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Info session on “Climate change as a driver of emerging risks for food and feed safety, plant, animal health and nutritional quality”

European Food Safety Authority (EFSA)

Abstract

An online info-session, held on the 8th of October 2020, was organized by EFSA to communicate the results of the recently concluded CLEFSA project: Climate change as a driver of emerging risks for food and feed safety, plant, animal health and nutritional quality. The project developed and tested new methodologies for the identification, characterisation and analysis of emerging risks linked with climate change, and described the uncertainties related to working in data-poor environments. A report on the project was published on 25 June 2020. The overall aim of this event was to discuss and disseminate the CLEFSA report to an international audience including EFSA panels and Scientific Committee members, European Commission services, sister agencies, H2020 projects, national agencies inside and outside the EU, international organisations with relevant expertise, coordinators of relevant international projects and programmes, farmers, breeders and citizens at large, and to identify opportunities for promoting synergies across related activities. After the opening plenary session describing the CLEFSA report, the participants discussed area-specific synergies and interactions with other projects/activities in the following fields: 1) contaminants, 2) animal health, 3) biological hazards to human health and 4) methodologies for emerging risks identification, characterisation and analysis. During the final plenary session possibilities for further actions and collaborations were presented. It was concluded that CLEFSA has been successful in bringing together the expertise of different stakeholders to address a complex, multidisciplinary problem, characterised by a high level of uncertainty. As a follow up, EFSA should strive to engage a wider variety of stakeholders, such as citizens, farmers or local authorities, in the implementation of systemic approaches for its emerging risks identification process, strengthen its collaboration with international bodies such as IPCC to disseminate its work on climate change and focus on a more detailed risk characterisation of priority issues.

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Key words: climate change, emerging risks, identification, characterisation, uncertainty, impacts, likelihood of emergence

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Table of contents

Abstract.....	1
1. Introduction	4
2. Panellists.....	4
3. Event feedback and outreach.....	5
4. Plenary session: aims of the event, methodology and results of the project.....	5
5. Breakout sessions: area specific synergies and interactions with other projects/activities.....	6
5.1. Breakout session 1: contaminants	6
5.2. Breakout session 2: animal health	7
5.3. Breakout session 3: biological hazards to human health.....	7
5.4. Breakout session 4: methodologies	8
6. Potential synergies with IPCC reporting and Climate, Health, Food and Sustainability Policy	9
7. Conclusions	10
8. Recommendations.....	10
References.....	12
Abbreviations	13
Appendix A – Results of the online polls.....	14
Annex A – Info session agenda.....	20
Annex B – General introduction: aim and structure of the event (presentation from Angelo Maggiore).....	20
Annex C – Project methodology: issue identification, characterization, analysis (presentation from Giacomo De Sanctis and Federica Barrucci).....	20
Annex D – Project results (presentation from Aleksandra Lewandowska).....	20
Annex E – Climate Change and implications in the marine ecosystems, with special attention to marine toxins as contaminants in seafood (presentation from Jorge Diogène)	20
Annex F – Climate change and emerging risks for animal health and welfare (presentation from Stefano Messori)	20
Annex G – Cascading risks from climate change for waterborne diseases in Europe (presentation from Jan Semenza)	20
Annex H – Emerging issues detection: Use of Text mining and Foresight tools (presentation from Jessika Giraldi).....	20
Annex I – From Science to Policy. Climate change as a driver of emerging risks for food & feed safety, plant, animal health and nutritional quality (presentation from Maria Cristina Tirado) .	20
Annex J – CLEFSA (Climate change and Emerging risks for Food Safety) project web event: plenary session (video recording)	20
Annex K – CLEFSA: area-specific synergies and interactions with other activities, part 1 - contaminants (video recording).....	20
Annex L – CLEFSA: area-specific synergies and interactions with other activities, part 2 - animal health (video recording)	20
Annex M – CLEFSA: area-specific synergies and interactions with other activities, part 3 – human health (video recording)	20
Annex N – CLEFSA: area-specific synergies and interactions with other activities, part 4 - methodologies (video recording)	20

1. Introduction

The world around us is changing very rapidly. There is a need of understanding these changes and the way they interact with the food system to predict, control and possibly prevent future risks. More importantly, intervening directly on these underlying drivers of change can diminish the likelihood of emergence of risks and reduce the associated human and economic costs. Driver analysis has already been used by EFSA and proved that the drivers interact with each other and cannot be separated. Climate change constitutes a relevant driver of emerging risks for food safety and has a cascading effect on the food system.

A broad range of forward-looking studies and reports examines the impact of climate change on health (through its social and environmental determinants such as clean air, safe drinking water and extreme weather events), farming and food security (by addressing the question of food production for a growing human population). However, future challenges for food safety and nutrition quality are not specifically studied, although food safety and food security are strongly intertwined. Achieving food security is not possible without considering food safety. The sensitivity of pathogens (including bacteria, viruses and parasites), potentially toxigenic microorganisms and various pests to climate factors suggests that climate change has the potential of causing, enhancing or modifying the occurrence and intensity of some food-borne diseases and the establishment of invasive alien species harmful to plant and animal health. Climate change may therefore affect food safety and nutrition, through impacts occurring at all stages of the food chain as food moves from production to consumption, or from 'farm to fork'.

Considerations of climate change are becoming more and more relevant in almost all areas in the EFSA's remit. Climate change poses challenges to future risk assessment, for which the EFSA's strategy 2020 outlines the need to be prepared. The CLEFSA project (Climate change and Emerging risks for Food Safety) aimed at developing and testing new methodologies for emerging risks identification and characterisation and to produce a list of emerging issues/risks in EFSA remit potentially affected by climate change. The final report of the project (EFSA 2020) is aimed at a broad audience, including all the relevant players in the food safety arena, from risk assessors, risk managers, researchers, to the general public.

2. Participants

Table 1: List of external speakers and EFSA staff who participated in the info session in different roles: speakers, chairs or rapporteurs.

	Name	Surname	Abbreviation	email	Affiliation
External experts					
	Jorge	Diogène	JD	Jorge.Diogene@irta.c at	EuroCigua
	Stefano	Messori	SM	S.Messori@oie.int	OIE
	Jan	Semenza	JS	JanC.Semenza@ecdc. europa.eu	ECDC
	Jessika	Giraldi	JG	Jessika.GIRALDI@ec. europa.eu	JRC
	Maria Cristina	Tirado	MCT	mcristinatirado@gmail .com	UCLA
EFSA					Unit
	Ana	Afonso	AA	Ana.AFONSO@efsa.e uropa.eu	GMO
	Federica	Barrucci	FB	Federica.BARRUCCI@ efsa.europa.eu	AMU
	Bernard	Bottex	BB	Bernard.BOTTEX@efs a.europa.eu	SCER
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	Aleksandra	Lewandowska	AL	Aleksandra.LEWANDO WSKA@ext.efsa.euro pa.eu	SCER

	Angelo	Maggiore	AM	Angelo.MAGGIORE@efsa.europa.eu	SCER
	Tobin	Robinson	TR	Tobin.ROBINSON@efsa.europa.eu	SCER
	Mirko	Rossi	MR	Mirko.ROSSI@efsa.europa.eu	BIOCONTAM
	Yves	Van der Stede	YVdS	Yves.VANDERSTEDE@efsa.europa.eu	ALPHA

3. Event feedback and outreach

Based on the post-event survey sent to the participants, the event successfully met its objectives. 75% of participants rated their overall experience as good or excellent, in line with the average customer satisfaction rate of EFSA's events. 88% of the participants declared that their knowledge increased to good or excellent after the event, which indicates that the info session effectively conveyed its key messages. The content of the presentations and availability of supporting documents in advance was praised. While the participants greatly enjoyed the breakout sessions, they would have liked more polls to express their views.

The event was well attended, with 260 out of expected 500 joining the info session and very few leaving before the end. Most participants were affiliated with EU nationalities, universities and other research institutes and heard about the event mainly through EFSA newsletter, focal points or word of mouth. 54.8% of participants were first-time attendees and 274 new contacts were generated, so the event succeeded in gaining the interest of a wider audience.

4. Plenary session: aims of the event, methodology and results of the project

The plenary session provided a short summary of all the sections of the recently published CLEFSA report (EFSA 2020). Angelo Maggiore explained the context in which the CLEFSA project has been conceived and its main goals. In the EU, food safety has been achieved through risk assessment and well-established monitoring and mitigation measures. However, the global changes in trade patterns, pollution, economic development and environmental changes including climate change might destabilize the food system in many ways. Thus, there was a need for developing a pipeline for identification, characterization and prioritization of the emerging risks for food safety resulting from these changes. These emerging risks are defined in accordance with EFSA's definition¹ and are all characterized by scarcity of data and high uncertainty. To overcome these obstacles, CLEFSA relied on the expertise of specialists in different areas in EFSA's remit. The "CLEFSA network", consisting of 6 EFSA staff and representatives of 13 international organisations, was formed with the aim to steer the development of the project and discuss its various aspects. Moreover, exchanges with the EFSA standing working group on Uncertainty addressed the methodological robustness of the chosen pipeline. This collaborative and interdisciplinary approach is in line with EFSA's effort to move into a system approach for risk assessment.

Federica Barrucci and Giacomo de Sanctis explained how the methodology for the project was developed. First, they discussed the climate change scenarios used for the issues assessment and different climate parameters taken into account. Secondly, the sources of information used for the identification of emerging risks were described, stressing the importance of crowdsourcing which allowed any concerned citizen to propose possible emerging risks potentially related with climate change. The obtained 600 responses led to the identification of 200 issues which were then merged and filtered to result in a list of 129 issues sent to the 60 experts involved in characterization and scoring. These experts selected the issues to work on, according to their self-assessed level of expertise. The expertise levels were not further elaborated, but a more thorough, objective assessment could be useful to weigh experts' input in similar future projects. Finally, the criteria for characterization and the mathematical model that was used to convert the expert scores into probability distributions were explained.

¹ <https://www.efsa.europa.eu/en/topics/topic/emerging-risks>

Aleksandra Lewandowska presented the results of the characterization and scoring stage and the methods chosen to visualize the outcome. Moreover, two numerical indicators were described, that help the reader to assess 1) the effect of climate change on the impact or likelihood of emergence of an issue, 2) the uncertainty of expert assessments. CLEFSA have developed visualization methods that could facilitate comparing different issues. The different sources of uncertainty were also listed. For the issues where sufficient information was collected, factsheets were developed and can be accessed in the supplementary data of the report².

CLEFSA has also identified a series of drivers interacting with climate change and indirectly driving the emergence of issues. For example, climate change may have an impact on the use (amount, type) and on environmental fate of pesticides.

5. Breakout sessions: area specific synergies and interactions with other projects/activities

The event included four break-out sessions. Contaminants, animal health and welfare, biological hazards to human health and methodologies for emerging risks identification, characterisation and analysis. These were the sessions with the highest number of participants, as predicted in the on-line survey implemented in the event registration phase.

5.1. Breakout session 1: contaminants

The CLEFSA report has identified marine biotoxins as one of the issues in the areas of contaminants with the highest likelihood of emergence. Jorge Diogène discussed the relationship between climate change and the occurrence of marine biotoxins (like ciguatoxins and tetrodotoxins) in fish. Seawater warming and other climate parameters (like pH, sea rise, precipitation and freshwater runoff) have a direct impact on phytoplankton growth and population dynamics, the amount and type of toxins it produces, frequency, duration and geographic distribution of harmful algal blooms, bioaccumulation of toxins in fish, and finally on human exposure. The EUROCIGUA project aims at characterising the risk of ciguatera fish poisoning in Europe and is collecting environmental data useful for understanding the impact of environmental changes on the abundance and distribution of the microalgae responsible for the production of ciguatoxins. The project has found that outbreaks typical of tropical and subtropical areas are now recorded also in the Macaronesia area. In addition, *Gambierdiscus spp.* has been found in the Mediterranean and, for the first time, in the Balearic Islands. These findings constitute signals of an emerging risk for Europe. The EUROCIGUA project has been presented at the COP25 UN Climate Change Conference in Madrid. Because of the impact of increasing sea surface temperature on the geographical distribution of *Gambierdiscus spp.*, Ciguatera Fish Poisoning (CFP) was flagged as an indicator of climate change. The emergence of ciguatera in Europe is driven not only by climate change but also by other drivers, including destruction or alteration of the habitat, like reefs, and eutrophication. One issue that has been identified as a potential problem for CFP prevention is the mislabelling of fish species, either unintentionally or by fraudulent initiatives.

While this problem is not new, toxins not previously reported in temperate latitudes are now emerging in Europe determining new patterns of contamination. Increased frequency of algal blooms (including cyanobacteria) has been reported in the Baltic Sea as well (Olofsson et al., 2020).

CLEFSA could provide useful information also in legislative frameworks other than those directly related with food safety. In particular, it can be linked with the assessment of the descriptor 9 (Contaminants in Seafood) of the Marine Directive and the achievement of a "good environmental status", for which the Marine Directive prescribes that the concentration of all contaminants should be below the maximum level set for human consumption, and preferably, should be declining. In fact, CLEFSA has identified several emerging contaminants which could indicate a bad environmental status.

Moreover, the CLEFSA approach is interdisciplinary, provides a holistic perspective following the One Health approach and its systemic view of the food system could contribute to achieving some of the

² <https://efsa.onlinelibrary.wiley.com/doi/10.2903/sp.efsa.2020.EN-1881>

Sustainable Development Goals. However, risk management is not in EFSA's remit and this project only aims to assist risk managers and policy makers. For each characterized issue the availability of risk management measures was also mentioned, and some examples can be found in the final report.

The poll at the end of the breakout session identified DON and aflatoxins as the issues whose likelihood of occurrence will be affected most by climate change, according to the event participants.

5.2. Breakout session 2: animal health

Stefano Messori analysed both generic and specific issues that were identified by CLEFSA in relation to animal health, in the context of current activities of OIE. These generic issues affecting animal health and welfare include: new or re-emerging viruses/bacteria (also those released from thawing permafrost, e.g. anthrax), increased susceptibility to diseases and the consequent decrease in livestock production (dairy cattle being very susceptible to heat and poultry feeding less due to heat, which results in lower body weight), expansion of the geographic range of several vectors carrying pathogenic agents, migrations caused by global warming, ocean acidification, increased sea levels, floods, forest fires and other extreme events (which results to spread of diseases into new regions and new interactions between domestic and wild animals).

Several specific examples were discussed, such as lumpy skin diseases for which reported outbreaks are steadily moving to higher latitudes, and avian influenza that reaches new areas due to changing avian migration patterns that lead to new interactions between species, as well as longer persistence of the virus in the environment. The issues affecting animal health need to be tackled through a holistic One Health approach, since many animal pathogens, such as *Leishmania*, are also harmful for humans. Moreover, climate change has a detrimental effect on plant health, which leads to decreased availability of animal feed.

While animal production contributes to causing climate change, it is also one of the sectors most affected by it. Thus, adaptation measures are necessary and should include preparation for outbreaks of climate-sensitive diseases, coordinated monitoring and preparedness efforts and capacity building. CLEFSA project will be instrumental for risk managers tackling animal health-related issues and could evolve into a continuously updated tool that could help capture new signals and be scalable to specific regions. However, there are currently many initiatives having similar goals and CLEFSA must find its own niche in this crowded field. This can be achieved by maintaining constant input from researchers, international institutions and concerned citizens, and ensuring the robustness of collected data, e.g. by systematic literature reviews. Moreover, connections between different issues should be explored more, and enlarging the expert base will help capture new types of expertise and provide a broader perspective. As the methodology, visualization methods and the list of issues are constantly updated, CLEFSA will become a tool useful not only to risk managers, but also policymakers, doctors, veterinarians and scientists who will be able to identify concrete data gaps and research needs related to animal health.

The poll at the end of the breakout session identified Bluetongue and Influenza A as the issues whose likelihood of occurrence will be affected most by climate change, according to the participants. Rift valley fever and Influenza A were chosen as the issues whose impact will be affected most.

5.3. Breakout session 3: biological hazards to human health

Jan Semenza presented the activities of ECDC that are related to monitoring and mitigating the biological hazards to human health. Their recent efforts focused on monitoring cascading risks from climate change for waterborne diseases in Europe. As the severity and frequency of extreme events (such as heavy rainfall and floods) increases, more waterborne outbreaks are observed, as already reported in Scandinavia (Semenza, 2020). If floods happen at the farming areas, including oyster farms or fishing ponds, food might be contaminated and lead to outbreaks due to food consumption. Thus, monitoring the early environmental signals that might trigger outbreaks is necessary for preparedness and will reduce the severity of the outbreaks if they occur.

Lindgren et al., (2012) performed a weighted risk analysis of climate change impacts on infectious disease risks in Europe and concluded that for most of the described issues there is no European surveillance system. To address this problem, ECDC created a tool – Vibrio map viewer (<https://geoportal.ecdc.europa.eu/vibriomapviewer/>), which monitors the incidence of Vibrio infections, identified as severely affected by climate change and increasing with warmer weather. ECDC is

monitoring twitter trends and sets up early warnings for increased *Vibrio* infection risk. On the other hand, *Vibrio* map viewer is currently calibrated to the Baltic Region in Northern Europe and would require modifications before being applied to other pathogens or geographical areas.

Outside of the Baltic Region, other regions are also at risk of waterborne disease outbreaks. In Southern Europe, consecutive drought and floods due to extreme rainfall will flush out the pathogens such as *Campylobacter*. Heavy rain is also correlated with spikes in *Cryptosporidium* outbreaks, as these bacteria survive chlorination in water treatment systems. *Salmonella* outbreaks will be more likely to occur due to climate change but public health practices could be sufficient to mitigate them. Thawing arctic ice might also release pathogens into the biosphere³. Warmer climate was observed to increase the transmission of antimicrobial resistance, but the molecular mechanism has not been explained yet. The poll at the end of the breakout session identified *Vibrio* and *Cryptosporidium* as the issues whose likelihood of occurrence will be affected most by climate change, according to the participants.

While ECDC has its own tools for prioritising infectious disease threats, CLEFSA exercise was considered useful for determining where early monitoring has to be implemented and where preparedness needs improvement. The preparedness must include both health professionals and citizens through public health campaigns. As COVID crisis is in the spotlight now, other potential global health risks of biological origin need carefully designed monitoring activities, which might include syndromic surveillance, monitoring hospital admissions, prescriptions and google searches.

5.4. Breakout session 4: methodologies

Jessica Giraldi presented the tools developed by JRC Competence Centre on Text Mining and Analysis that aim to make sense of the ever-increasing amount of data in form of text. These tools assist EU institutions, including EFSA, in monitoring ongoing research and innovation activities. Europe Media Monitor (EMM) is used for analysing data in traditional and social media, covering 70 languages, 11000 sources and 8000 topics. The tool focuses on verified news sites and a team working on disinformation uses several techniques to flag websites and spot the propagation of false info. The customised version of EMM called Medisys covers medical and health-related issues and is currently used by EFSA to monitor plant health- and climate-related topics. Medisys was one of the tools used by CLEFSA to identify the emerging issues related to climate change. It was also applied by the EU Environmental Foresight System (FORENV) for identification of emerging environmental issues.

The other tool, Tools for Innovation Monitoring (TIM), makes use of semi-structured data from scientific publications, patents and EU grants coming from Scopus, PatStat and CORDIS databases. TIM allows the user to perform enrichment, indexing, filtering and visualization of the data retrieved through text mining; in the context of CLEFSA, it was used to retrieve topics and perform keyword analysis (emergence over time, detecting trends, identifying most important keywords). Several targeted versions of TIM exist, such as TIM Climate to monitor Green Deal objectives, TIM Open Access open for all users, but only containing open access databases, and TIM trends used for detection of weak signals in science and technology development. The key part of TIM trends is a dictionary of concepts, which is a list of emerging keywords automatically extracted from the corpus of documents. It eliminates the bias of prior user's knowledge and allows for real screening of all areas, impossible to be done by one person.

While the text mining tools enable us to screen large amount of data from diverse sources and to detect patterns, its output still needs to be assessed and refined to eliminate irrelevant and inaccurate records, and later communicated to the risk managers and policymakers in a clear manner. Moreover, the available tools are not suitable for all projects and need to be customized for a specific purpose. Regular trainings organized by JRC as well as guidelines for open access tools will be helpful to determine the best tool for each research question. Both TIM and Medisys are continuously expanded, in order to include new sources of information (including gray literature) and refine social media monitoring, which is currently not extensively used to capture emerging research trends. These tools will be used during

³ <https://www.nap.edu/catalog/25887/understanding-and-responding-to-global-health-security-risks-from-microbial-threats-in-the-arctic>

ongoing EFSA-JRC collaborations on emerging chemical risks, plant health, animal health and welfare, and competence mapping of organizations.

Participants of the breakout session have indicated through the poll that engaging with universities, scientific institutions, communities, breeders and farmers would be an effective way to increase the number of detected food safety issues related to climate change.

6. Potential synergies with IPCC reporting and Climate, Health, Food and Sustainability Policy

Maria Cristina Tirado put the results of the CLEFSA project in the broader context of international efforts to tackle climate change. IPCC's Fifth Assessment Report (AR5)⁴ recognised the importance of a change towards less emission-heavy diets (which rely less heavily on animal-based products) that will have beneficial effects both for human health and the environment. IPCC also monitors National Determined Contributions (NDCs), which are instruments used to respond to Paris treaty, as well as National Adaptation Programmes of Action (NAPAs). Sadly, there are very few instruments that are directly tackling food safety issues – only 3 NDCs and 2 NAPAs, and most focus on agriculture and food waste. The reason might be that food safety is an interdisciplinary problem that lies between health and agriculture and most instruments tend to focus directly on these areas. There are currently no commitments directly focusing on diet change.

IPCC is investigating the impact of climate change on the food system on many levels, production, trade and distribution, which affects not only food safety, but also security. CLEFSA's work is most aligned with the tasks of the IPCC Working Group II - Impacts, Adaptation and Vulnerability, but it is also relevant for topics such as food, health and the regional chapter on Europe. Further collaboration with IPCC will help to disseminate the outcomes of CLEFSA to a broader audience through potential discussions in the context of the upcoming assessment reports.

Among other initiatives related to climate change, IPBES is currently scoping the next thematic assessment on the interlinkages among biodiversity, water, food and health⁵, which are all linked to climate change and resulting food safety issues. Moreover, they are also working on the thematic assessment of invasive alien species and their control⁶, currently under review⁷. This document will be relevant for any zoonotic diseases that affect food and feed safety, as the spread of invasive species is in many cases facilitated by climate change. Furthermore, in 2016 JRC has published a foresight study "JRC policy report: Delivering on EU Food Safety and Nutrition in 2050 – Future Challenges and policy preparedness". This study proposes scenarios based on specific drivers that will affect the food system (global trade, population growth, new technologies, climate change etc.) and proposes policy options to address the emerging risks. The Global Risks Report 2020⁸ of the World Economic Forum cites risks related to climate change (environmental disasters, climate action failure, extreme events) as the ones with the highest potential impact and likelihood of emergence.

Finally, CLEFSA's work will fit in the thematic scope of two upcoming UN events. The UN climate change conference 2021⁹, postponed from 2020, will focus on revising the NDCs, while UN Food Systems Summit 2021¹⁰ will be addressing loss of biodiversity, climate change, malnutrition as well as transforming food systems to reach the Sustainable Development goals. EFSA is a member of the summit's scientific committee. Finally, One Health initiatives will benefit from CLEFSA's input and vice versa – implementing the One Health approach will be useful to link different issues retrieved by the project and describe how they interact.

⁴ <https://www.ipcc.ch/report/ar5/syr/>

⁵ https://ipbes.net/sites/default/files/Initial_scoping_nexus_assessment_EN.pdf

⁶ https://ipbes.net/sites/default/files/ipbes-6-inf-10_en.pdf

⁷ <https://ipbes.net/invasive-alien-species/FOD-review-registration>

⁸ <https://www.weforum.org/reports/the-global-risks-report-2020>

⁹ <https://ukcop26.org/>

¹⁰ <https://www.un.org/en/food-systems-summit>

7. Conclusions

During the final discussion, the speakers agreed that climate change is a multidisciplinary and complex issue which is going to have cascading effects on the food system. CLEFSA results clearly show that many food safety issues will have increased severity, duration and frequency of potential effects, but there is an even more prominent increase of the likelihood of emergence driven by climate change. The results of the characterization stage suggests that plant health and marine biotoxins are the areas showing the highest likelihood of occurrence. Nevertheless, so far there is little data available on the hazards and exposure characterization, which poses a challenge to risk assessors. Solving such a complex and underreported problem requires cooperation, engaging new stakeholders and public participation. Instead of assessing each emerging risk in isolation, an integrated One Health approach is needed to determine how each issue could affect human, animal and plant health as well as the environment. Moreover, many emerging risks are interconnected and a systems approach is needed to study these interactions and discover patterns in the emergence of new risks. For instance, one extreme event (such as flood or hurricane) or migration of species into a new area might induce several emerging risks due to multifaceted changes in ecosystems.

8. Recommendations

The findings of CLEFSA project clearly indicate that current risk assessment methodologies need to be adjusted to incorporate global environmental changes, and, in particular, climate change considerations. Moreover, surveillance and monitoring schemes need to be upscaled and synchronized between countries to enable good information flow and early detection and mitigation measures. Integrated EU policies are also needed to tackle the emerging food safety issues; these efforts need to be consistent with the already existing legislation, such as the marine directive.

The CLEFSA info-session generated large interest and attracted a high percentage of first-time attendees, which shows that adoption of a more systemic view of the food system brings on board a wider variety of stakeholders. These collaborators should be engaged in all trans-disciplinary, systemic and one-health approaches to adapt and mitigate the potential effects of climate change. The CLEFSA project itself has welcomed the contributions from different organizations on different stages of its works to tackle the issue from different perspective and to maintain efficient communication with the policymakers. However, there is a need for more engagement from the farmers, breeders and local competent authorities who are often the first to be affected by the impact of climate change. They can be engaged in EFSA's activities by participating in the work of EFSA stakeholder discussion group on Emerging Risks and other stakeholder networks, and their voice needs to be prominent in any conversation about the food chain under a systems perspective. In this regard, the event and the whole CLEFSA project has been a useful case study of cooperation and co-design that will inspire future agriculture innovations and adaptation measures.

The interest in the developed methodology clearly indicated that there is a need for horizon scanning or weak signals to retrieve information on emerging risks. However, data collected from a wider variety of stakeholders demands for innovations in the way we retrieve, filter and verify information and characterize the detected risks. Especially in case of citizen science and social media scanning, due attention is needed to avoid noise and fake news. As a possible follow-up, CLEFSA methodology could be continuously repeated to detect new signals as they appear. Another step ahead would be to perform a detailed characterization of selected issues or focus on specific regions or climate variables. One possibility is bringing together CLEFSA and EUROCIQUA project and to develop predictive modelling tools on the impact of specific climate change variables on the distribution of potentially toxigenic microalgae and transfer of these toxins up the food chain.

Finally, one of the outcomes of CLEFSA is strengthening the collaboration between EFSA and IPCC, which could result in future joint initiatives. For a start, EFSA will be involved in the UN climate change conference 2021 and UN Food Systems Summit 2021 to make sure that food safety considerations are a part of a global conversation about climate change

References

- EFSA (European Food Safety Authority), Maggiore, A, Afonso, A, Barrucci, A, De Sanctis, G, 2020. Climate change as a driver of emerging risks for food and feed safety, plant, animal health and nutritional quality. EFSA supporting publication 2020:EN-1881. 146 pp. doi: 10.2903/sp.efsa.2020.EN-1881
- Lindgren E, Andersson Y, Suk JE, Sudre B, Semenza JC. Public health. Monitoring EU emerging infectious disease risk due to climate change. *Science*. 2012 Apr 27;336(6080):418-9. doi: 10.1126/science.1215735. PMID: 22539705.
- Olofsson M, Suikkanen S, Kobos J, Wasmund N, Karlson B. Basin-specific changes in filamentous cyanobacteria community composition across four decades in the Baltic Sea. *Harmful Algae*. 2020 Jan;91:101685. doi: 10.1016/j.hal.2019.101685. Epub 2019 Oct 11. PMID: 32057344.
- Semenza JC. Cascading risks of waterborne diseases from climate change. *Nature Immunology*. 2020 May;21(5):484-487. DOI: 10.1038/s41590-020-0631-7.

Abbreviations

AMU	Assessment and methodological support Unit, EFSA
BIOCONTAM	Biological Hazards and Contaminants Unit, EFSA
ECDC	European Centre for Disease Prevention and Control
GMO	Genetically Modified Organisms
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IPCC	Intergovernmental Panel on Climate Change
JRC	Joint Research Centre, European Commission
OIE	World Organisation for Animal Health
SCER	Scientific Committee and Emerging risks Unit

Appendix A – Results of the online polls

A.1. Plenary session: aims of the event, methodology and results of the project

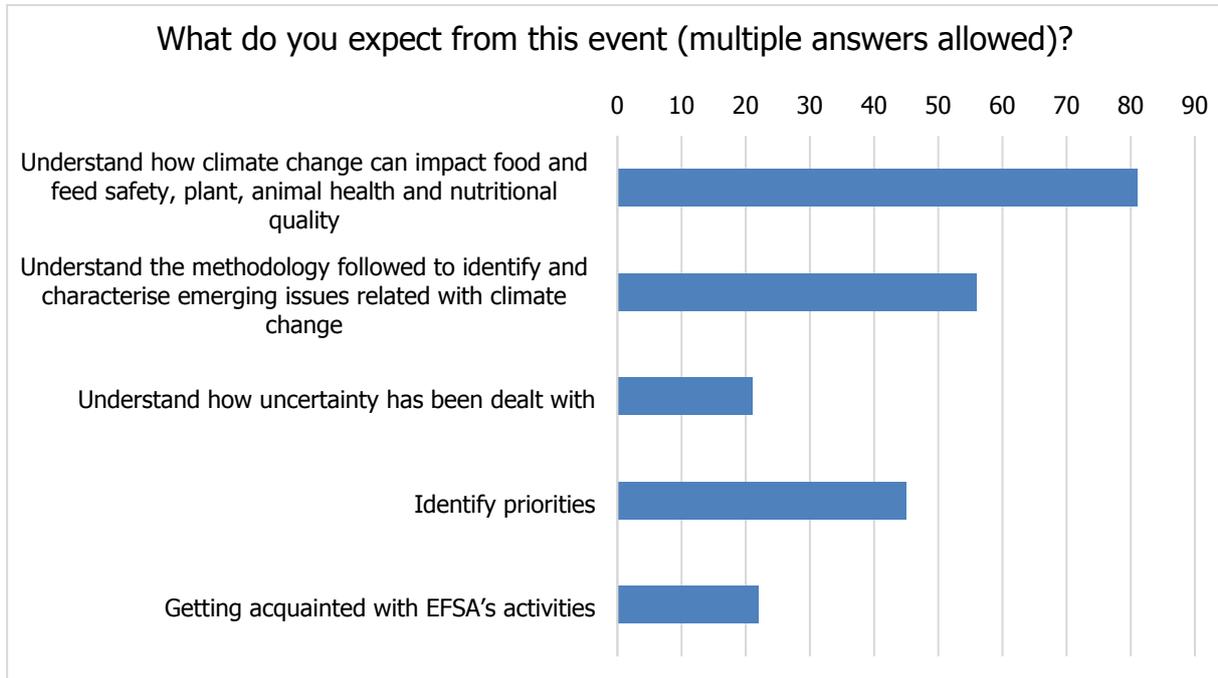


Figure 1: Results of the online poll launched at the beginning of the plenary session.

A.2. Breakout sessions: area specific synergies and interactions with other projects/activities

A.2.1. Breakout session 1: contaminants

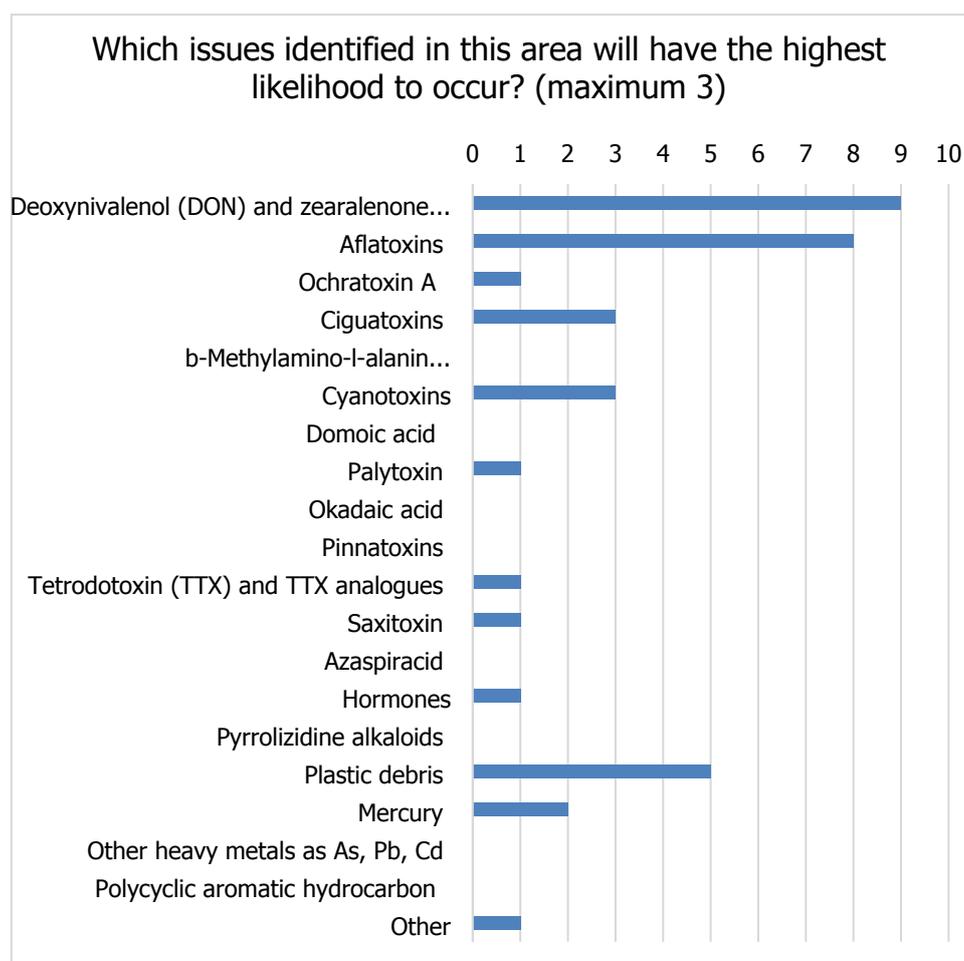


Figure 2: Results of the online poll launched during the first breakout session (contaminants).

A.2.2. Breakout session 2: animal health

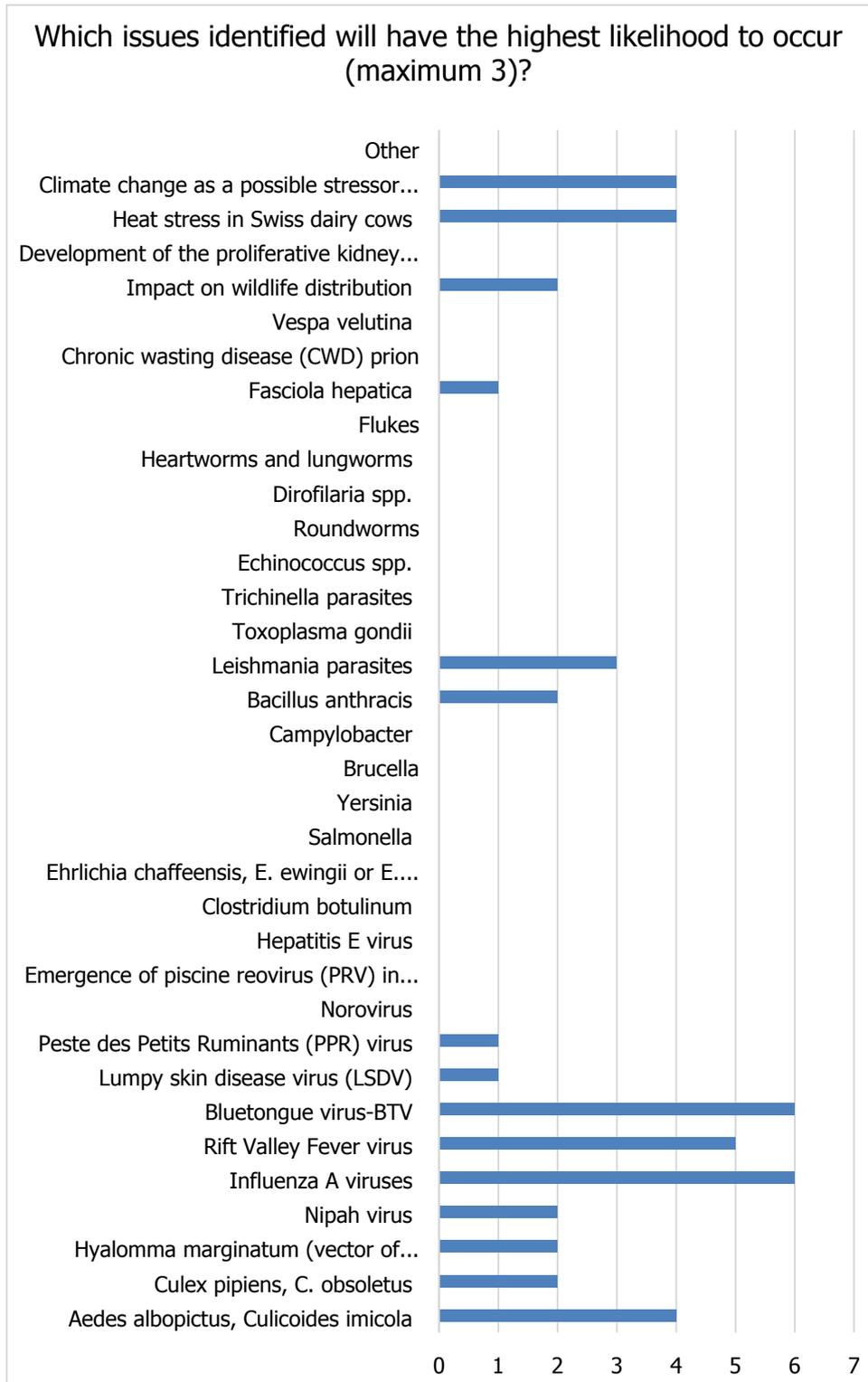


Figure 3: Results of the first online poll launched during the second breakout session (animal health).

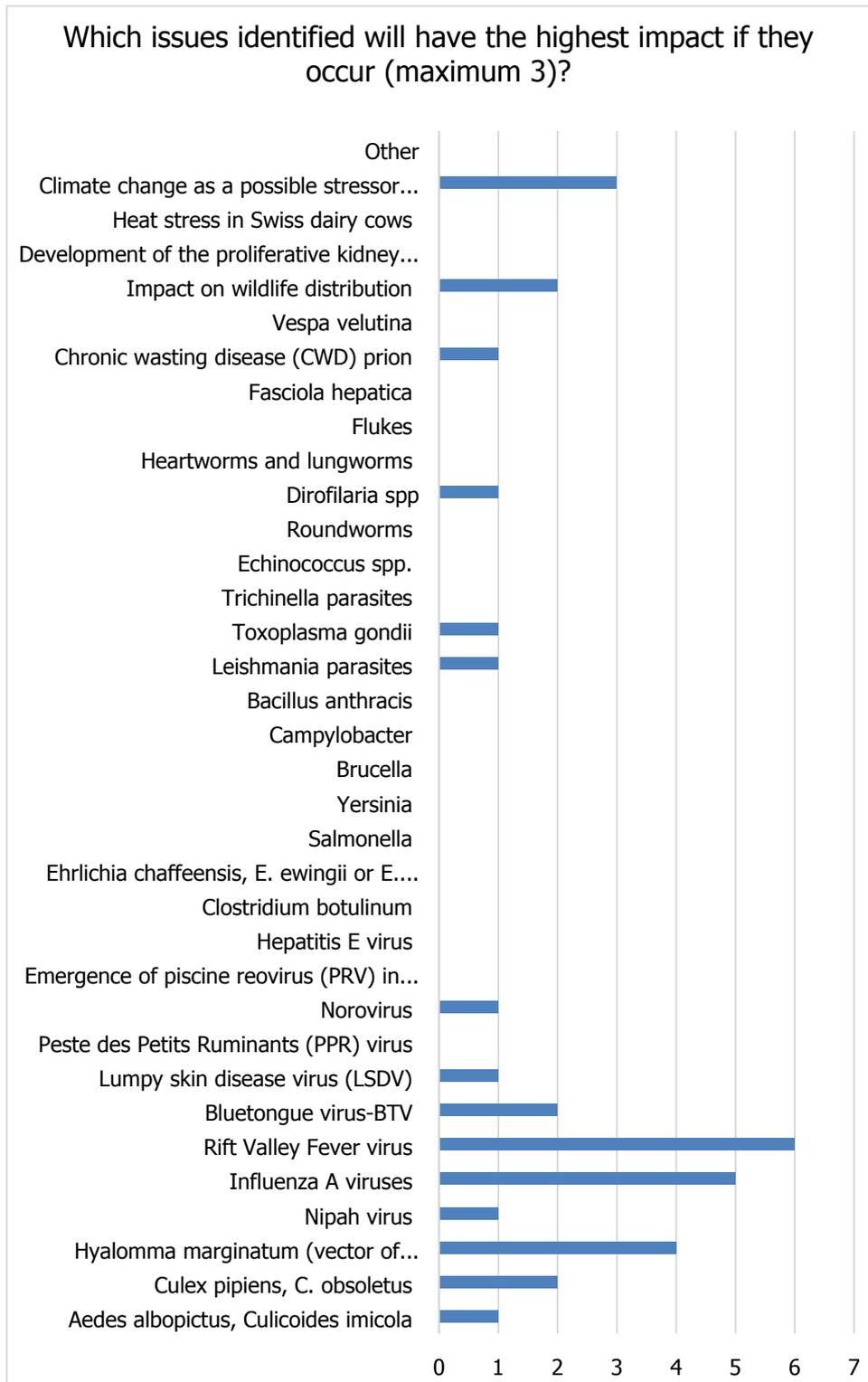


Figure 4: Results of the second online poll launched during the second breakout session (animal health).

A.2.3. Breakout session 3: biological hazards to human health

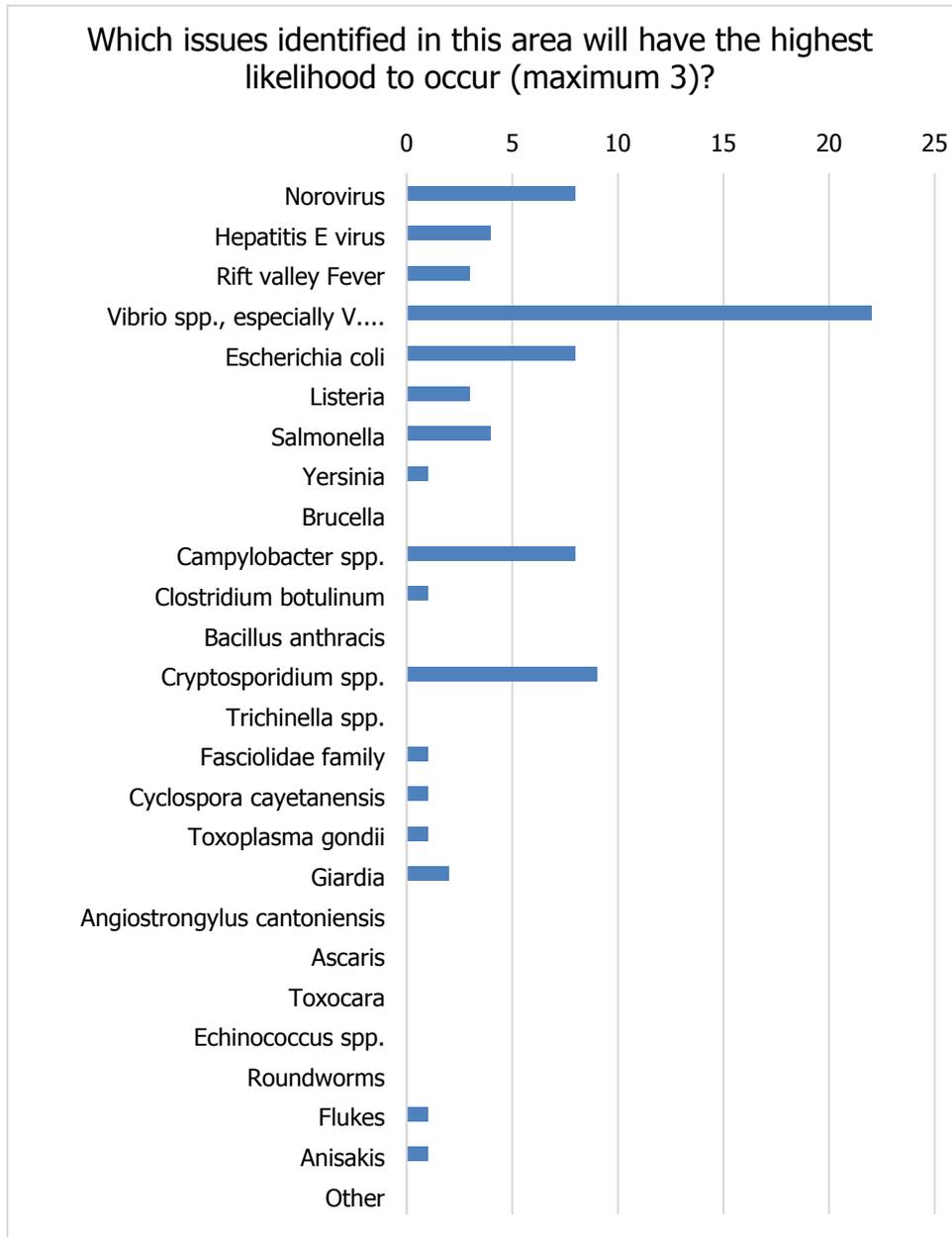


Figure 5: Results of the online poll launched during the third breakout session (biological hazards to human health).

A.2.4. Breakout session 4: methodologies

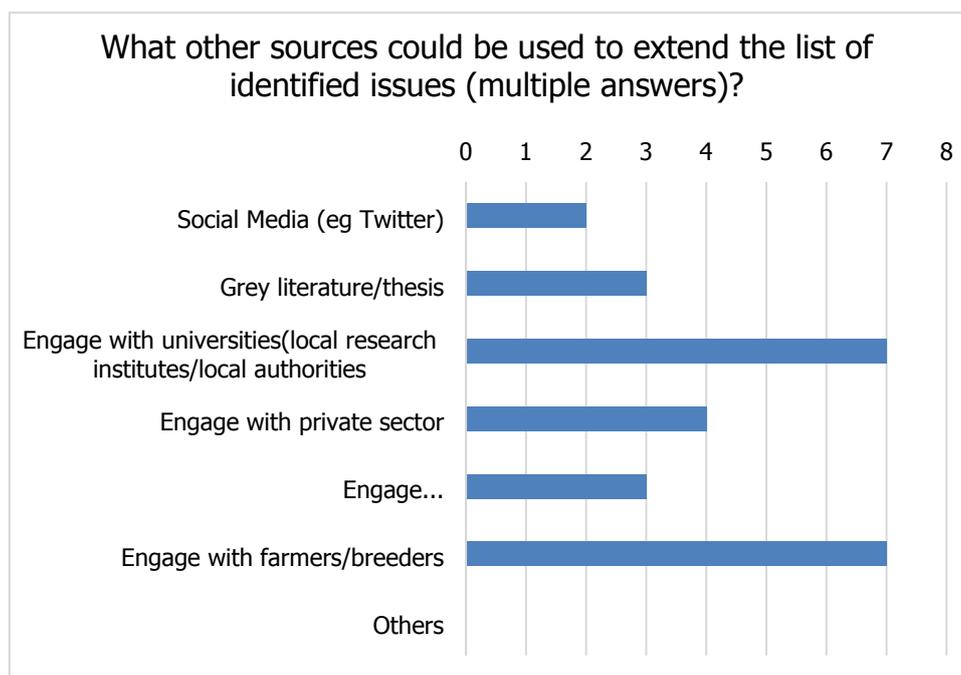


Figure 6: Results of the online poll launched during the fourth breakout session (methodologies).

Annex A – Info session agenda

**Annex B – General introduction: aim and structure of the event
(presentation from Angelo Maggiore)**

**Annex C – Project methodology: issue identification, characterization,
analysis (presentation from Giacomo De Sanctis and Federica Barrucci)**

Annex D – Project results (presentation from Aleksandra Lewandowska)

**Annex E – Climate Change and implications in the marine ecosystems,
with special attention to marine toxins as contaminants in seafood
(presentation from Jorge Diogène)**

**Annex F – Climate change and emerging risks for animal health and
welfare (presentation from Stefano Messori)**

**Annex G – Cascading risks from climate change for waterborne diseases
in Europe (presentation from Jan Semenza)**

**Annex H – Emerging issues detection: Use of Text mining and Foresight
tools (presentation from Jessika Giraldi)**

**Annex I – From Science to Policy. Climate change as a driver of emerging
risks for food & feed safety, plant, animal health and nutritional quality
(presentation from Maria Cristina Tirado)**

**Annex J – CLEFSA (Climate change and Emerging risks for Food Safety)
project web event: plenary session (video recording)**

**Annex K – CLEFSA: area-specific synergies and interactions with other
activities, part 1 - contaminants (video recording)**

**Annex L – CLEFSA: area-specific synergies and interactions with other
activities, part 2 - animal health (video recording)**

**Annex M – CLEFSA: area-specific synergies and interactions with other
activities, part 3 – human health (video recording)**

**Annex N – CLEFSA: area-specific synergies and interactions with other
activities, part 4 - methodologies (video recording)**

Annexes A–N are available at <https://www.efsa.europa.eu/en/events/event/info-session-climate-change-driver-emerging-risks-food-and-feed-safety> .