ΙΔΡΥΜΑ ΚΡΑΤΙΚΩΝ ΥΠΟΤΡΟΦΙΩΝ IKY

EUROPEAN UNION

Erasmus+
Enriching lives, opening minds.

BIOSHIELD

WORKSHOP

REPORT

WORKSHOP OBJECTIVES

The subsequent phase of data collection centres around 1 local-level workshop organization conducted with academicians, industry representatives, associated partners and students. Workshops include discussion and brainstorming sessions regarding biotechnology response to global climate change.

Overview

- To specify the effects of global climate change and increasing disasters threatening biological life on the Earth, especially agricultural product yield.
- To clarify in which areas industrial and agricultural biotechnology has developed solutions so far and what their efficiency on a global scale is
- To reveal the future research and industrial and agricultural solution/remediation areas that can be developed through biotechnology
- To contribute to developing innovation in Biotech higher education towards upskilling students by delivering a curriculum

PROGRAMME FLOW

01

Opening

Welcome and presenting workshop objectives

02

Session 1

Overview of Climate Change and Its Global Impact - Climate Change and Disasters' Effects on Agricultural Productivity

03

Session 2

Current Biotechnology Applications in Climate Change and Climate Change-Oriented Disaster Mitigation

04

Session 3

Promising Research Areas in Biotechnology and Role of Biotechnology in Disaster Resilience

05

Session 4

Discussion for Regional Variations in Climate Change Effects - Case Studies - Experiences

06

Evaluation

Participants' Opinions on Workshop Organization

07

Closing

Participants' Opinions on Workshop Organization

DATA COLLECTION METHOD

Data Collection Process includes document preparation for workshops, questionnaire preparation, stakeholder communication, workshop facilitation, quality evaluation survey design and implementation.

Participant Profiles

The eligible departments for biotechnology professionals: biology, chemistry, genetics, energy, biochemistry, molecular biology, ecology, geography, eco-remediation

The sector representatives can be from the following sectors by technique: genetic engineering, molecular breeding, molecular diagnostics and tissue culture.

Workshop Materials

We, all partners, contribute to developing workshop organization materials, presentations, and resources.

Know-how Exchange

Participants will exchange their know-how about climate change and resulting disasters, its effects on agriculture, current applications, and emerging research areas.

Workshop questions will guide participants to share their know-how, creative ideas and solution offers.

Workshop Outcomes

Case studies and recommendations will be generated during the workshops.

Data Analysis

Data analysis includes demographic information about participants, themes created from the answers to the questions, highlights from each session, and quality evaluation results.

Participant Profiles

Participant Profiles	Academician	Sector	Associated Partner	Student
Number / Percentage	8/34,8%	6/26,1%	3/13,0%	6/26,1%

Participant Age

Age Range	18-25	26-35	36-45	46+
Number / Percentage	4/17,4%	4/17,4%	10/43,5%	5/21,7%

Gender

Gender	Female	Male
Number / Percentage	13/56,5%	10/43,5%

Data Analysis

Session 1

Questions of Session 1	Themes	Sub-themes	Excerpts of participants
Q1 **What are the specific skills and knowledge gaps in current biotech education related to climate change mitigation?**	• Climate change and the effect on biodiversity and natural resources. • The effect on the food production supply chain. • Interconnection of industry and academics.	• The effect of natural disasters on the increased production cost of food and feed. • The importance of food waste on greenhouse gas emissions.	• The representing partners from the food industry highlighted that the increased periods of droughts entail losses in agricultural production and the subsequent necessity to procure raw materials elsewhere that leads to increased costs for the manufacturing of food products. • The production of nutritional and pharmaceutical veterinary products faces similar challenges, whereas deforestation phenomena were highlighted, in search of expanding cropland for agriculture. • The increased cost of raw materials for animal feed has also resulted in a domestic reduction of livestock. • Food industries have implemented strategies to reduce and/or valorize by-product streams either for the extraction of bioactive compounds or towards the production of animal feed. • All industrial partners noted that the current biotechnology tools are characterized as “one size does not fit all” as biotechnology strategies should be tailored to the needs of each industry. As an example, the seasonality of catering and hotel services should be considered. • Industrial partners underlined the lack of adequate motives towards the transition to sustainable production of food and feed.

			• European and national strategies should further promote the deployment of resilient manufacturing processes and engage in the development of central and organized facilities to valorize food waste.
Q2 **What knowledge and skills should the students acquire?**	• Introduction of holistic and multidisciplinary education.		• Interdisciplinary approach to educate students. • Education on successful biotechnology examples. • Implementation of workshops to bring together students and industrial partners.

Session 1 – HIGHLIGHTS

1. Climate change and the effect on raw materials, leading to increased cost of production (food and feed).
2. Intense reduction of arable land, combined with deforestation to expand cropland.
3. Lack of communication between industries and academics.
4. Agricultural producers and food industries lack motivation to transition to sustainable practices and the implementation of biotechnological solutions.
5. Biodiversity threats deriving from climate change and overexploitation.
6. Greenhouse gas emissions are intensified, amplified by food waste.
7. Current biotechnological tools are not yet fully developed for application in every sector (e.g. seasonal catering and hospitality centres)
8. Absence of central and organized facilities to collect and handle agricultural and food waste.
9. Agri-food by-products should be holistically valorized in a sustainable manner.

Data Analysis

Session 2

Questions of Session 2	Themes	Sub-themes	Excerpts of participants
Q1 **What are the key gaps in biotechnology research for climate change mitigation?**	• The shortage and the cost of natural resources and raw materials.		• Industrial partners raised and discussed the topic of alternative protein sources, either for food or feed production. Biotechnology can offer several solutions, for instance microbially produced protein through bioconversion processes (e.g. fungal protein). • Alternative protein sources could also be extracted from agro-industrial waste and by-products streams. • Likewise, insects as an alternative protein source were discussed and what the current impediments in large scale production and subsequent application in the development of food products or as components in animal feed products. • Participants also discussed on the biotechnological solutions to develop modified crops that tolerate sustained periods of drought.
Q2 **Which technologies for analysing climate data are currently most useful in**	• The use of artificial intelligence (AI) and modelling technologies.		• Academic partners elaborated on the use of AI systems in agriculture along with use of satellite imaging and the effect on soil microbiome as a cutting-edge technology. • Precision agriculture, AI applications and machine learning were also included, as tools to increase the resilience of agriculture. Smart

biotechnology and agriculture, and how can they be integrated into educational programs?			technologies can be applied to optimize agricultural production, yield and cultivation techniques.
Q3 **What are the most appropriate indicators for assessing the impact of biotechnological solutions on reducing greenhouse gas emissions in agriculture?**	• ESG (Environmental, Social and Governance) management and reporting • Life Cycle Analysis (LCA) and techno-economic analysis		• The importance of ESG reporting was raised and meticulously discussed in this section, since catering facilities and food industries have inaugurated the implementation of ESG reports to assess the environmental, social and governance impacts. • Reduction of plastic and food waste were mentioned as prominent steps. • Participants also discussed about LCA as a useful tool to evaluate GHG. During this session, students mentioned the importance to be trained on LCA and techno-economic analysis. The latter is of paramount importance to assess the economic feasibility of biotechnological solutions offered by academics to the industrial sector. This was combined with previous discussions on the importance of the costs associated with the transition to circular economy.

Session 2 – HIGHLIGHTS

1. Extraction of bioactive compounds from different production side streams (e.g. Mills of Crete).
2. Biogas production integrated with livestock breeding.
3. Alternative protein sources for food and feed (microbial-based and insects).
4. Biocompatible food packaging material to substitute conventional plastics.
5. Precision agriculture using AI tools to increase agricultural crop yield.
6. Development of crop varieties to tolerate drought conditions.
7. ESG reporting and LCA have been identified as appropriate indicators to assess and improve the sustainability targets of a company or a process.

Data Analysis

Session 3

Questions of Session 3	Themes	Sub-themes	Excerpts of participants
Q1 **What are the key industry demands for biotech professionals in this field?**	• Collaboration of industry, academia and research centers • Connection of primary and secondary sectors		• Discussion initiated with the urgent need of fostering collaborations between universities and industries. • Industrial partners noted that university courses should include and combine primary knowledge on food science and biotechnology along with education on cutting-edge technologies. The interconnection of biotechnology, society, environment and economy should be also considered, in the context of delivering a more universal approach to education. As a result, students will be expected to be better prepared for their future professional careers.
Q2 **How can we integrate interdisciplinary approaches, such as systems thinking and ecological**			• During this session, all participants discussed on the provision of engaging students with industrial partners, particularly through the organization of workshops and the presentation and training of successful biotech examples. • Moreover, the students should be also trained and learn about the socio-economic impact of biotechnological solutions. • Specifically, for the students in the field of food science and technology, it is crucial to educate them about the strategies regarding climate change

economics, into biotech education for climate adaptation and mitigation?			mitigation, including the European Green Deal, the Farm-to-Fork strategy and Circular Economy. ● Academics can encourage and guide students to participate in competitions in collaboration with industries (such as the European food innovation competition "Ecotrophelia") to enhance their critical thinking, foster an interdisciplinary approach in solving problems and inspire them to create new ideas.
Q3 **Which emerging biotech fields (e.g., synthetic biology, CRISPR-based crop editing, microbial biofertilizers) hold the most promise for climate adaptation and resilience, and how can these be integrated into the curriculum?**			● In combination with previous discussions, participants (specifically industrial partners) raised the need to develop agricultural crops that will tolerate prolonged periods of drought, considering climate change. ● Alongside, the need to upgrade biogas production to biomethane was raised. ● Moreover, the partners discussed projects that evaluate the streams deriving from biogas production as biofertilizers. In combination with satellite imaging and AI, the project could evaluate field sustainability (and the effect on organic nitrogen, humidity levels and the microbiome) and subsequently the crop yield. ● The potential to leverage biotechnology in order to exploit food waste and/or organic waste in general towards the production of biostimulants was also addressed, in the context of sustainable food systems.
Q4 **What infrastructural**	● Implementation of digital	● AI, modelling and	● In this question, the participants' answers were focused more on precision agriculture and the use of AI. It was noted, that so far, research has developed tools to allow for tailored cultivation techniques on the field (e.g. crop spraying

needs (lab equipment, digital resources, field stations) must be addressed to support hands-on learning in biotech relevant to climate challenges?	resources and lab equipment.	precision agriculture.	that adjusts according to the lack of specific nutrients) these are not fully promoted by government initiatives. Likewise, the use of AI will benefit from data validation and digitalisation, and this can be achieved by providing more input, that can be obtained from field experiments. Data input are strongly associated with infrastructure as more field stations will be required to generate better fitting models for cultivation techniques. ● At a national level, these challenges could be combined with educating students in two directions: using modelling tools and data analysis, agricultural techniques, and the implementation of precision agriculture.
Q5 **What specific skills related to digital tools (e.g., bioinformatics, climate modeling) should be included in the biotechnology curriculum to prepare students for climate-related challenges?**	● Education on techno-economic analysis ● Education on ESG strategies		● During the discussion of this session, participants stated that it could be possible to educate students on the implementation of ESG reports, that are correlated and derive from the actualization of legislation initiatives to increase sustainability. ● Also, training on techno-economic evaluation could also provide an additional tool for students. In fact, the industrial partners raised the importance of economic analysis as a tool to project and validate the economic feasibility of research results to actual implementation.

Session 3 – HIGHLIGHTS

1. Imperative need to foster interdisciplinary approaches (producers, food industry. Legislative authorities and academia)
2. Fundamental necessity to support producers and provide motivation to switch to sustainable practices.
3. Production of value-added products apart from biofuels, also towards the concept of One Health.
4. Communication of research findings to industries
5. Engagement and training of consumers towards the selection of sustainable food products.

Data Analysis

Session 4

Questions of Session 4	Themes	Sub-themes	Excerpts of participants
Q1 **How will the curriculum align with EU policies like the European Green Deal and Sustainable Development Goals (SDGs)?**			• How to increase the average yield per hectare in agriculture at a national level to compete with other markets. • At a national level, we should implement and promote practices that combine bio-economy and biotechnology. • The necessity of alternative protein sources emerged in the context of identifying potential solutions at a local level, focused also on small scale producers. • The challenges of agro-industrial waste valorization were discussed, whereby participants underlined the importance to generate value added products via biorefining processes. The differences between the implemented strategies at national and local levels were introduced. In the end, the participants concluded that the integration of biorefineries at a local level will be more beneficial and feasible in several aspects (e.g. jobs creation that could enhance local economies, reduced cost of logistics etc.) compared to centralized solutions for waste and by-product management.

Q2 **How can universities and industry work together to develop interdisciplinary programs that combine biotechnology, climate science, and policy?**	● Focus on consumers' education.		● The importance to educate consumers on handling food waste was highlighted. Increasing consumers' awareness will enable and facilitate the transitions towards circular economy and the industrial implementation of processes following the pillars of bio-economy. ● Consumers' education should be based on the economic impact of climate change on the resilience of food systems and agricultural production to enable the adoption of circular economy concept.
Q3 **How can we improve the transfer of research findings in biotechnology to industrial practice for more effective climate change mitigation? What are your suggestions, best practices?**	● Provision of round tables and workshops to foster collaboration.		● The participants discussed that currently there is a gap on the transfer of research findings to actual industrial implementation. The challenges of scaling-up biotechnology processes to mitigate climate change was also raised. ● In order to actualize the connection between academia and industry, it is important to perform round tables and/or workshops to allow for the fruitful opinion exchange and evaluate potential solutions. ● Development of advisory boards which will include the representatives from industry ● As mentioned before, academics can encourage and guide students to participate in competitions, such as the European food innovation competition "Ecotrophelia", in order to incorporate and present novel research ideas.

Q4 **How can we ensure the scalability and economic feasibility of biotechnological solutions for small-scale farmers? How can we scale-up biotechnological research/results from micro to macro level? How can we better align biotechnology research with regional and global policy frameworks for climate change?**			● The scalability of biotechnological solutions to valorize agro-industrial waste and by-products and subsequently mitigate climate change was highlighted several times during the workshop. A potential tool as previously mentioned, could be the techno-economic evaluation of bioprocesses to assess the economic feasibility and also identify weak points that could be optimized. ● Small-scale farmers could benefit from governmental support, aiming to facilitate the transition towards precision agriculture and the adoption of more sustainable practices. The provided support should include education for farmers (considering that the majority of them do not familiarize with novel cultivation techniques) but also economic support as an initiative to integrate state-of-the-art technology that could enhance crop yield.
Q5 **What role does public perception**			● In this session, the consortium thoroughly discussed the importance of public education on the current problems deriving from climate change and how

and acceptance of biotechnology play in its implementation for climate change mitigation? What are the potential ethical concerns related to the use of advanced biotechnological tools in addressing climate challenges, and how can they be addressed?			biotechnology can provide solutions to enhance the resilience of primary and secondary sector. ● In this regard, academics merit a significant role to communicate research findings to the general public to increase the engagement to sustainable solutions.

Data Analysis

Session 4 – HIGHLIGHTS

1. Specific tools for students could be directed towards alternative and more interactive teaching methods and/or internships.
2. Implementation of specific case studies and successfully applied paradigms along with workshops to facilitate the connection with the industry.
3. Industry and academia should collaborate for the development of syllabus to align with industry demands but also regulatory mandates.
4. The significance of agro-industrial waste and by-products valorisation through the development of integrated biorefining processes that will be primarily applied at regional level.
5. The importance of alternative protein sources to mitigate protein shortages in the food/feed industry.
6. Establishing an interdisciplinary approach that will connect society, economy and environment towards the transition to bioeconomy.

Quality Evaluation

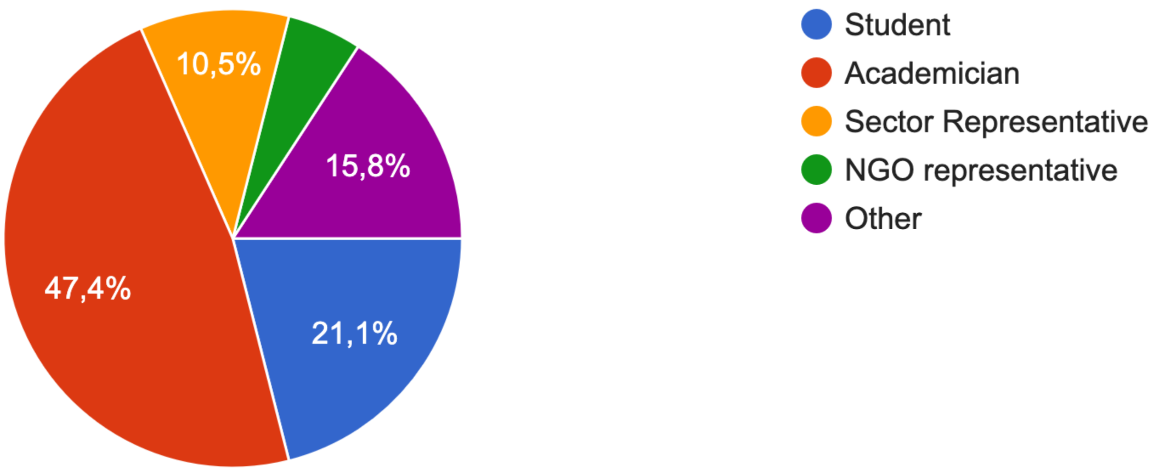
Questions	Student	Academician	Sector representative	NGO representative	Other
Q1	21,1%	47,4%	10,5%	-	15,8%
	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Q2				15,8%	84,2%
Q3			5,3%	15,8%	78,9%
Q4				36,8%	63,2%
Q5			5,3%	36,8%	57,9%
Q6				21,1%	78,9%
Q7				5,3%	94,7%

COMMENTS ON THE QUALITY EVALUATION

The majority of the participants (19/23) undertook the online quality evaluation form after the completion of the workshop. As seen in Figure 1, the majority of the participants was from the Academic sector (47,4%), followed by students (21,1%), whereas 15,8% and 10,5% were other participants and sector representatives. These correspond to participants from the food and feed industry, research centres and representatives from scientific committees and hospitality centers.

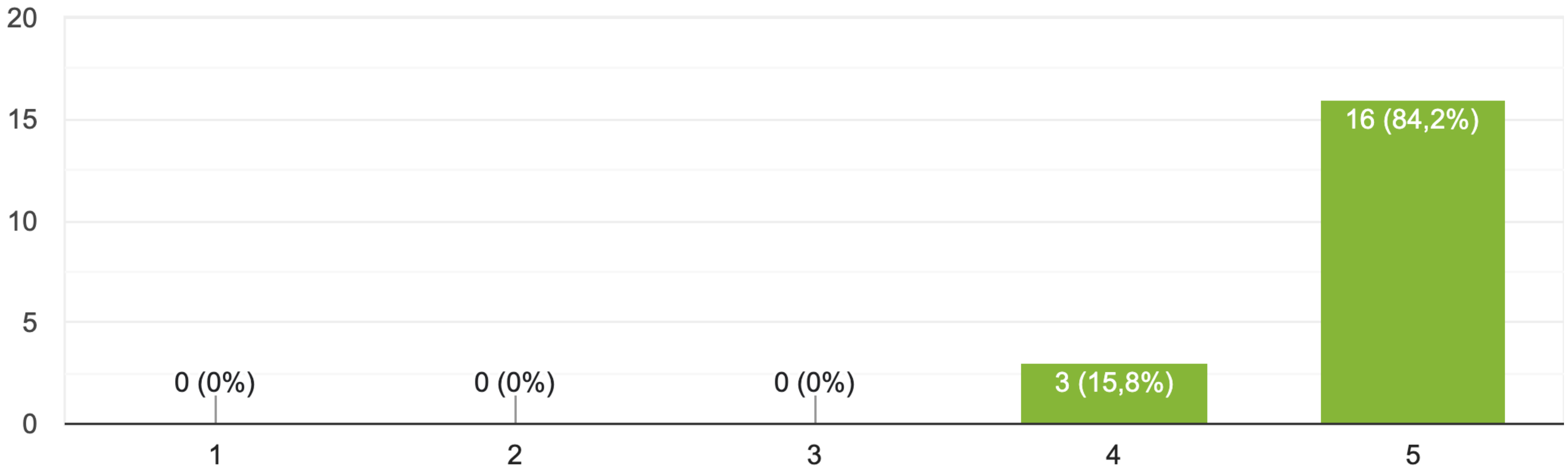
1- Your occupation

19 απαντήσεις



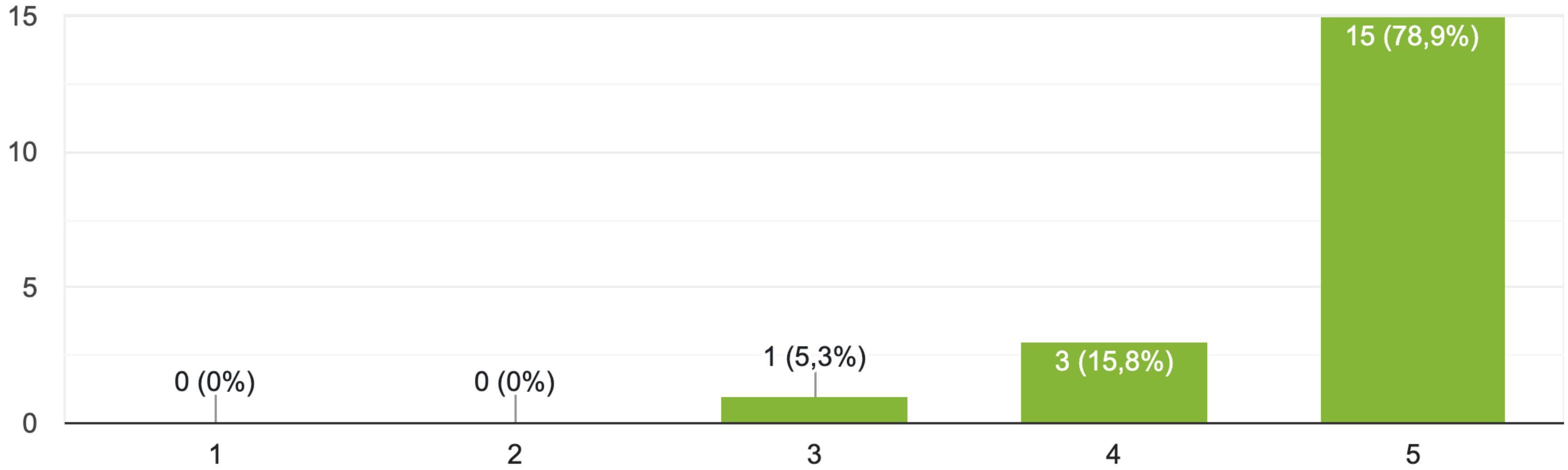
2- The workshop was well-organised in general.

19 απαντήσεις



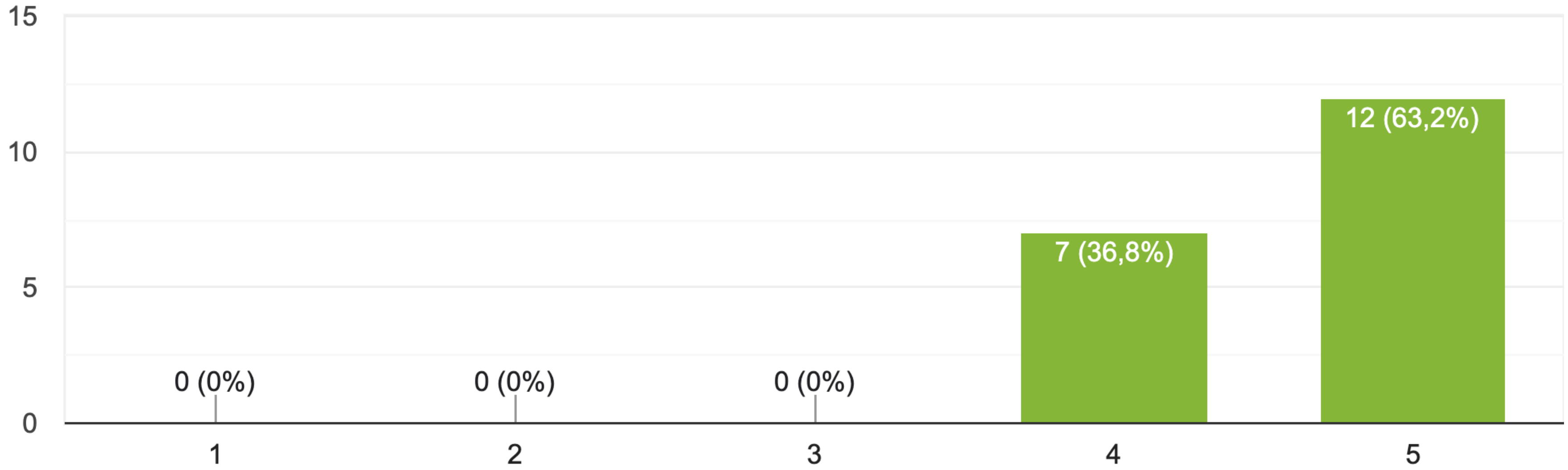
3- The discussions and shared information regarding climate change effects on agricultural product yield were valuable.

19 απαντήσεις



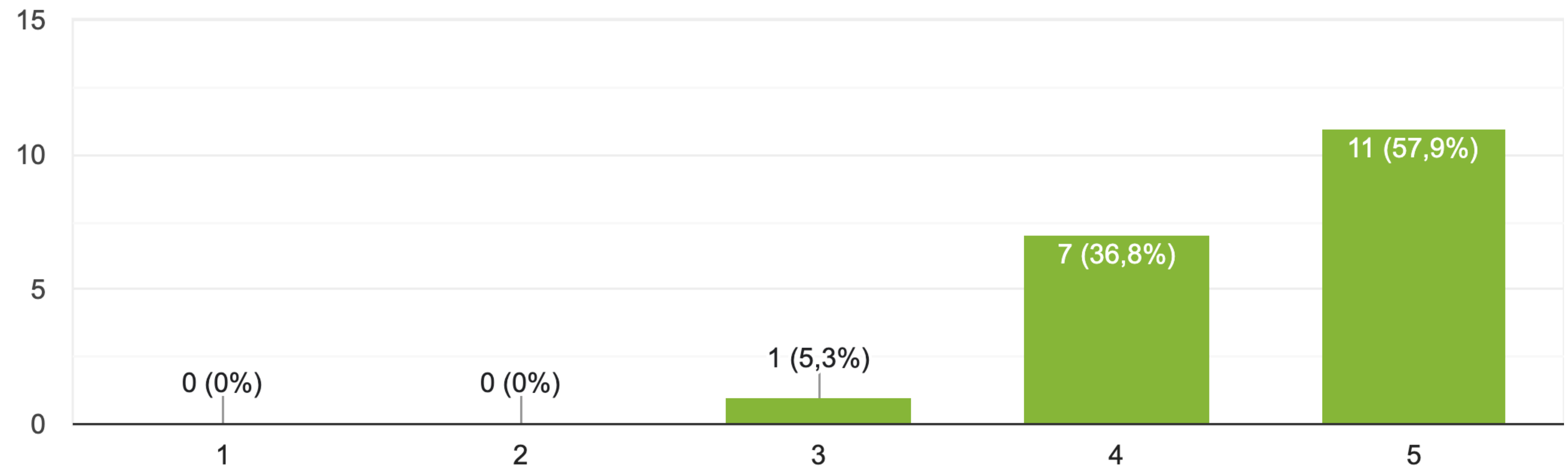
4- The discussions and shared information in the workshops regarding the assessment of industrial and agricultural biotechnology solutions in climate change and disaster mitigation were valuable.

19 απαντήσεις



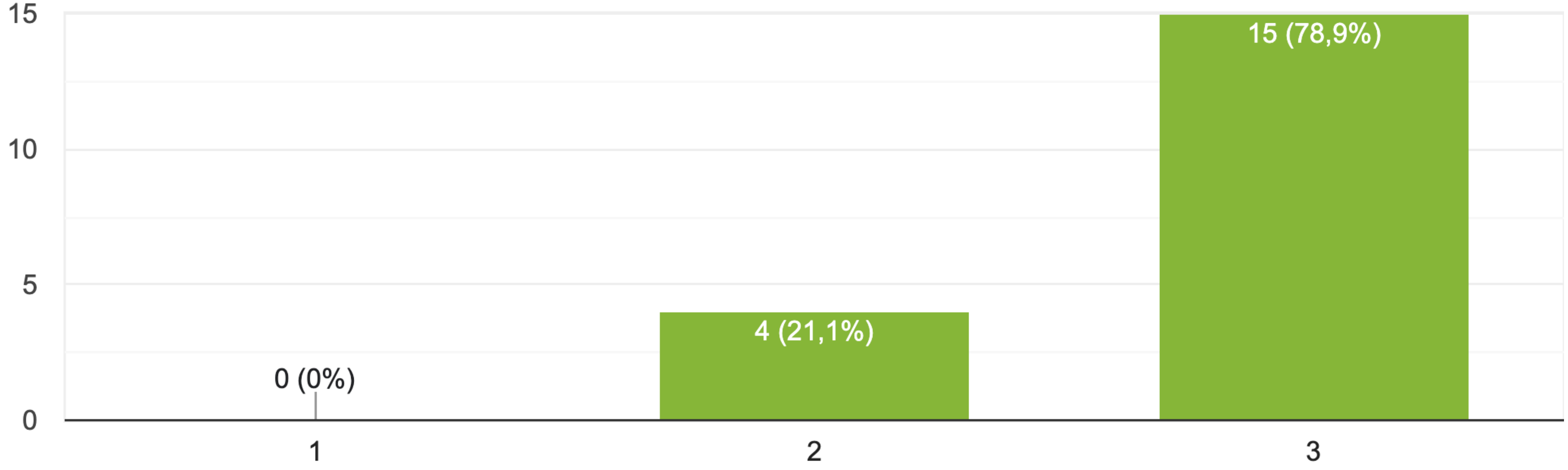
5- The discussions and shared information regarding future research areas and industrial solutions in biotechnology for climate change challenges were valuable.

19 απαντήσεις



6- The question-answer sessions were sufficiently useful and open to idea development.

19 απαντήσεις



7- Each participant could exchange knowledge and ideas during the discussions.

19 απαντήσεις