include the opinions of peers and experts (Hilimire, 2016; Kerry, 2012; Lankester, 2012). As expressed in one of the focus groups: "*Combining knowledge is important, as well as critical thinking about that knowledge. Nature is so complex.*" (Researcher, Norway).

Thus, it is not enough to be able to identify and understand new knowledge, it is also necessary to be able to reflect critically on this knowledge, and to be able to value others' assumptions and experiences as important sources of learning that enhances sustainability (Lankester, 2012).

4.1.2 Skills for innovation and problem-solving

Other aspects of the theme are identified across all datasets through wordings such as 'innovation', 'problem-solving', 'experimentation', 'product development', 'thinking outside the box' - all encompassing the skills to create what does not already exist, whether this being products, knowledge, systems, policies or other solutions to existing and future needs and challenges.

Within the identified articles, innovation encompasses the ability to be proactive through basic experimentation and problem solving competencies (Ashby et al, 2009, Charatsari, 2019, Duru, 2015), and in seeking new ideas and create opportunities for innovation rather than simply reacting to outsider agendas (Ashby et al, 2009). Closely related to this, the focus groups discuss skills within experimentation. This is described as a mindset of staying open to try new solutions, or as skills to work more systematically with development, such as implementation of new technologies, practices, etc. and systematically document the results, and build on the documented experiences when planning the next steps.

Problem-solving (often formulated as 'real-life problem-solving) is identified across most data (though not emphasized in the non peer-reviewed literature), and includes the skills to continuously handle the challenges that arise, and find solutions that consider both immediate and long-term effects. Some focus groups discuss problem-solving as the ability to balance long-term planning with improvisation based on deep knowledge of the local context and '*elasticity to change priorities based on the contingencies of the moment*' (aquaculture farmer, Italy). Another aspect of problem-solving which is discussed in the focus groups is to think broadly and holistically, e.g. including a broad range of knowledge and/or stakeholders.

The peer-reviewed literature identify hindsight and future thinking as important aspects of problem-solving (Charatsari & Lioutas, 2019; Ommer, 2012; Kerry, 2012). One article illuminates this through an example where farmers and municipal employers were able to predict potential impacts of climate change (future thinking) based on discussions of previously observed weather changes in the local area (hindsight thinking) (Kerry, 2012).

4.1.3 Adaptability

Adaptability is emphasised across the four datasets and across actors in different professional categories and includes the need for skills to adapt to changes within a broad range of areas, such as climate, market and consumption patterns, technology and robotics, policy and political frameworks.

The review of peer-reviewed literature shows that the ability to be adaptive is a prerequisite especially for a sustainable agriculture. This adaptiveness includes experimenting and monitoring of the outcomes, ensuring a flexible farm organization, that increase the option for new activities for the farmer and the family (Darnhofer et al., 2010), as well as future thinking, risk prediction, hindsight, critical thinking and decision-making (Kerry et al., 2012). Besides being able to develop an adaptive farm management, the literature also highlight the ability to live with change and uncertainty (Sumane et al., 2018), and having the capacity to respond to changing natural and agronomic conditions (Benett and Franzel, 2013). Some of the focus groups likewise emphasise that the implementation of new methods or practices is a process of bravery, where old routines which previously have proven effective in relation to maximisation of yields, needs to be changed often without assurance that the new methods will prove equally effective. One focus group with farmers (Greece) describes a motivation to reduce the use of pesticides; however, a current increase in plant diseases has instead led the farmers to increase the use. Thereby, using pesticides seems to be a "safer" decision, reducing the level of farmers' perceived production risk (Charatsari, Jönsson, & Papadopoulos, 2019). Such psychological factors are expressed in several focus groups, which implies that working with changes is a general challenge that needs to be responded to.

Adapting to climate change

An aspect of adaptability that stands out across all data is challenges and worries related to climate change. '*Climate change impacts on all productive activities, resilience to climate change will be a fundamental requirement*' (focus group summary, food enterprise owners/employees, Italy).Thus, the data points out a need for current and future actors to be able to deal with climate change. This is also identified in the

literature on the forestry sector, along with a gap in knowledge about climate change in relation to forestry (Arevalo, Pitkänen, & Kirongo, 2014).

Some of the skills needed for adaptability are presented in the other themes in this report, such as skills to implement new technological and digital solutions and to collaborate with others. Climate change further emphasizes the importance of such skills. Furthermore, the peer-reviewed literature shows that sharing everyday experiences about the local region qualifies the ability to do risk prediction, future thinking, critical thinking and decision-making (Kerry, 2012; Nguyen, 2014), and thereby qualify optimal use of contemporary resources in the local food system. Responding to local climate changes also encompasses application of holistic local knowledge, such as social issues and ecological knowledge (Kerry, 2012). Responding to local climate change therefore entails both to understand basic sustainable production and natural resource management, as well as identifying and understanding the interdependencies among farms and the wider landscape. (Francis et al., 2017).

4.2 Collaboration

Different aspects of collaboration are highlighted in all datasets as one of the most important skills for the development of a sustainable, future agrifood and forestry system. The most highlighted skill in this theme is interdisciplinarity, but the theme also includes collaborations across current divisions between the scientific/generic and practical/local spheres, and divisions by sector or institution, as well as by culture, geography or generation.

The overall argumentation behind the need for collaboration is that the current and future challenges are too complex to solve within isolated arenas, and that there is a need to combine and balance different dimensions of sustainability, such as environment, economy and the social dimension (Herrera-Reyes, 2018; Sumane et al., 2018; focus group interviews). The focus groups thus showed that many practitioners and advisors have experienced that collaboration with other professionals as well as multidisciplinary/cross-sectional collaboration has gained importance during their work life, and they expect it to become increasingly important in the future. The questionnaires and focus groups for example highlight circularity and recycling, or reduction of the value chain, as increasingly important issues to be developed and improved, which will require collaboration with stakeholders in other parts of the food system or in entirely different sectors. The peer-reviewed literature highlights a related challenge in understanding the many roles in sustainable agriculture, which requires more inclusive, flexible modes of knowledge-generation, -integration, and -sharing between all kinds of stakeholders involved in formal and informal knowledge in sustainable agriculture (Sumane et al., 2018).

Furthermore, the peer reviewed literature as well as the focus groups both point towards a knowledge gap between practitioners and research, where new knowledge ‘stays in academia’ and where practitioners are often not able to understand, use and translate current scientific knowledge to their daily work (Jones, 2015; Focus group interviews).

In relation to farming, the agricultural advisors play an important role in such integration of the theoretical and practical, and the focus groups indicate that they might not always have the sufficient skills to carry out this translation in practice.

This gap is also identified in relation to education. The peer-reviewed literature points out that scientific knowledge (sometimes referred to as formal or generic knowledge), generally has a higher status in education in conventional agriculture, than informal knowledge (sometimes referred to as 'farmers' knowledge' or local knowledge) (Sumane et al., 2018). The focus groups similarly requested a closer collaboration between educational institutions and farms/enterprises/organisations within the agri-food system, in order to better prepare graduates to relate the theoretical learning to real-life problems. As expressed by a student in agroecology: "*You need facts and then you need skills to combine the different facts to solve your problems. Ability to think broadly and creatively*." (Norway).

One of the consequences of having a dominating science-driven knowledge is a tendency for farmers to give less weight to their own experimentation and knowledge (Sumane et al., 2018). As agriculture is highly dependent on the local environment, local knowledge is of particular importance as it usually considers local systems as a whole, taking into account their social, ecological, environmental and economic aspects (Sumane et al 2018; focus groups), and tends to be dynamic and adaptive in character (Kerry et al., 2012). The focus groups furthermore pointed towards a need for skills to engage with ancestral/traditional knowledge.

Thus, the data points towards a need for knowledge integration between practical/local/traditional and scientific/generic knowledge, as well as a need to address the deficits in the current knowledge transfer practices across various interfaces: science to policy, science to industry/profession and science to society (Jones, 2015; focus group interviews). However, there is a potential ambivalence in both recognising traditional and local knowledge, as well as integrating new knowledge, and staying open and adaptive to changes in the local context. Thus, there is a need for skills to balance and integrate these approaches.

The focus groups furthermore pointed towards a need for research that is closer to the actual practical work, since this would be more relevant and more easily integrated in the daily practice. A few of the interviewees have had good experiences with research partners that supported a more sustainable practice. One respondent mentions a collaboration with a research partner that helped them reduce the use of fertilizers. Another example is how one respondent gained an international network through their participation in a research project that has since helped them to develop their practice. These examples underlines the potential in a stronger integration between research and practice.

4.3 Systems perspectives

Across all datasets emerged a need for future professionals to be able to understand the agrifood or forestry system as a larger whole, in order for them to see their own role in a larger perspective, and in order to efficiently manage the future challenges. This is given high emphasis in the peer-review literature and focus groups, while only mentioned in few sources/by few respondents in the non-peer reviewed literature and questionnaires.

The category of 'systems perspective' encompasses formulations in the data such as: 'systems thinking/perspective', 'using systems thinking', 'holistic system understanding', 'integrated and holistic approach', 'life cycle/supply chain analysis', 'ecological footprints', 'system analysis', 'from cradle to end products', 'global socio-political understanding'. "recognize multiple systems", "food systems", "adapt multi-criteria sustainability assessment of the food systems". Together, these direct focus towards a need for skills that support professionals and practitioners to operate in complex agri-food and forestry systems where all 'pieces' of the system are interlinked.

We need not technical skills but integrated and holistic approaches, both in the short and the long term. (Focus group resume, ISEKI)

The peer-reviewed literature highlights skills to understand multiple perspectives involved in the system, and in integrating interdisciplinary knowledge into this system (Warbach, 2012), as well as to understand the need to incorporate multiple groups, perspectives and institutions in decision making (Warback, 2012). Furthermore, a systems perspective is also about being aware of the complexities involved in real life practises (Cerutti, 2017). Another article identifies a knowledge gap between agroecological principles and practical application and explains this as a lack of systems thinking in order to understand the relation between ecological processes, ecosystem services and agroecological principles (Duru et al., 2015). Also, two articles in the forestry sector, highlights the importance of citizens involvement, as this can contribute to a larger societal transformation of both consumer behavior, production patterns, and technological development (Grundel & Dahlström, 2016).

The focus groups expressed that skills within systems perspective are both currently needed, as well as gaining in importance. They argue that many professionals only have a limited understanding of the system of which they are part, and that this can prohibit their motivation to implement potential changes. They therefore highlight an increasing demand for education within the full life cycle/value chain perspectives, or knowledge of energy- and waste cycles in order to partake in a sustainable transition.

Sustainability begins at the primary production level – with the purchasing of the seeds! – do the small producers understand what it means to buy seeds from far away? Do they realise the consequences in the larger picture? (Focus group resume, ISEKI)

It is likewise identified in the peer-reviewed literature, that continuing education is important in the future, to increase the understanding of sustainability as a solution, that goes across the food chain (Cerutti, 2017, Davidson et al., 2015).

The focus groups also points towards a gap in research that can support a holistic/system based approach, as expressed by a Norwegian student:

I would like to see more work on transitions. Not only trying to fix tiny bits of the problem, but actually addressing the root causes of the problem. Would like to know how transitions can be carried out in different contexts. Building resilience at farm level. (Student, Norway).

They particularly request research into the production cycle, circularity and waste recycling.

Lacking an understanding of the overall functions, values and tendencies in other parts of the system, can make it difficult to collaborate about improvements, whether in

regards to sustainability, health, quality or other issues. Thus, according to the focus groups, knowledge and values within one discipline/profession is often not communicated outside of this profession, and furthermore this potential communication is difficult because other actors have no background for understanding it.

4.3.1 Skill to interact within a policy framework

Political and legal frameworks are important parts of the agrifood and forestry systems, and especially the peer-reviewed literature pointed towards the need for skills to interact with and within such frameworks. In the peer-reviewed literature such skills are primarily discussed in relation to academics and politicians, however, the conclusions are based on interviews with agronomists, practitioners, scientists, economists, and advisers. This political aspect relates to skills of interacting with political stakeholders, e.g. on different government levels, for example to develop shared goals for sustainable development (Davidson, 2015). Another article on sustainable aquaculture (Jones, 2015) identifies a need for more communication between policymakers and scientists, in order to produce a strategy for strengthening the link between relevant practitioners and ongoing research.

Furthermore, one article (Davidson, 2015) identify funding skills as important for sustainable transition, which was also pointed out in several focus groups.

This theme generally does not gain much attention in the other datasets, apart from a few exceptions. One focus group discuss the current legislative and political system, and argue that it is not supportive of sustainable production: "*If you are going to do sustainable farming, you have to cheat the system*" (Norway). This hints towards a need for skills to navigate within the legal and political frameworks in non-traditional ways, however, this needs to be further examined before conclusions can be reached.

Another focus group briefly mentions the need for skills to anticipate up-coming regulatory interventions, such as the EU policy to reduce one-time-only use of plastic. The questionnaires hint towards a need for skills not only to act within a given framework, but also to incluence this framework through formulations such as "skill to improve networking and advocasy to engage policy makers in the food and NRM business". However, this is only given little emphasis and is not further elaborated, and therefore needs further examination. Policy frameworks and perceptions hereof are thoroughly dealt with in the Nextfood WP 5 (Dimitrievski and Jönsson, 2019).

4.4 Digital and technical skills

Technical and subject specific skills in the agri-food and forestry systems are essential and obvious in order to do a specific practice. However, the questionnaires and focus groups raise the perspective that such skills are likely to become outdated, and that these can more easily be updated or improved after graduation, while skills in many of the other themes are more difficult to achieve later. They therefore argue that such skills should have a reduced focus in education, to give room for some of the other themes identified in this document, such as skills related to lifelong learning. This being said, all interviewees agreed that some level of technical knowledge and competency within the specific field is necessary.

Within this theme, the data generally highlights needs for skills in implementing new technology and techniques, as well as a need for developing digital skills. Amongst others, the focus groups identify an unexploited potential in using new software and technologies to support sustainable production, while staying cost-effective, and expect such issues to gain in importance.

4.4.1 Implementation of new technology and technical principles

It is commonly expressed across data, that the future will entail the development of new technologies and techniques that should be integrated in the agrifood and forestry systems (Charatsari, 2019; Davidson et al., 2015; focus groups, questionnaire). However, implementation of new technologies and/or techniques require a change in work practices, and the skills to learn how to manage and use these technologies and techniques, as well as potentially a change in mindset. The peer-reviewed literature therefore point towards the need for creative thinking in order to implement new techniques and technologies, such as a change in the monoculture mentality to a diverse and creative thinking (Francis et al., 2017). Another article identifies a need for knowledge and skills in how to use different technical principles in farming, for example in using ecological principles to inform the design of farming and food systems and the ability to apply ecological science to current issues (Warbach, 2012). The focus groups similarly point towards a need for keeping up with technological developments, and point out that it will be increasingly important to be able to utilize the advantages of new technologies in the future, as these potentially can help overcome the obstacles of climate change and help replace 'old' unsustainable practices. Such skills are simultaneously highlighted as some of the most important for the future, as well as currently missing amongst farmers and advisors to farmers. One focus group for example points out that advisors to farmers cannot advice about alternative treatments of diseases besides the use of pesticides. Thus, this points towards a need for a change in focus in what kind of technical and subject-specific skills are developed, from a focus on existing techniques to a focus on how to keep-up with development in technology and a changing climate and knowledge-base.

4.4.2 Digital skills

The need for digital skills were primarily highlighted in the focus groups, but also touched upon in the questionnaries, covering formulations such as 'digital skills' (within both communication, production, sales and management), 'programming', 'digital soft skills', 'advanced statistics', 'Combine digital and physical marketplaces'.

Digital skills are among the skills that focus group participants most often mention as something that has changed from being peripheral to central, and as skills that they expect to be increasingly needed in the future. This is particularly in relation to using and understanding digital tools for market analysis and web-trade, in order to simultaneously respond to- and influence trends within sustainable consumption patterns. Digital skills are thus emphasized as important for developing and reaching markets for sustainable, local and quality products and for trade (e.g. webtrade, reaching global markets).

Also, the focus groups point towards an increasing need for digital and computational skills to ensure integration of technological solutions to support more sustainable production, including robotics. One example is the use of software and technologies that help minimizing the use of fertilizers, e.g. using programs for analyzing the soil

and systematically tracking its development in order not to use unnecessary fertilizers, or using mobile phones to predict insect attacks. Others mention the use of digital tools to track the cycle of the farm, and thereby gain a systematic overview of potential changes in the yearly cycle. Some also gives the example of installing sensors for humidity, temperature and more, while others point towards virtual communication tools increasingly important.

Digital skills are hardly touched upon in the literature, besides one article about forestry curricula (Arevalo et al., 2014) that identifies a lack in generic skills such as computer skills.

4.5 Building and maintaining networks

The importance of networks, both across and within respective fields of work, is especially highlighted in the questionnaires, however, also pointed out in the focus groups and both literature studies, as being increasingly important. The theme is further stressed by the importance given to collaboration as previously discussed, since networking is interlinked with skills to collaborate. The theme encompasses terms used in the data such as 'Networking', 'Building networks', 'Learning in social networks', 'Cross-sectional partnerships and networks', 'Effective networking for inter-disciplinary and technical skills', 'How to establish and maintain big, impersonal networks (EU project, etc)', as well as 'communication' and 'facilitation', 'building capacities in local learning communities', and 'Create awareness, engage/transfer with local stakeholders, key food system actors and the wider society'.

The peer-reviewed literature and focus groups identifies the need for different kinds of networks, ranging from informally sharing knowledge and experiences within a variety of subjects to more or less formalised networks, such as joint negotiation of prices, or creation of new infrastructures. One article (Charatsari, 2019) found that the lack of network, especially among agronomists, had the most significant influence on the lack of ability to elevate sustainable transition in the agri-food system.

Formalised networks are especially emphasized in the focus groups, where examples are given of such successful networks, or through the expression of visions of such networks.

Thus, they refer to difficulties in competing with large companies and monopolized-like structures, which makes it important for smaller producers and companies to be able to form formalised networks that enhances their ability to negotiate and influence market structures.

Networks across geography are also mentioned in the focus groups, as a way to gain inspiration and knowledge about shared issues. One focus group with farmers (Greece) points out the Erasmus program as a source of networking, that they have recently entered and have high expectations towards.

To form and maintain formalized networks, facilitation becomes a key skill, as expressed in one focus group: '*To bring in sustainability, it is important to involve the local stakeholders as much as possible – so facilitation as a skill plays a major role*'. (Focus group summary, Calcutta).

Informal networks are discussed in the focus groups, through examples such as social media as an increasingly important platform for networking. The advantage of this kind of platform is that it is dynamic and can respond fast to new challenges and possibilities. According to the focus groups, such social media groups serve as discussion fora and information channels where farmers exchange information and knowledge on issues of common interest. They are, amongst others, informed about prices, plant and animal diseases, subsidies, how to handle different applications and formal requirements, and new equipment. However, other focus group interviews point out that along with the access to this kind of platforms comes a need for skills to critically assess the information that is shared. This thereby emphasizes the need for skills related to 'critical thinking', described in theme 4.1 Life-long learning.

In the peer-reviewed literature, networking is also related to local learning communities that facilitate knowledge sharing among farmers (Laforge, 2018), or in the neighbourhood (Laforge, 2018). These local learning communities support farmers in sharing experiences about the neighbourhood and in developing shared skills (laforge, 2018). The literature both talks about formal and informal learning communities, both identified to improve skills such as capability to solve internal conflicts and building knowledge capacities (charatsari, 2019, Sumane et al., 2018).

In order to build and maintain networks, the peer reviewed literature highlight an important need for collaboration and communication skills, including both written and oral communication with other stakeholders and decision-makers (Bullard, 2014). This is also highlighted throughout the focus groups and questionnaires, along with skills in facilitation, conflict solving and general teamwork skills.

4.6 Strategic development and marketing

All datasets point towards skills that are related to strategic development in different ways. Both literature studies and the focus groups point towards a need for future skills in responding to- and strategically influencing the market, while all four datasets to some degree touched upon skills related to visioning, management and leadership. The last three are more evident in the focus groups, non-peer reviewed literature and questionnaires, while only slightly touched upon in the peer-reviewed literature. The theme includes phrasings from the data such as 'Marketing', 'Socially sustainable leadership that attracts people to work in the company', 'Responsible management (CSR)', 'Marketing and understanding new trends, and the needs and wants of the consumers', 'Circular business models (less waste)', 'Internationalization of business', 'Systems management principles', 'Business plans and management guidelines', and 'transforming food systems in emerging markets'. In the questionnaire, 83 % of the respondents answered 6 or more on a scale from 1-10 to the question: 'Planning for the future (visioning) will be more important than daily tasks' (10= strongly agree, 1= strongly disagree), with 29% answering 9 or 10. In the focus groups, 'Leadership' was highlighted a skill of high importance presently, however, not much emphasized in the discussions about future skills.

Business management, planning, and financial understanding is relevant in all types of organisations and enterprises and includes a wide variety of skills. However, some

of the focus groups discuss how the business and marketing strategy change as a consequence of a focus on sustainable production. '*When I started, the paradigm was to be productive and get the maximum profitability. Now, I´ve had to learn to valorize biodiversity*.' (Farmer/agronomist, Chile).

Thus, value and how value is created will possibly change and needs to become part of the strategic development of a farm or other business. Thus, the skills to work strategically with such issues is key to actors in leading/strategic positions. Furthermore, a few focus groups discuss that a shift towards sustainable production might potentially include an aim to achieve certain certifications, which then requires skills to plan and implement a process towards certification.

The peer-reviewed literature identifies a need for skills within understanding and responding to market development, based on the argument that the food system is primarily driven by the market (Nguyen, 2014, Herrera-Reyes, 2018). A similar point is raised throughout most of the focus groups, that mentions need for skills such as understanding different consumer segmentations, their needs and how to reach them, as well as having the skills to 'educate the consumer', thus, influence market development. A sustainable transition might involve the development of new products or new valuations and positionings of old products, such as a return to seasonal and domestic products, which require a change in consumer food culture and habits. One focus group (Farmers, Greece) also discussed that it is difficult to sell high quality products to profitable prices and that finding new ways to such markets is needed. Therefore, such producers or distributors will need the skills to interact with consumers and interfere with current trends.

In line with this, two articles in the forestry sector, highlights the importance of citizens involvement and development of consumer awareness, as this can contribute to a larger societal transformation of both consumer behavior, production patterns, and technological development (Dwyer et al., 2018, Grundel & Dahlström, 2016).

Furthermore, two of the peer-reviewed articles identify a need for being able to identify and analyse profitable opportunities for collective marketing (Nguyen, 2014, Herrera-Reyes, 2018).

4.7 Interpretation and negotiation of sustainability

As stated earlier, it is evident that, even though all sources of data talks about skills for sustainability, they do not always define the term similarly - or at all. Thus, different aspects of sustainability in the agrifood and forestry systems are differently highlighted and prioritized. The following theme therefore looks into how sustainability is defined in the focus groups and peer-reviewed literature (since it is not clearly defined in the non-peer reviewed literature and questionnaire. Thus, the aim of the analysis is not to come to conclusions on what sustainability is, nor is it to go in depth with such a discussion, but rather to shine a light on the existence of different interpretations.

The general tendency across the focus group interviews is that they directly quote the definition in The Brundtland Report: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." (Brundtland, 1987) or express similar definitions in their own wording. Several focus groups also refer to the 'three pillars of sustainability": Social, environmental and economic (see e.g. Purvis, Mao, & Robinson, 2018 for elaboration

in the literature), and generally argue that sustainable food production/food systems are systems where the three pillars are integrated and balanced. In spite of this, it is very different what is highlighted in the discussions about more concrete issues. The most common topics are:

Resources: More than half of the focus groups agree that a sustainable food system is a system that generally use fewer resources and / or rely on renewable and recyclable resources. Three focus groups also mention circular economy as a concept that can support a more sustainable use of resources.

Environmental footprints in a life cycle perspective: About half of the focus groups agree that sustainability in relation to food needs to take into consideration the full life cycle of a product and that the aim is to reduce the environmental footprints. A few focus groups mention local food as more sustainable than global food chains, whereas others mention the possibility of entering global markets as a source to economic sustainability. Thus, this is a potential conflict embedded in the different interests and understandings of sustainability.

Equality: A little less than half of the focus groups discuss equality as an important aspect of sustainability. Equality relates both to the equal distribution of profit, advantages and job opportunities and working conditions locally, as well as to global aspect of not exploiting poor populations. Food security is also mentioned in several focus groups as an important aim of a sustainable food system. This could be interpreted as social sustainability in the three-pillar model.

Of other issues discussed in a few focus groups were: Soil management, weed management, biodiversity, reducing pesticides, preserving traditions and typical production, animal welfare and health, implementation of environmentally friendly technologies.

There are disagreements between the focus groups about whether economic and environmental sustainability are supportive or contrasting of each other. Some participants argue that a turn to sustainable production includes a reduction in costs with the use of fewer resources, such as pesticides, a reuse of resources and use of bi-products that thereby become valuable. Others argue that sustainable production is expensive and that there isn't a big enough market for high-price products to support an up-scaled transition, as implied in the following quote:

'*When asked,"what is the difference between a sustainable cereal business and a common cereal business?" the half joking answer was "Profit*".' (Focus group resume, ISEKI).

The general experience as expressed by the agricultural advisors that participated in the different focus groups is that farmers generally have a poor tolerance of sustainable perspectives if they require additional costs.

There is a tendency in the peer reviewed articles, that sustainability is valued in relation to the three pillars identified within sustainability; environment, economy and social. Not all of the articles explicitly describe what they identify and mean by sustainability, however, most of them express complexity in the concept.

”Sustainability is a broad concept that is sometimes considered ambiguous because it means different things to different people at different periods of time. As a consequence, many definitions of sustainable agriculture can be found, but most of them are connected to the three pillars of sustainability: society, economy and environment” (Cerutti, 2017).

The peer-reviewed literature mainly emphasizes sustainability in relation to climate and the biological, ecological and socio-economic changes hereoff, such as *“the costs and consequences of resource degradatio*n” (Khan, 2010), and “*complex global and local changes of coastal marine social–ecological systems”* (Ommer, 2012). Besides that, concepts related to ecological aspects are emphasized, such as “ecosystems services”, “resource-conserving agriculture”, “farming systems”, ”diversity-based agriculture”, and “Agroecological approaches to farming, including permaculture, organic, biodynamic, ecological, and holistic management”. However, in order to deal with these environmental and socio-economic changes, most of the articles emphasise a holistic perspective that can encompass complexity.

Based on the indifferences represented in the focus groups, the complexities discussed in the articles, as well as the future consequences of climate change and limited resources, we hypothesize that such differences in what sustainability is and how it’s different aspects should be prioritized will be discussed much more in the future. As stated in one focus group: “*The discussion also centered around the importance of defining ”sustainable” skills rather than talking about soft, transversal and technical skills*.” (Focus group summary, ISEKI). Thus, there is a need for practitioners to be able to relate the many complex meanings and interpretations to their concrete practices, as also stated in the following article quote:

”One widely circulated definition is: ‘meet the needs of the present without compromising the ability of future generations to meet their own needs’ (World Commission on Environment and Development, 1987). However, it is probably less important that people and organizations agree on a definition of sustainability than that they develop the ability to competently deal with how natural systems of the earth operate, and how people relate to each other and the planet.” (Warbach, 2012**).**

This implies that the ability to handle the element of sustainability negotiation potentially will become more important for the future. However, this needs to be further examined before conclusions can be reached.

5 Conclusions and next steps

This inventory of skills gathers the first steps of the work from mapping the skills needed to support a development, towards more sustainable agriculture, forestry and associated bio-value chains. In order to investigate how to educate future generations to meet the challenges of climate change and support a transition to more sustainable agrifood and forestry systems, NextFOOD WP1 identifies and analyses the most important skills and competencies needed. This report presents the first round of findings of task 1.1, which will inform the following work in WP1 and other work packages of NextFOOD. On the basis of a methodology comprising of i) a review of peer reviewed articles, ii) a review of non peer-reviewed literature, iii) focus group interviews with professionals, practitioners and academics in the agrifood and forestry system in Europe, Africa, Asia and South America, and iiii) a questionnaire, the data for this work have been produced. The results have been compared to each other in order to identify the skills that are emphasized across the data. This has resulted in an overall list of skills, representing the skills identified through all datasets, as well as a qualitative analysis of the skills with the aim of contextualizing them, providing an understanding of their different meanings, dilemmas and operationalization. These methods together offer this analysis a comprehensive way of validating the outcome of this work. Also it provides an informed platform for the follow up in the next stages of NextFood.

The main findings point towards a need for skills to deal with complex and wicked problems, and to adapt to and live with changes, whether coming from climate changes, technological developments or new strategies related to farming, the food system in general or the markets.

The skills to network and collaborate outside of one's own practice/subject is furthermore increasingly required of both practitioners, advisors and academics. This is especially highlighted in relation to sustainability, since this includes complex problems that can not be solved inside isolated operations/areas. It points towards a more holistic and syncronized re-design of the knowledge institutions and their regimes.

In relation to this, the results suggest that the skills to integrate theoretical knowledge from different areas and local/informal knowledge is increasingly important in solving challenges related to complex issues such as sustainability in the agri-food and forestry systems

In relation to farming practices, agricultural advisors play an important role in such integration and dissemination of theoretical, conceptual and practical knowledge, and it is therefore relevant to examine in depth whether such skills on sustainability, regenerative agriculture, climate smart food etc are substantially trained in the educational system for the advisors.

The follow up will also include the NextFood cases in the further development of the inventory. These case studies produce research protocols that contains data and analysis that will further add to the validity and updating of our methodology. We will add skills from the case studies as soon as the case study research protocols are

analysed. Parallel to this we, together with the partners, will conduct Delphi techniques and/or similar co-creation methods with stakeholders and on the basis of the harvested information we plan to develop trend analysis that will discuss and outline possible development trends that can support the planned development of new trans-european educational activities within this field.

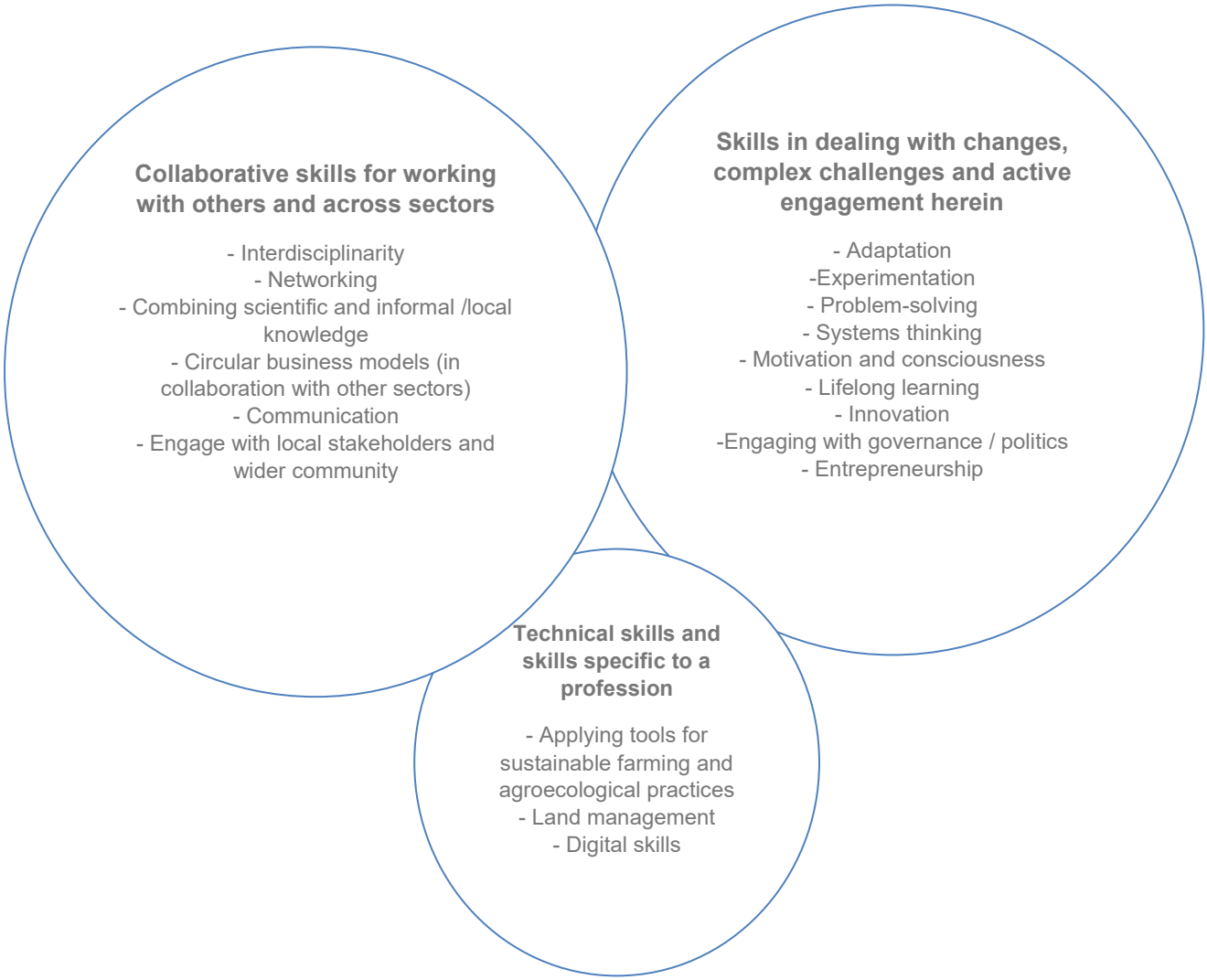

Figure 5. Future skills highlighted across the four datasets

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ANNEX 2. 30 Sources from non-peer reviewed literature

YEAR	TITLE
2001	Integrating foraging attributes of domestic livestock breeds into sustainable systems for grassland biodiversity and wider countryside benefits
2005	Encouraging Collective Farmers Marketing Initiatives
2011	Farming Transitions: Pathways Towards Regional Sustainability of Agriculture in Europe
2012	Training Network for Monitoring Mediterranean Marine Protected Areas
2012	Agroecology education: Former student's reflections on transferability of tools, skills and knowledge in sustainable development
2015	Embedding crop diversity and networking for local high quality food systems
2015	Space for Agricultural Innovation
2015	Strategic Use of Competitiveness towards Consolidating the Economic Sustainability of the European Seafood sector
2015	The role of agroecology in sustainable intensification.
2015	Solutions for Sustainable Agriculture and Food Systems TECHNICAL REPORT FORTHE POST-2015 DEVELOPMENT AGENDA
2015	The real cost of food, examining the social, environmental and health impacts of producing food
2015	A framework for assessing effects of the food system
2016	Managing soil and groundwater impacts from agriculture for sustainable intensification
2016	Learning towards Access to Land
2016	Youth Agro Empowerment Project
2016	Capitalising the full potential of on-line collaboration for SMEs innovation support in the Agri-Food ecosystem
2016	BOULPAT
2016	Le trasformazioni agro-alimentari tra qualità e sostenibilità
2017	University and business learning for new employability paths in food and gastronomy
2017	EduACtion Towards the Creation of Alternative Food NeTworks
2017	Food system framework. A focus on food sustainability
2017	Food systems for an urbanizing world

2017 Innovating the future of food systems: A global scan for the innovations needed to transform food systems in emerging markets by 2035

2017 Global partnerships for small scale fisheries research: Towards sustainable small-scale fisheries: Key considerations for trans disciplinary teaching and training

2018 Agroecology as a pathway towards sustainable food systems

2018 TEEB for agriculture and food. Chapter 2: systems thinking: An approach for understanding "ECO-AGRI-FOOD SYSTEMS"

2018 USING SYSTEMS THINKING TO TRANSFORM SOCIETYThe European Food System as a Case Study

2018 Increasing food system resilience for nutrition sensitivity: A decentralized analysis for India

2019 Healthy diets from sustainable food systems FOOD PLANET EARTH

2019 Quantitative approach to sustainability of short food supply chains

ANNEX 3. List of conducted focus groups.

Country	Conducted by	Participants	Language
Sweden	SVERIGES LANTBRUKSUNIVERSITET	Representatives from: - The Swedish Research Institute - Competence centre for business management at the Swedish University of Agricultural Sciences - The Societies of rural economy and development - Global food manufacturer in the Nordic and Baltic region - Swedish Board of Agriculture, dept of Agriculture - The Federation of Swedish Farmers	Swedish
Austria	ISEKI-Food Association	1 representative from a large multinational cereal company, 1 from an enzyme supply company, 1 from small industry, 1 consultant, 3 scientists.	English
Denmark	Roskilde University	6 farmers within dairy, cereal, meat and vegetable production	Danish
Denmark	Roskilde University	4 representatives from large and smallscale fisheries	Danish
Greece	AMERICAN FARM SCHOOL	18 agronomists working as experts and advisors to farmers, primarily in the Thessaloniki region.	Greek and English
Greece	American Farm School	5 farmers in the Kavala region, focused on table grapes, but also some table olives and honey.	Greek and English
Greece	Agronutritional Consortium of the Region of Central Macedonia	5 farmers with specialty to rise and feed stock production	Greek

Greece	Agronutritional Cooperation of the Region Central Macedonia	6 researchers within agronomy	Greek
Czech Republic	Bioinstitut	9 agronomists and representatives from University of South Bohemia.	Czech
Norway	Norges Miljo- og Biovitenskaplige Universitet	5 students, 1 researcher, 1 researcher/farmer, 1 farmer, 1 farmer/chef	English
Italy	Universita di Bologna	2 fish farmers, 1 aquaculture consultant, 1 vet from a major fish feed company, 1 researcher, 2 academic teachers in the field of aquaculture and fish pathology, 2 students.	English
Italy	University of Gastronomic Science	Nine stakeholders from enterprises within the following areas: - Enterprise producing snails and frogs - Beer production - Agricultural cooperative - Small scale cooperative producing yogurt - Chocolate company - Fruit and vegetables processing company.	Italian
India	University of Kerala	8 researchers within the area of sustainability and agriculture, 1 farmer, 1 CEO, Farmer Producer Company Ltd.	English
India	Calcutta University	3 farmers, 3 entrepreneurs, 3 extension workers, 6 University employees, 2 sustainable agriculture trainers	Bengali
Chile	UNIVERSIDAD DE CHILE	13 stakeholders related to sustainable food production: farmers (5), teachers/researchers (3), students (2) and agronomists (3).	Spanish

Ethiopia	Mekelle University	6 Instructors from Mekelle University	Amharic
Ethiopia	Mekelle University	10 small scale subsistence farmers who are working in the midland areas of Sease Tseadamba District in Tigray Regional state of Ethiopia.	Tigrigna
Ethiopia	Mekelle University	10 small scale subsistence farmers who are working in the midland areas of Sease Tseadamba District in Tigray Regional state of Ethiopia: 4 extension workers, 1 from cooperative finance, 1 kebelle administrator, 1 credit provider from Dedebit microfinance, 1 women association representative and 1 from cooperative head.	Tigrigna
Ethiopia	Mekelle University	The group consisted of small scale subsistence farmers who are working in the warm lowland areas of Abi Adi District in Tigray Regional state of Ethiopia.	Tigrigna
Ethiopia	Mekelle University	The group consisted of 7 participants that include extension agents from the Bureau of Agriculture and Rural Development (4), Kebelle administrator (1), Dedebit Microfinance (1) and Cooperative head (1).	Tigrigna

Table 6. List of conducted focus groups

ANNEX 4. NEXTFOOD Focus group outline

Step 1. Write down the goal

All groups have the same goal: Identify skills and lack of skills around sustainable food production.

Identify the overall theme of your focus group: Food production skills (agricultural or blue), Competitiveness (market actors), Sustainability (all three: social, economic and environmental), Research and education, or another.

Step 2. Define your target audience

At least one focus group needs to be conducted per partner. Focus groups can consist of either a group of professionals from a specific part of the agrifood chain (farmers or other producers, food manufacturing, advisors, researchers, etc), *or* a combination of farmer/s and other relevant actors, such as researchers/experts/advisors/educators, students, market actors*, authorities. Note that farmers or other producers must always be included in your focus group.

*market actors being the connectors that bind the producers to the market. Can be both conventional actors in wholesale, logistics and retailing or alternative food networks (AFN)

Step 3. Find a venue

Aim for a location near the work of most of the participants in the focus group.

Step 4. Recruit participants

A functional focus group is normally 5-10 persons. Invite up to 20 in order to secure a functional group and make your choice from the ones that accept.

Set aside 1,5 hrs for the focus group. Define the most important questions for your focus group, all questions in the template (attached) will probably not be possible to deal with during 1,5hrs.

Tips for inviting stakeholders:

- Consider motivating factors for participating – Explain "What's in it for me?" For example, Improving business through an extended network, Impact on research

and policies, International contacts. A small gift is always appreciated, if available.

- Send out notifications the day before the focus group to remind participants. Use a communication channel that participants are used to (thus do not use email if participants rarely check it)

Step 5. Design your questions

See template.

Step 6. Moderate the group

Ideally, the focus group is moderated by a team consisting of a moderator and an assistant moderator. The moderator facilitates the discussion, sitting in the circle with the participants, while the assistant runs the video camera or audio recording, takes notes and otherwise supplements the moderator.

Before the participants arrive, set up a round table with a small information card prepared beforehand and a blank name tag for each participant. Provide pens. The information card should ask for relevant data such as name, position, years of experience. As participants arrive, ask them to fill out the card and collect them. Serve something to drink and possibly a few snacks.

After greeting each group participant, the moderator should begin by sharing information about the focus group including the goal of the event and how the information will be used. Stress that all participants remain anonymous – no comment will ever be attached to any person.

Next, set the ground rules for the discussion, such as raising your hand before talking (usually only for larger groups), and emphasize that the goal is not that participants come to agreement on the topics, but rather to have many different perspectives expressed. Stress that everything that happens during the focus group is confidential, the recording is for researcher use only and no one will ever be identified by name. Pose an ice breaker question, such as "what is your typical working day like", just to get people talking (see template for further questions).

It is good moderator practice to paraphrase and summarise long, complex or ambiguous comments. It demonstrates active listening and clarifies the comment for everyone in the group.

LIST OF SKILLS - printout as inspiration for the participants. A list of skills, both technical and soft, will be developed in the NextFood project. In the meantime, other inventories of skills can be used. An example list from the TrackFast project is attached. An example of a list of soft skills can be found here: http://people-project.net/people-community/database-of-skills/)

At the end of the session, thank the participants for attending and hand out the incentive.

IMMEDIATELY AFTER THE FOCUS GROUP: Moderator and co-moderator write a one-page summary on points of emphasis and interests during the group. What was interesting and what seemed noteworthy. Also write down brief notes on the atmosphere and the relations between the participants - conflicts, awkwardness, relaxed etc.

Step 7. Process data

Transcribe, translate and thematize data. Ideally, the moderators transcribe the focus group word-for-word through repeated listening to the audio tape. The moderators and a third, independent, researcher review the transcript and identify key words and phrases.

Step 8. Send to WP1 leader

Question guide for the focus group

If the focus group seems to be reluctant, consider starting with this initial theme, to get the discussion going. Otherwise, begin with theme 2.

Optional! Theme 1: Getting started, background information and defining the participants' networks

Q1.1: Describe a typical work day

Q1.2: Who are your most important collaboration partners in your daily work?

Moderator's notes to theme 1:

Theme 2: Skills

Q2.1: What are the most important skills in your daily work day?

Note for the moderator: If the focus group includes actors from different parts of the food chain, make sure that skills of farmers/producers is in focus by re-phrasing the question as 'What do you consider to be the most important skills in the daily work of farmers/food producers?'

Q2.2: Compared with when you started your professional career, what new skills have you had to develop?

Q2.3: Are there any skills that you no longer use the way you used to?

Q2.4: When you look at the future, what kind of new skills do you think that you or the people working for you will have to develop further?

Q2.5: When you think you need new skills or knowledge, who do you turn to?

Note for the moderator: If the following issues did not come up in the initial discussion, ask the following: Do you go to any of the following actors: Relatives, experts, local community, advisors, universities, market actors

Q2.6: A list of skills – which do you think are important?

Note for the moderator: Here is a good time to hand out the list of skills and ask the participants to rank the skills going from least important to most important in their job. They should add skills that they find important if they are not present on the list.

The compilation can be conducted in different ways -

- each participant gets the list in paper and ranks it by numbers with a pen - discuss afterwards (most suitable for groups with experts or students)

- a whiteboard or large poster with the list and the moderator (assistant) ranks with numbers based on the discussion of the participants (most suitable for groups with only farmers/producers)

Q3.8: Do you think the list and its ranking will change within the next 5-10 years?

Moderator's notes for theme 2:

Theme 3: Sustainability

Q3.1: What is sustainable food production to you?

Notes to the moderator: If the following does not come up in the discussion, ask: What is social sustainability, What is economic sustainability, What is environmental sustainability?

Q.3.2: What role does sustainability play in your daily work?

Q 3.3 What are your most important skills in relation to sustainability?

Moderators notes for theme 3:

Theme 4: Education and research

Q 4.1: Have you been involved in education of students and if so, what is/was your role?

Q4.2: Do you think that students develop the skills that you are looking for in today's education system?

Q4.3: What are the most critical gaps in student skills and competencies?

Q 4.4: Have you been involved in academic research, and if so, what is/was your role?

Q4.5: Do you think that the research (connected to the agrifood sector) conducted today is relevant for you?

Q4.6: What are the most critical gaps to tackle in order to get research more relevant in the daily practice of food professionals?

Moderator's notes for theme 4:

Final Question:

Is there anything that we have not discussed that you think is important to create a research and education system better fit to deliver to practice?

List of skills for inspiration.

NON SECTOR-SPECIFIC SKILLS

I. Fundamental Skills

- Communicating
- Managing information
- Using numbers
- Thinking & solving problems
- Providing leadership
- Managing personnel

2. Personal management skills

- Demonstrating positive attitudes & behaviours
- Being responsible
- Being adaptable
- Learning continuously
- Working safely
- Improving own performance

3. Teamworking and interpersonal skills

- Working with others
- Participating in projects & tasks
- Communicating with others

4. Business skills

- Business planning & strategic management
- Sales and marketing
- Finance and resource management
- Customer service

5. Pedagogical skills

- Learning and assessment

SECTOR NON-SPECIFIC SKILLS

6. Skills for food quality and food safety

- Quality management, quality assurance and quality control
- Food safety management, food hygiene and food safety control

7. Skills for research and development

- Product development

8. Skills for food production and manufacturing

- Engineering maintenance
- Health, safety and the environment
- Production management
- Production operations
- Cleaning and preparation
- Control operations
- Waste disposal

9. Skills for food retail and the supply chain

- Food retail
- Goods received and storage
- Supply to production
- Pick and pack
- Livestock droving

10. Skills for logistics

- Transportation

SECTOR-SPECIFIC SKILLS

11. Skills for food processing sectors

- Meat and poultry processing – preparation and abattoirs
- Meat and poultry processing – production butchery
- Meat and poultry processing – retail butchery
- Fish and shellfish processing
- Dairy products
- Brewing production
- Beer packaging
- Milling and cereals
- Dough and dough products
- Flour confectionery
- Chocolate
- Sugar confectionery

ANNEX 5. Skills presently needed divided by profession

	Skills needed presently
Farmers 7 focus groups discussed skills for farmers	The following skills were identified in 3 or 4 of the 7 focus groups: - Learning Continuously - Providing Leadership - Business planning and strategic management - Marketing (strategies and techniques) - Adaption, development and, experimentation - Digital skills - Being conscious and responsible - Communicating - Collaboration (incl. interdisciplinary, multicultural) - System thinking/applying holistic knowledge
Advisors to farmers (Mostly agronomists) 5 focus groups discussed skills for advisors	The following skills were identified in 3 or 4 of the 5 focus groups - Interpret and translate theoretical and scientific knowledge to farmers - Leadership The following skills was identified in 2 of the 5 focus groups - Strategical planning and development - Collaboration (interdisciplinary, multicultural) - Technical skills in general - Facilitation (involve local stakeholders and researchers) - Build networks - Observation - Adaptation, experimentation and development - Marketing - Understanding of habitat and ecosystem

Food enterprises and industry 6 focus groups discussed skills for employees in food enterprises/ industry	The following skills were identified in 3-5 of the 6 focus groups - Sales and Marketing (incl. trend analysis, market development) - System thinking - Innovation - Communication - Collaboration - Networking - Product Development - Leadership (incl. socially sustainable leadership) - Technical skills in general - Digital skills
Academia 4 focus groups discussed skills for academia	The following skills were identified in 2-4 of the 4 focus groups - Communication - Project management - Positive attitudes and behaviors - Teamworking and interpersonal skills - Problem-solving - Being Adaptable - Personal management skills - Observation

Table 7. Skills presently needed divided by profession. Focus groups.

ANNEX 6. Findings Nextfood WP1 Questionnaire on Skills for the Future of Sustainable Food/Forestry

Number of respondents: 31

Available at www.iseki-food.net from 1st August to 15th October 2019. Emailed to ISEKI members and to NextFOOD partners

Q1. In which of the following stakeholder roles do you work?

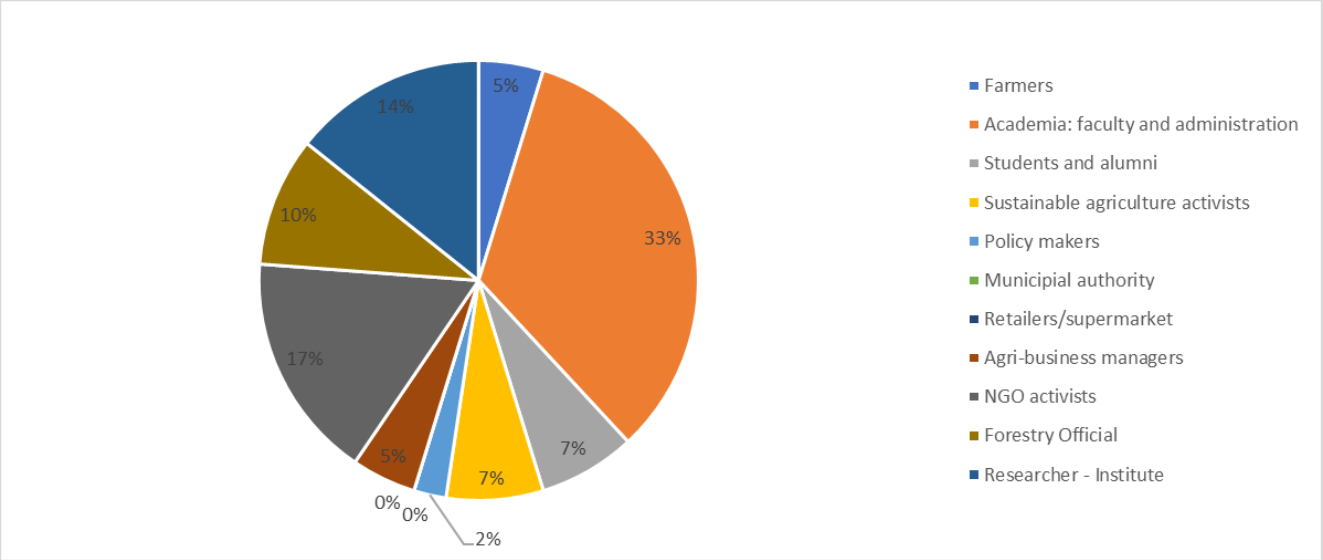


Figure 6. Affiliation of questionnaire respondents

Q2. What are the 3 most important skills in your daily work, in order of importance:

	Skill #1:	**Skill #2:**	**Skill #3:**
1	self discipline	networking	attention to detail
2	communication	networking	soft skills
3	Research planning	Research management	Problem solving
4	Writing of project proposals, funds mining	Teaching	Management
5	Coordination of research activities, incl	Coordination with stakeholders, incl oral	General knowledge about the research area

	oral and written communication	and written communication	
6	organisation of work	analisis of the approach based on the different sources	well formulated arguments
7	Communication	Time management	Food Science
8	Decision making and problem solving	Adaptability	Interpersonal abilities
9	Research competences	Teaching and learning competences	Organisational and transversal competences
10	Networking and understanding of changing needs of students	In depth matching methods and new problems	Vision about the sector
11	Knowledge, trust and commitment of farmers to apply new technologies	research and technical backup to improve livelihood of farmers	commitment of policy makers to sustain new developments
12	quality of data, independent evidence and analyses	Policy strategy and writing-up court evidence	networking
13	Project Management	Data analysis	Report writing
14	Knowledge	adaptability	colaboration
15	Team working	Management and financial skills	Networking
16	Grass-roots level communication skills	Translating theory into daily-life practice and case-studies	Tools for vision building with blending of theory and practices
17	Communication	Networking	Management
18	working in an interdisciplinary way	ability to keep several dossiers together	being creative
19	effcient use of resources	adaptability	problem-solving
20	Conservation	Remote sensing	Writing
21	Projekt manageing	Problem solving	Forestry education

22	Communication	Human relations	Technology and operations in forestry
23	Project management	How to handle people and lead meetings	Database management
24	Cooperation, both within the organization and with other organizations	Long-term strategic work	Knowledge based decisions
25	Critical thinking	Understandings of research related topics	Pedagogical skills
26	Communication	Knowledge about the subject	Drive for change
27	Maintaining contacts and network (polite and precise emails and phone calls)	Coming up with new ideas / creative thinking	Finding and evaluating specific information
28	Anlytic and synthesis	Knowledge in my topics	Administrative
29	Communication	Creativity	Teamwork
30	Versatility	networking	dialogue
31	Being able to adopt approaches aimed at self-diagnosis, self-correction and continuous improvement	Being able to identify and promote business processes (internal and external) aimed at improving hea	acquire and use resources for a correct and effective financial activity for the corporate

Table 8. List of most important skills in the daily work. Questionnaires.

Skills #1:

- **Communication mentioned 8/31 (26%) times**
- **Project management mentioned 3/31 (9%) times**

Skills #2:

- **Networking mentioned 4/31 (12%) times**
- **Adaptability mentioned 3/31 (9%) times**

For the following statements about skills for the future of sustainable food / forestry, please indicate how much you agree or disagree (10= strongly agree, 1= strongly disagree)

Q3. Networking skills will become more and more important (10= strongly agree, 1= strongly disagree) ***87% over 7***

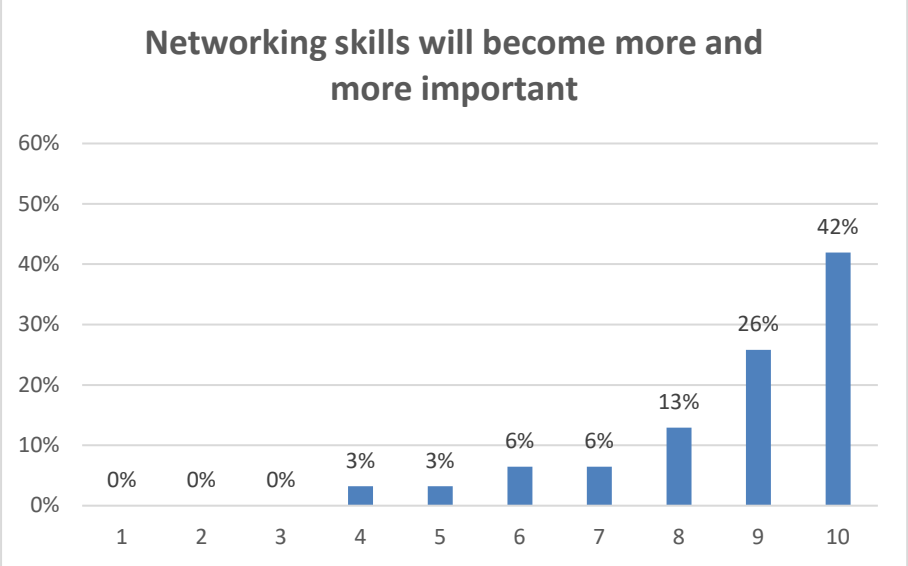


Figure 7. The importance of networking skills. Questionnaires.

Q4. Interdisciplinary skills will be more important than specific technical skills (10= strongly agree, 1= strongly disagree) ***68% over 7***

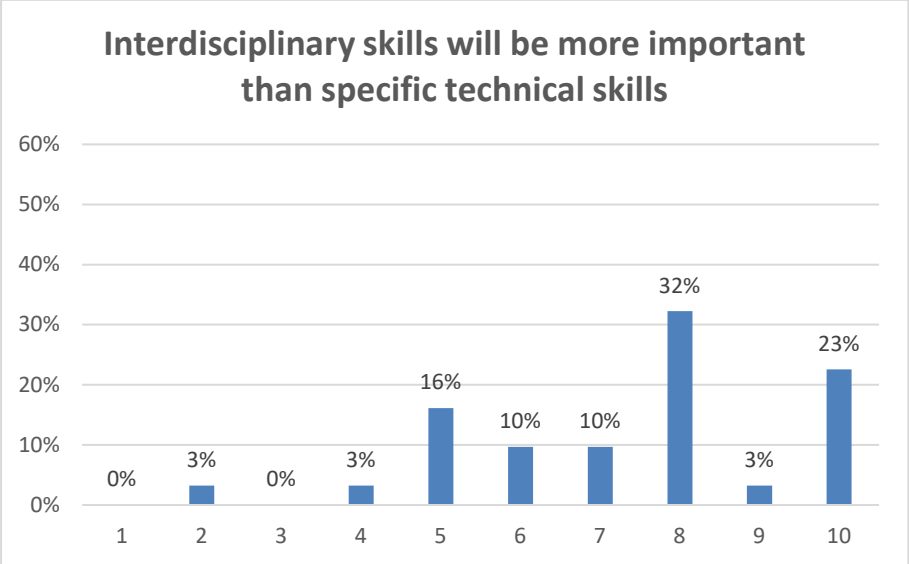


Figure 8. The importance of interdisciplinary skills. Questionnaires.

Q5. Planning for the future (visioning) will be more important than daily tasks (10= strongly agree, 1= strongly disagree) ***61% at 7 and over***

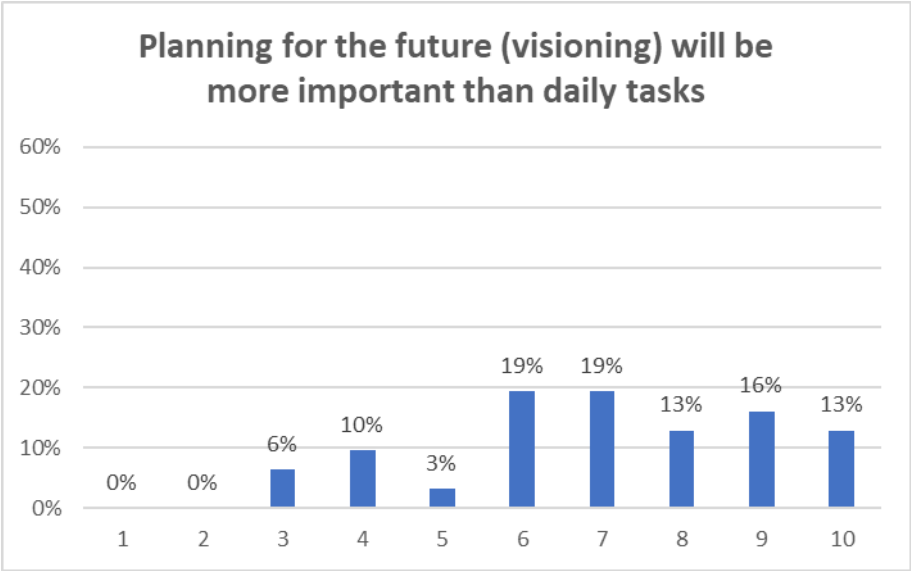


Figure 9. The importance of skills to plan for the future (visioning). Qustionnaires.

Q6. Ability to adapt to changes will be among the most important skills (10= strongly agree, 1= strongly disagree) ***87% at 7 and over***

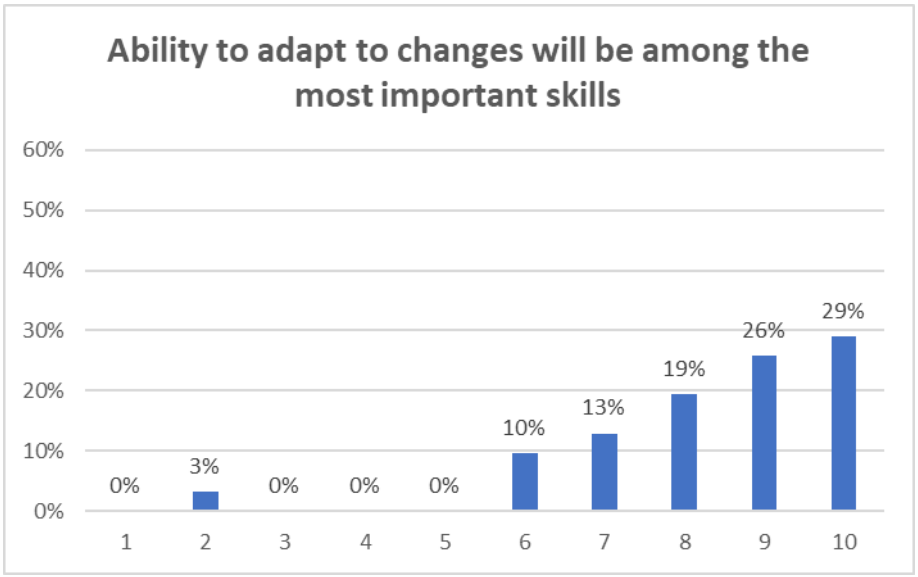


Figure 10. The importance of being able to adapt to changes. Questionnaires.

Q7. Efficient use of resources (e.g., decrease waste, use local) will be essential (10= strongly agree, 1= strongly disagree) ***87% at 7 and over***

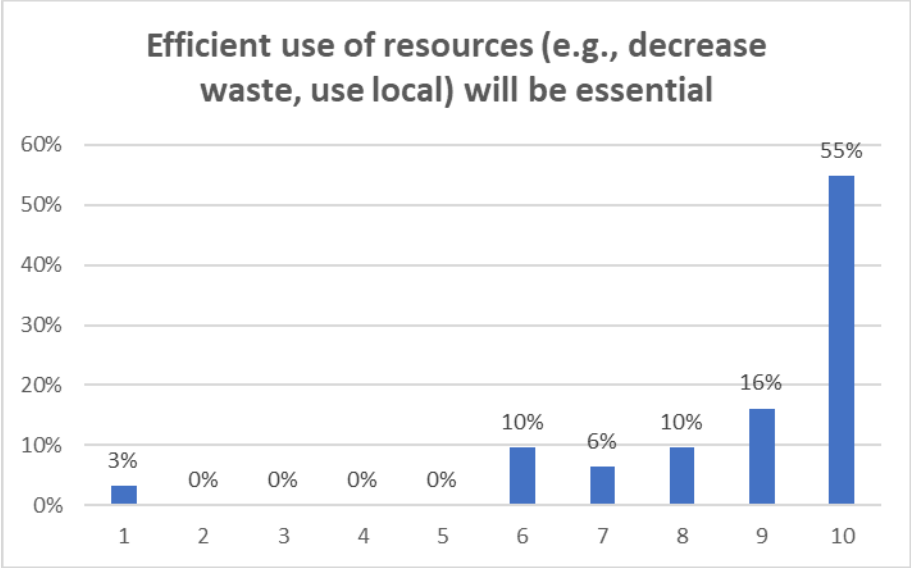


Figure 11. The importance of skills to efficiently use resources. Questionnaires.

Q8. Real-life problem solving will be more important than understanding theory (10= strongly agree, 1= strongly disagree) ***69% at 7 and over***

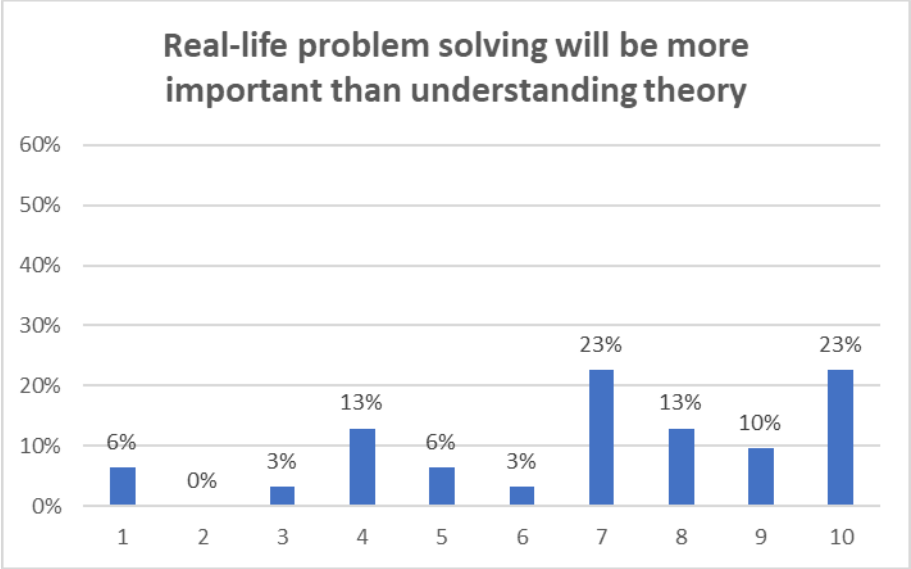
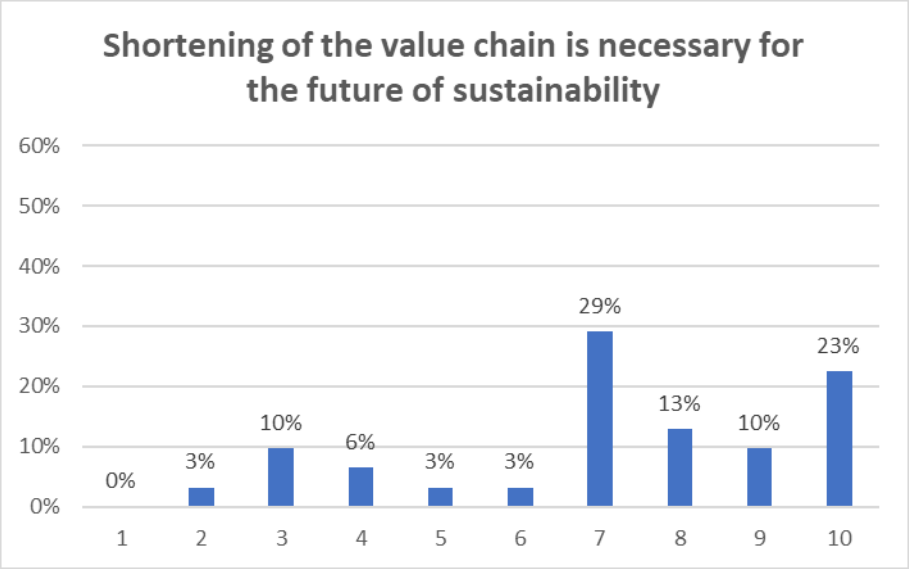


Figure 12. The importance of skills to solve real-life problems. Questionnaires.

Q9. Shortening of the value chain is necessary for the future of sustainability (10= strongly agree, 1= strongly disagree) ***75% at 7 and over***



Q10. Which 3 skills would you most like to have for your future as a successful stakeholder in sustainable food and forestry

	Skills #1	**Skills #2**	**Skills #3**
1	IT	collaboration	writing
2	adaptability to changes	real-life problem-solving skills	skills to better visualise project results graphically
3	Interdisciplinary	Visioning	Efficient use of resources
4	Adapt to technological changes	Real life problem solving	Experiential Teaching
5	Science-based knowledge in my field and adjacent	Ability to synthesize and communicate	Leading open innovation activities
6	-	-	-
7	Responsibility	Interdisciplinarity	Teamspirit
8	Networking	Interdisciplinary	Adaptability
9	Sustainability	Interdisciplinarity	Problem solving
10	Pedagogical methods	Learning in social networs	New working group methods
11	skill to improve networking and advocasy to engage policy makers in the food and NRM business	continues capacity improvement and technical skill in line with the daily activity	understanding the real challenges of different sectors and ability to solve the problems
12	data and analyses	converting to policy strategy	networking
13	Programme Evaluation	Participatory Action Research	Qualitative Research Methodologies
14			
15	Networking and collaboration with stakeholders, researchers and Universities	Implementation of new quality standards which lead in sustainable food and forestry.	Continuous training of farmers and agri consultants on quality of production and sustainability.

16	Evolving methodologies and tools for efficient resource use management	Skills to establish linkages of theory and daily tasking of within farming systems and	Effective networking for inter-disciplinary and technical skills
17	System Analysis	Facilitation	Communication
18	facilitating visioning activities	stimulating multi and interdisciplinary and sector approaches	facilitating sustainable business development
19	Shortening of the value chain	managerial skills	visioning
20	Remote sensing	Computer programing for automatization	genetics
21	Projekt manageing	Environmental knowledge	Diplomatic
22	Communication	Human relations	Technology and operations in forestry
23	Programming	The ability to drive harvester/forwarder	
24	Knowledge and understanding	Entrepreneurship	Strategic
25	Collabroration	Responsible management (CSR)	Communication
26	Working as a bridge between science and society	Reaching out to lesser informed stakeholders	See sustainable changes through, from cradle to end products
27	Advanced statistics (multivariate analysis, how to use AI in practise)	How to establish and maintain big, impersonal networks (EU project, etc)	Handling härskartekniker/old men's networks/inbred patriarchy
28	Analytic and synthesis	Networking	Multidisciplinary
29	Adaptability	Networking	Interdisciplinary
30	Problem solving versus complex real life problems	efficient management of resources	adaptability to change
31	critical sense	solve complex problems	advanced skills in food technology

Table 9. List of needed skills in the future. Questionnaires.