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The FarmForward Project: Sustainable and Transformative Strategies for Climate-Resilient Agriculture in VET

WP2

Needs Analysis National Report

Bulgaria

Project Partners

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The FarmForward Project: Sustainable and Transformative Strategies for Climate-Resilient Farming in VET

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Section 1 SURVEY ANALYSIS OF LEARNERS IN BULGARIA

The study involved 42 randomly selected individuals. The interviewees are interested in the sustainable development of agriculture in a changing climate environment. The majority of them have participated in training related to the impact of climate change on agriculture and have plans to work in this sector of the economy.

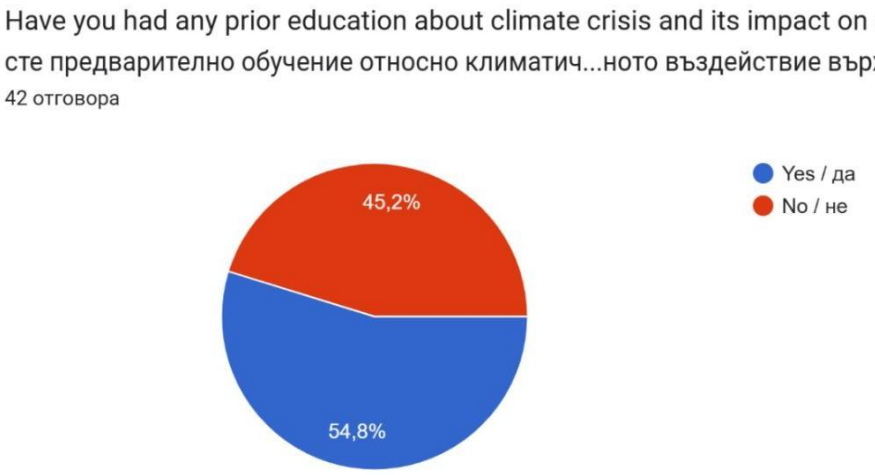

Figure 1 Background of learners

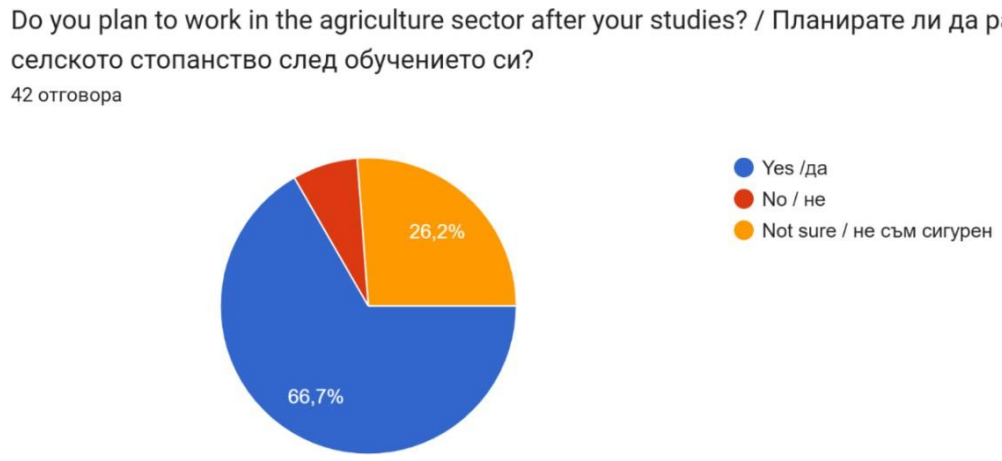

Figure 2 Background of learners

Two criteria were used to determine the profile of the interviewees – current level of education and professional interest. According to the level of education, the largest share is held by those who study at a university, representing half of the respondents. These individuals undergo complex training and have diverse interests. The next largest group is those who study at vocational centers, with their share amounting to nearly 30%. Their interests are strictly specific and

their training is aimed at solving specific problems in their professional field. The smallest group is the group of students, about 20%, representing the youngest part of society. Their opinion is important for how they see these problems even before they have encountered them professionally.

Figure 3 Level and Field of Study

Depending on the professional field in which the respondents work or plan to work, the distribution of the respondents represents the structure of the agricultural sector in the Republic of Bulgaria. The largest share is that of those related to crop production, nearly 55%, which is the priority production at the national level. The second largest group is agribusiness representatives with nearly a quarter of those surveyed. These are individuals working in close relationships with agricultural producers and are suppliers of raw materials, equipment, and marketing intermediaries. Next is the group of representatives of mixed agriculture (crop and livestock farming) with about 12%. The smallest group is those specializing in livestock production, which are not preferred nationally.

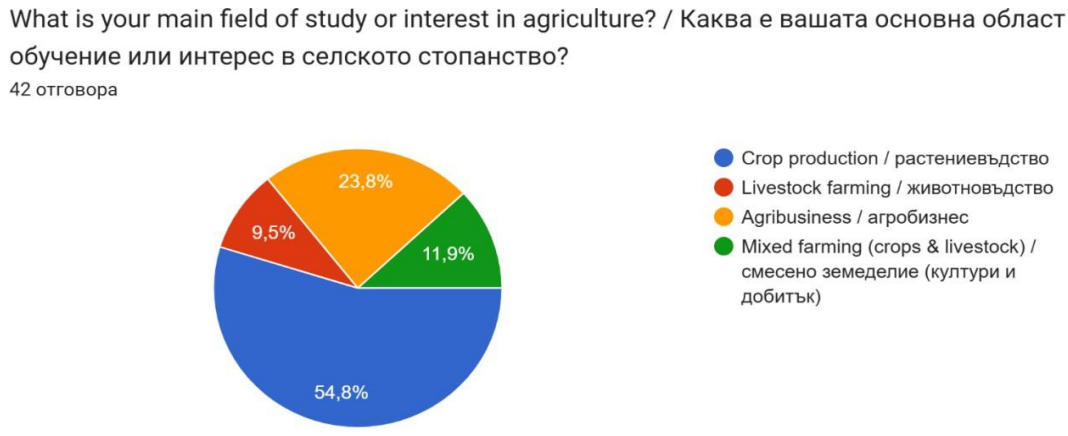

Figure 4 Career Aspirations

1. Current Training on Climate Topics

To analyze the current state of education on climate change-related topics, two criteria were used – the level of knowledge of climate threats and the quality of education on these topics. A five-point scale was used to assess them, with a higher score indicating a higher level of agreement on the part of the respondent. When asked about the level of knowledge of the problems arising from climate change, nearly 90% answered affirmatively, which is evident from the high scores they gave. This gives us reason to determine that the surveyed group has a competent opinion on the issues studied.

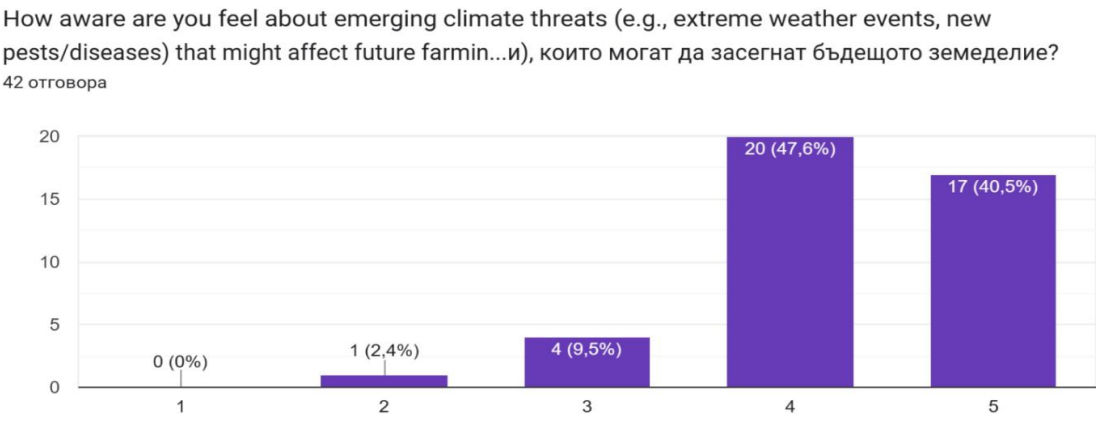

Figure 5 Awareness of Climate Threats

Although almost all respondents stated that they are aware of the problems arising from climate change, it turns out that this understanding is not only a result of the training provided, as 1/3 of respondents rated with a neutral or lower degree the extent to which the training provided them with an understanding of the impact of climate crises on agriculture. The questions regarding the formation of practical skills and the focus of training on sustainable and adaptive agricultural methods show that nearly half of the trainees define their attendance as insufficient. Even more categorical are the results regarding the extent to which climate change training presents real-world examples of coping with and adapting to climate crises. Here, low levels of agreement prevail and the majority of trainees are not familiar with specific examples of practice that have shown success.

My training provides me with a strong understanding of climate crisis impacts on agriculture. / Моето обучение ми осигурява ясно разбиране...иматичните кризи върху селското стопанство.
42 отговора

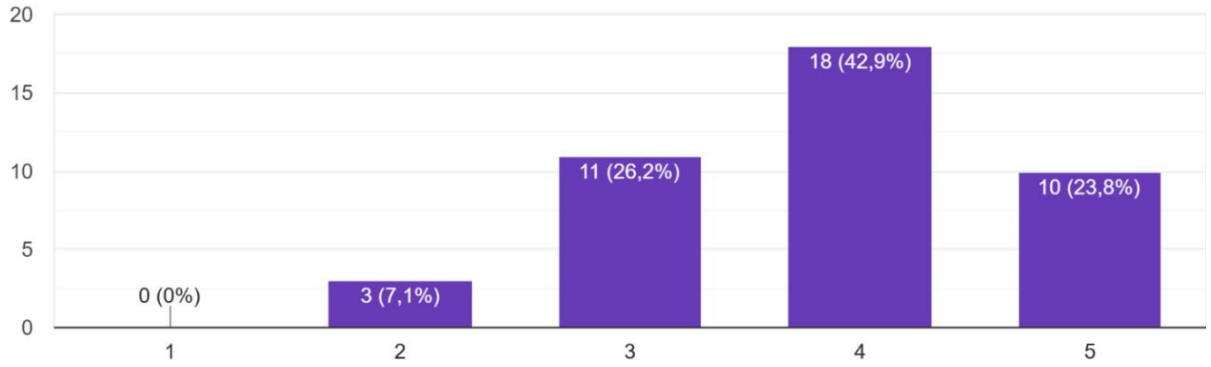

Figure 6 Training Quality

My training includes practical skills to help address climate challenges in farming. / Моето обучение включва практически умения за спра...матичните предизвикателства в земеделието.
42 отговора

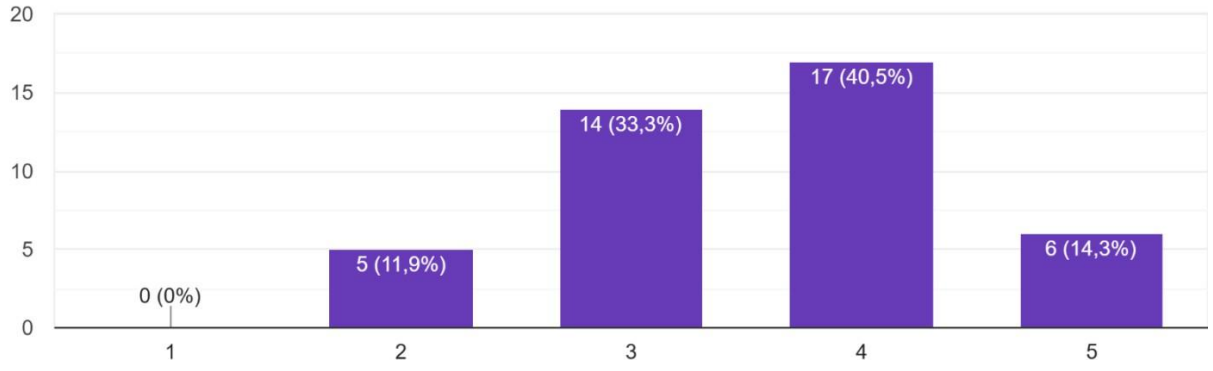

Figure 7 Training Quality

There is sufficient focus on sustainable and adaptive farming methods in my coursework. / Има достатъчен фокус върху методите на устойчиво...меделие в обучителния курс в който участвам.
42 отговора

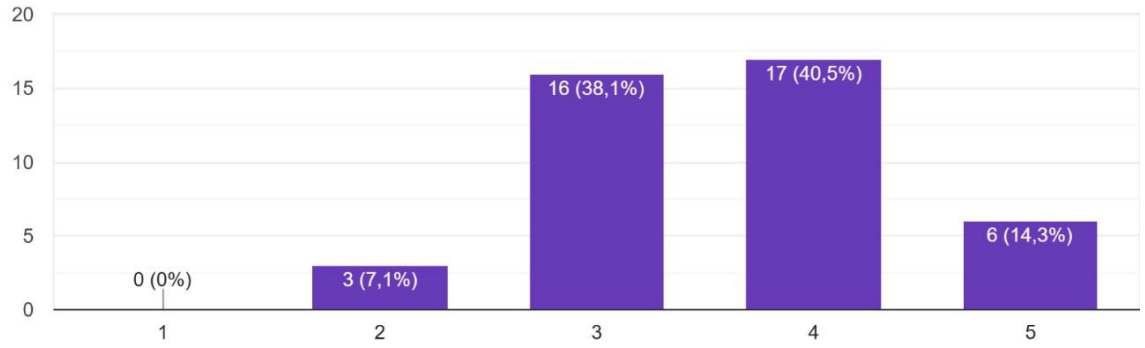

Figure 8 Training Quality

I believe that agricultural education includes enough real-world examples of adaptation to climate crisis. / Вярвам, че земеделското образование...примери за адаптиране към климатичните кризи.
42 отговора

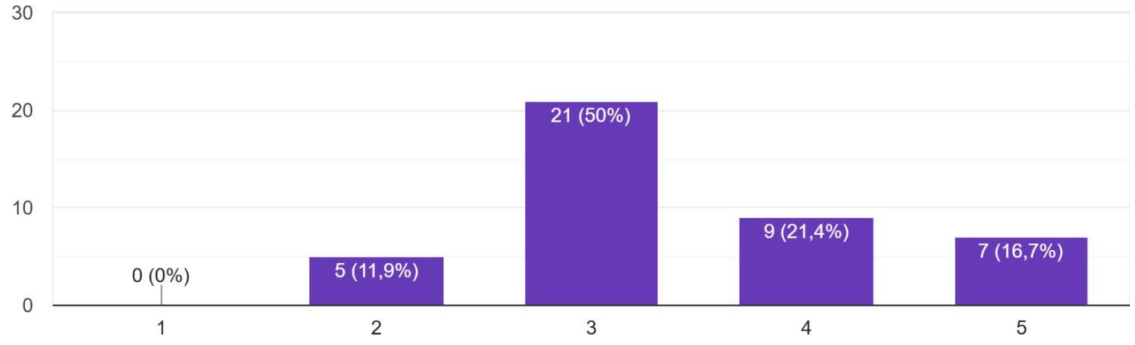

Figure 9 Training Quality

All these findings also determine the relatively low level of confidence among learners that they are well prepared to deal with climate challenges. Apparently, the training they are participating in does not give them the necessary confidence to successfully solve climate crises, and out of 37 people who say they are aware of climate threats, only 24 believe they have the preparation to deal with the challenges arising from climate change.

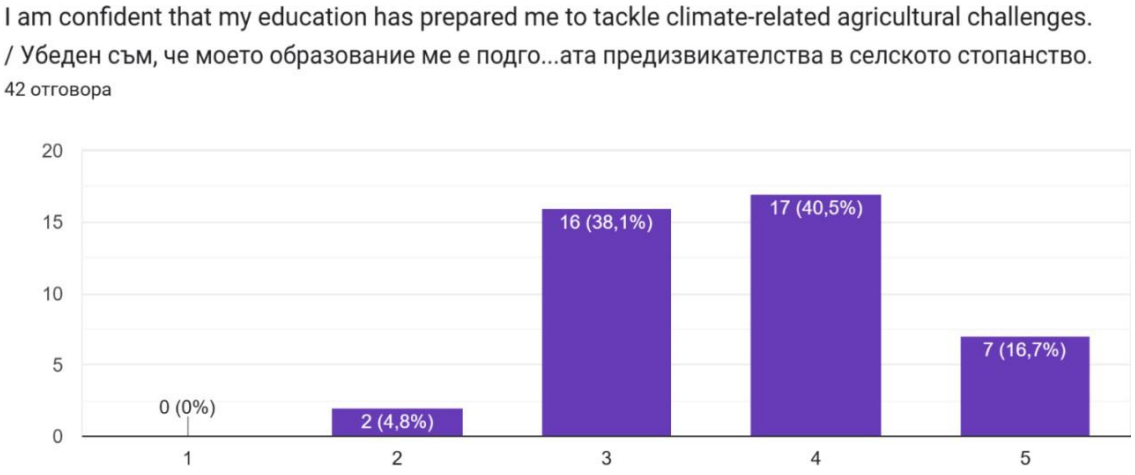

Figure 10 Preparedness

2. Interest and Engagement

The findings may explain the high level of interest in studying climate-resilient practices in agriculture, as well as the desire to participate in future educational courses on topics related to the climate resilience of agriculture.

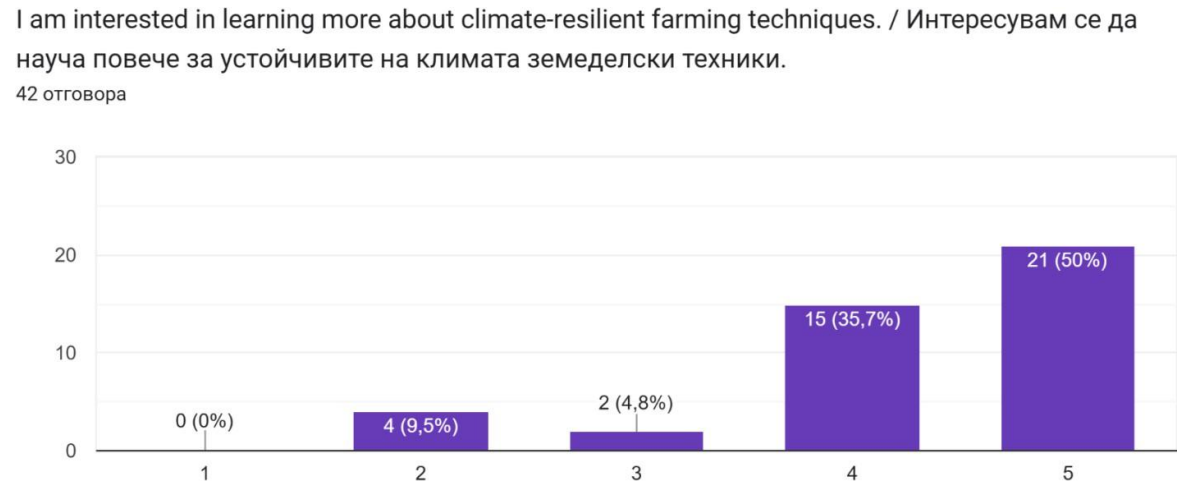

Figure 11 Motivation to Learn

Figure 12 Participation Interest

In the context of their training, trainees also determine the preparedness of their teachers on topics related to climate crises in agriculture. As the respondents are divided in half in their opinion. It is obvious that it is necessary to improve the preparation of the teachers themselves so that they can convincingly teach in this area.

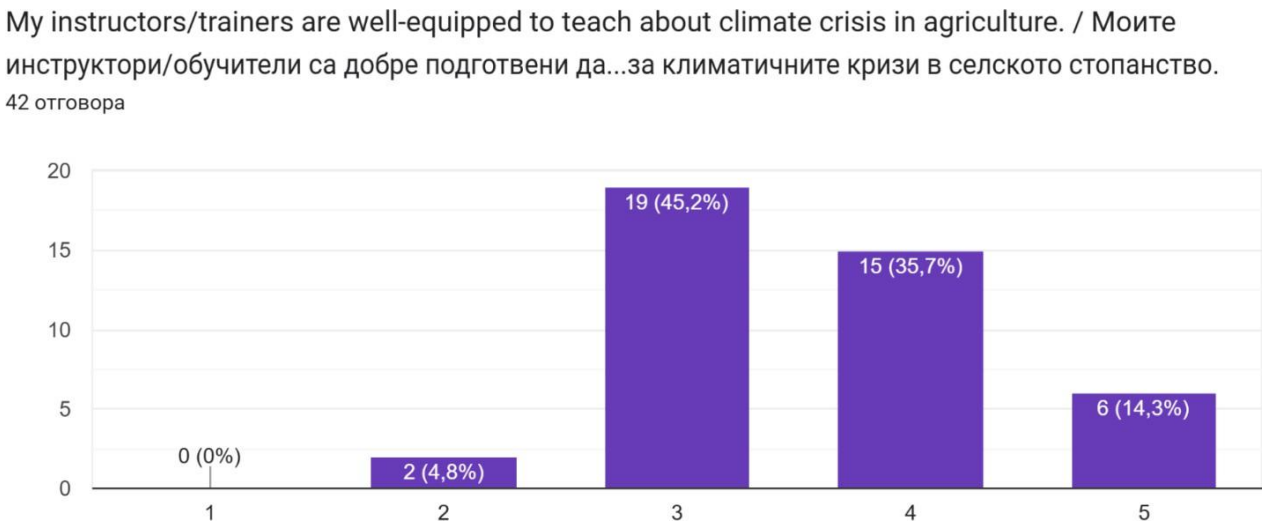

Figure 13 Instructor Preparedness

3. Learning Preferences and Needs

To assess preferences for future training and future needs, respondents answer questions related to the areas in which it is important to provide training and what forms of training are appropriate.

In the previous questions, answers were given about insufficient practical training on the topics of climate crises and the presentation of real examples from businesses for dealing with their negative impacts. Therefore, the main format that is preferred for training is conducting practical seminars or visits to real farms in which the effect of the applied good practices can be demonstrated. Online resources and the use of digital tools also report a high approval rate, with over 50% of respondents responding positively. There is the least interest in classroom training, which is natural given the subject matter studied.

When identifying the most important aspects that need to be given greater attention when it comes to developing climate-resilient agriculture with fewer negative impacts on the environment, respondents clearly prioritize maintaining soil health and implementing regenerative practices. And the area of Integration of renewable energy in agriculture is rated the lowest. Only two respondents have indicated this area as a priority. The answers given can be explained by the existing problems related to soil protection in Bulgaria and their use in a long-term perspective.

The need for training on specific topics has been assessed through possible options. The strongest interest is in topics related to Climate Adaptation Strategies (e.g. drought-resistant crops) followed by Precision Agriculture and Smart Technologies and Regenerative farming or nature-based solutions. All three topics are desired by more than half of the respondents to receive additional training. In the topic of Renewable Energy Integration, interest is significantly lower, as the result can be explained by the findings already made about the weaker interest in renewable energy in general in Bulgaria. Nearly half of respondents said that community-led policy frameworks and actions are an important part of building climate- resilient agriculture and would like to receive training on this topic.

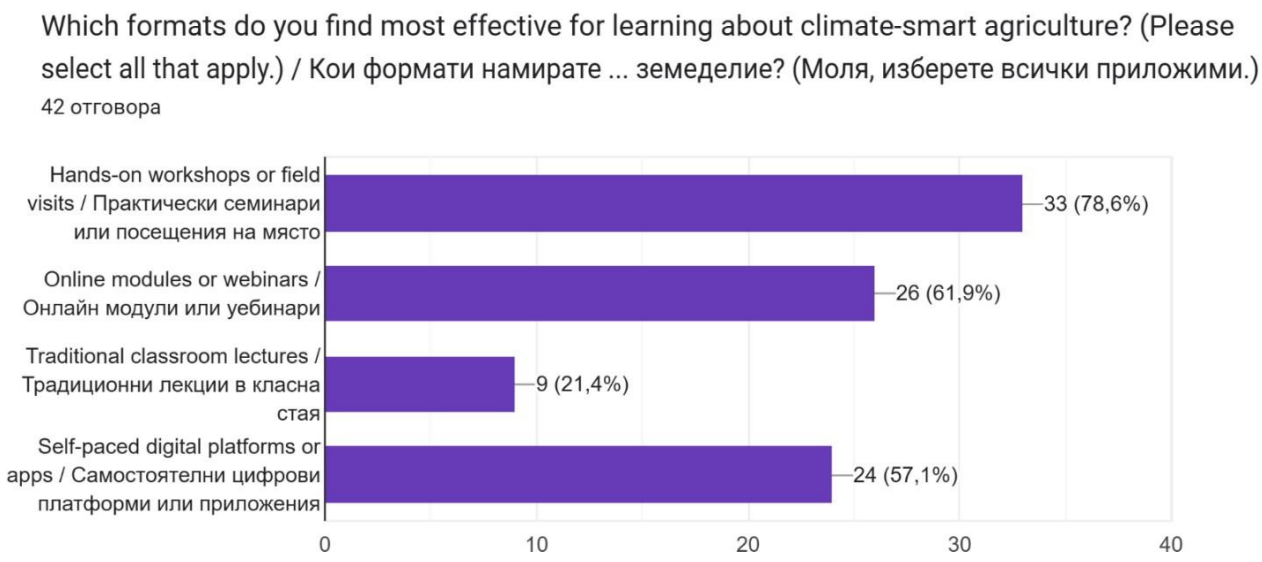

Figure 14 Preferred Formats

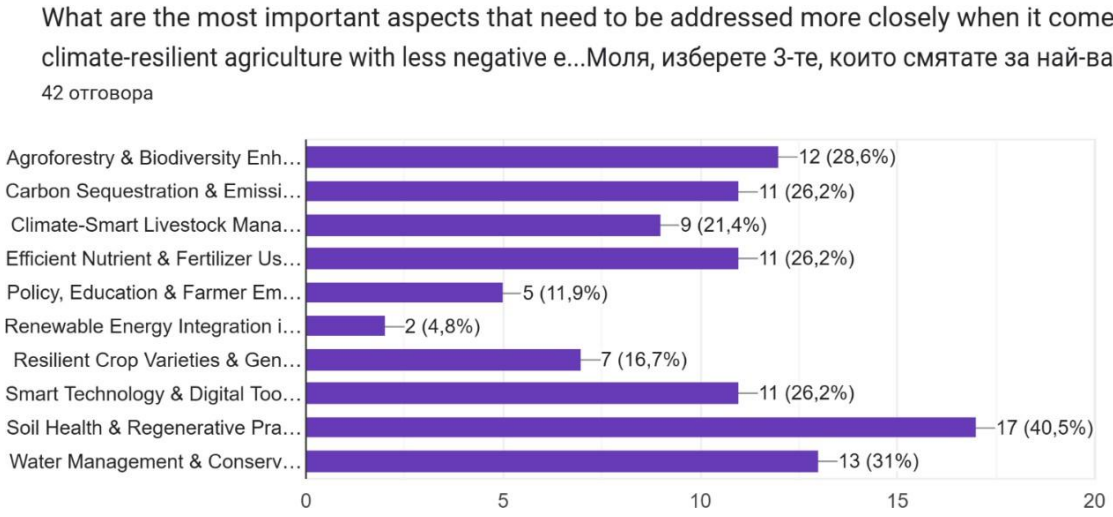

Figure 15 Important areas of education in climate-resilience agriculture

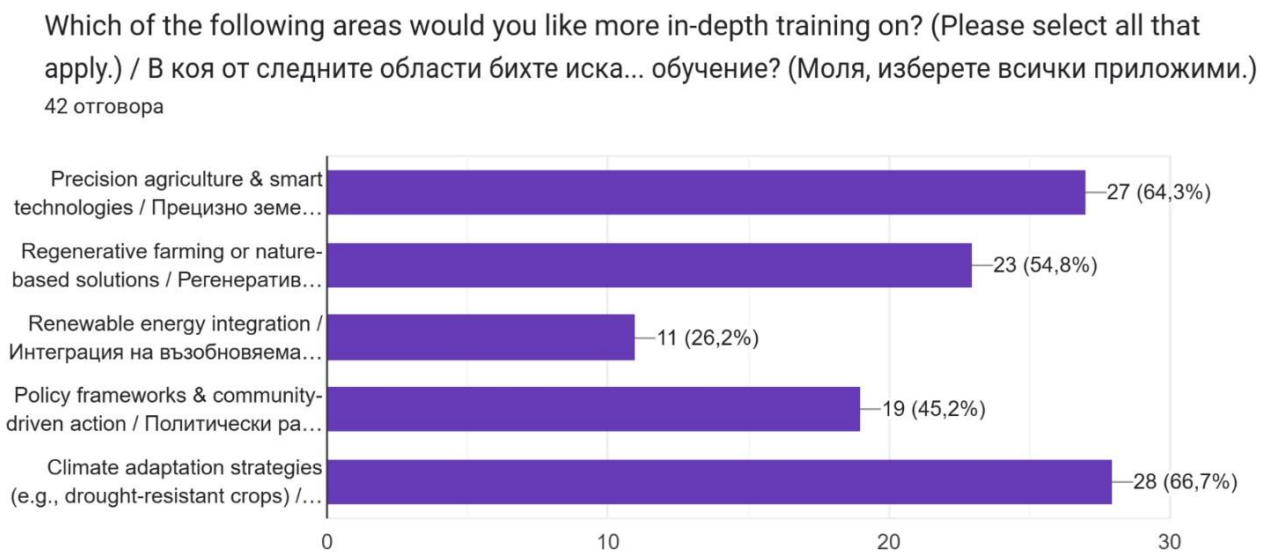

Figure 16 Training Needs

4. Knowledge Gaps and Challenges

To better prepare for climate-resilient agriculture learners stated that many training programs are missing key practical, systems-based, and future-focused skills and knowledge. What's lacking in Bulgaria, and why it matters:

1. Systems Thinking and Climate Risk Analysis. Low ability to connect climate trends (e.g. rainfall variability, heatwaves) to agricultural decision-making. Missing understanding of how climate risks intersect with markets, soil health, water, and livelihoods.

It matters because a systems-thinking approach enables farmers and extension workers to shift from reactive responses—such as addressing crop failures after they occur—to proactive strategies, including diversification of crops and investment in water storage infrastructure. This transition is essential for building long-term resilience.

2. Data Interpretation and Use of Digital Tools. Missing **s**kills to interpret weather forecasts, seasonal outlooks, or satellite data, use of mobile apps, GIS tools, or digital dashboards for farm-level decision-making.

Although digital climate services are increasingly available, their effective utilization remains constrained by low digital literacy and the absence of locally contextualized training. Building capacity in data interpretation is fundamental to timely and informed decision-making at the farm level.

3. Climate-Smart Agribusiness and Finance. Missing knowledge of climate risk financing, insurance, and carbon credit markets. Missing skills in building business

plans that integrate resilience (e.g. investing in water-saving tech or local seed systems).

Financial literacy and risk management tools are prerequisites for scalable and sustainable adaptation. Without them, adoption of climate-resilient innovations often remains economically unfeasible.

4. Agroecology and Regenerative Practices. Lack of hands-on experience with intercropping, cover cropping, soil regeneration, and biodiversity management. Low understanding how these practices enhance resilience (e.g. through pest control, moisture retention, carbon storage).
Agroecological and regenerative practices offer low-cost, high-impact solutions for climate adaptation. However, their effectiveness is undermined when taught in abstract terms without practical demonstrations.

5. Climate and Environmental Policy Awareness. Low understanding how national climate policies, subsidies, or regulations affect farmers. Missing how to advocate for supportive policy change or navigate compliance (e.g. deforestation laws, carbon farming schemes).

Farmers are influenced by systems beyond the farm. Climate resilience depends not only on farm-level practices but also on navigating broader institutional and policy environments. Training programs must therefore equip participants to understand and influence these systemic factors.

Summary: Top Missing Skills & Their Impact

Missing Skill/Knowledge	Impact if Addressed
Systems thinking & climate risk analysis	Smarter, long-term decision-making
Digital/data literacy	More precise, timely, and adaptive farm practices
Climate finance & agribusiness	Better investment and access to markets/insurance
Agroecological methods	Healthier soils, increased biodiversity, lower risk
Policy literacy	Empowerment and alignment with broader climate goals

5. Adoption Obstacles

Based on the research, the biggest obstacles to learning or adopting climate-smart farming techniques tend to fall into six core categories. Here's the most common barriers in Bulgaria and why they persist:

Lack of Local Relevance or Evidence. Climate-smart

techniques promoted in one region may not work elsewhere without adaptation. If farmers don't see clear benefits—especially in the short term—they are unlikely to change practices. Pilot fatigue: Farmers are often "tested on" by short-term projects that disappear without scale-up.

Farmers adopt what they trust — often based on peer experience, not outside claims.

1. Limited Access to Resources. Farmers often can't access drought-tolerant seeds, organic fertilizers, or equipment needed for new practices. High costs and lack of affordable loans or insurance discourage farmers from experimenting with new approaches. Many rural farmers don't receive timely, localized, or actionable climate-smart advice.

Even when knowledge is available, adoption stalls without the physical means to implement it.

2. Risk Aversion and Uncertainty. Farmers often avoid change because new techniques carry unpredictable short-term results. Climate impacts make it harder to predict success of any one technique in a given season. Without safety nets (like insurance), the cost of failure is too high.

Adaptation requires experimentation and confidence — both are hindered by economic vulnerability.

3. Training Gaps and Ineffective Extension Services. Many training programs are too technical, top-down, or not tailored to local contexts. Limited follow-up or on-farm demonstrations means knowledge isn't retained or put into practice. Some farmers lack basic literacy or digital skills, limiting access to mobile tools or apps.

Training must be hands-on, iterative, and embedded in community practices to succeed.

4. Cultural and Social Norms. Long-standing traditions can conflict with recommended practices, like shifting planting calendars or diversifying away from staple crops. Youth may be excluded from leadership or decision-making, despite being key adopters of innovation.

Ignoring social dynamics limits who adopts climate-smart farming and how quickly.

5. Weak Policy and Market Signals. Government subsidies often still favor unsustainable practices (e.g., chemical inputs, water-intensive crops). Market demand for climate-smart products (like organic produce or carbon-sequestering grains) may be underdeveloped. Lack of infrastructure (like cold storage, processing units) discourages adoption of value-added practices.

Without policy and market support, farmers have few incentives to change.

Summary Table

Obstacle	Impact on Adoption
Techniques not locally adapted	Low trust and poor performance reduce uptake
Limited access to inputs & finance	Farmers can't afford or source needed tools
Risk aversion & lack of safety nets	Fear of failure prevents experimentation
Poor training & extension delivery	Skills don't stick; info isn't acted upon
Cultural and social norms	Limits participation and leadership in adaptation
Weak enabling environment (policy/market)	No long-term incentives to stay with smart practices

6. Future Vision

In 5 to 10 years, many learners in climate-smart agriculture envision themselves in roles that combine practical application, advocacy, and innovation. Here are main directions one might pursue:

1. Managing or Supporting a Sustainable Farm. The goal is to operate or advise a farm that uses regenerative, agroecological, or permaculture techniques. They will manage soil health, carbon sequestration, water efficiency, local food systems. Hands-on work allows you to directly apply and adapt climate-smart techniques while contributing to food security and environmental restoration.

2. Pursuing Advanced Research or Education. Conduction of research on climate-resilient crops, low-emission practices, or climate modeling for agriculture. Science and innovation drive scalable solutions and influence policy.

3. Becoming an Advocate or Educator. They want to promote sustainable farming practices, influence policy, or empower communities through training. They will work on farmer education, policy lobbying, communication campaigns. Change happens when people are informed, mobilized, and equipped with the right tools.

4. Building or Leading an Agritech or Climate-Adaptation Enterprise. They will develop technology or services that support climate-smart agriculture (e.g., weather tools, soil sensors, carbon marketplaces). The f**ocus areas are i**nnovation and digital agriculture. Scalable solutions require entrepreneurial thinking and tech-savvy leadership.

5. Influencing Climate and Agricultural Policy. To shape regional or national climate adaptation strategies and agricultural reforms. Focus areas: Policy design, subsidy reform, adaptation finance, global food systems. Enabling environments are critical to scale climate-smart practices beyond pilot programs.

7. Suggestions for Education Improvement

Improving climate-related agricultural education requires moving beyond conventional training methods toward context-driven, participatory, and future-ready learning. Based on current challenges and best practices, here are strategic suggestions for enhancing your institution or training program:

1. Make Training Farmer-Centered and Locally Relevant. Conduct needs assessments with local farmers to tailor content to real-world challenges. Use local case studies, languages, and agroecological examples. Focus on what farmers can do now, not just theoretical knowledge.

This helps because relevance increases engagement, retention, and adoption of new practices.

2. Use Hands-On, Demonstration-Based Learning. Establish field schools, demo plots, or climate-smart pilot farms where trainees can see results in action. Use "learn by doing" methods: composting, water harvesting, seed treatment, or using weather tools on-site. Incorporate peer-to-peer training, where farmers who've adopted practices train others.

This helps to builds confidence, shows proof of concept, and reinforces retention.

3. Integrate Digital Tools and Climate Services. Train farmers and extension agents to use weather apps, satellite imagery, and SMS advisory platforms. Provide tablets or phones to community trainers if infrastructure allows. Include digital literacy modules, especially for youth and women.

This strengthens real-time decision-making, especially under variable conditions.

4. Include Climate Literacy and Systems Thinking. Teach basic climate science and its agricultural impacts (e.g., rainfall shifts, heat stress). Introduce resilience thinking — focusing on risk reduction, diversity, and recovery. Use scenario planning tools to help farmers anticipate and adapt to different futures.

This builds long-term, adaptive mindsets rather than short-term fixes.

5. Strengthen Institutional and Extension Capacity. Train trainers and extension staff in climate-smart principles, participatory methods, and facilitation. Provide ongoing refresher courses, field visits, and resource materials. Create incentives for trainers to experiment and improve.

This helps because the quality of teaching often determines success more than curriculum alone.

6. Link to Markets, Finance, and Policy. Teach how climate-smart practices can meet certification, quality, or export standards. Incorporate modules on microfinance,

insurance, and business planning. Update trainees on climate-related agricultural policies and subsidy reforms.

Farmers need both knowledge and incentives to adopt and sustain change.

8. Recommendations

Key Insights

Priority Action Areas

Focus Area	Key Improvement Idea
Curriculum Relevance	Use local examples, co-design with farmers
Delivery Methods	Prioritize hands-on learning, peer-to-peer training
Digital Integration	Train in weather tools, SMS services, apps
Climate Systems Knowledge	Teach climate risks, adaptation logic
Institutional Capacity	Invest in skilled, motivated trainers
Link to Incentives	Connect to finance, markets, and policy frameworks
Evaluation and Feedback	Focus on outcomes, adapt based on farmer input

Section 2 SURVEY ANALYSIS OF EDUCATORS IN BULGARIA

The study involved 34 randomly selected people. The interviewees teach in the field of agriculture and are representatives of various training institutions. Although they express an interest in the sustainable development of agriculture, the majority of them have not participated in training related to the impact of climate change on agriculture. This, in turn, is a prerequisite for a low level of confidence in teaching approaches to addressing climate crises.

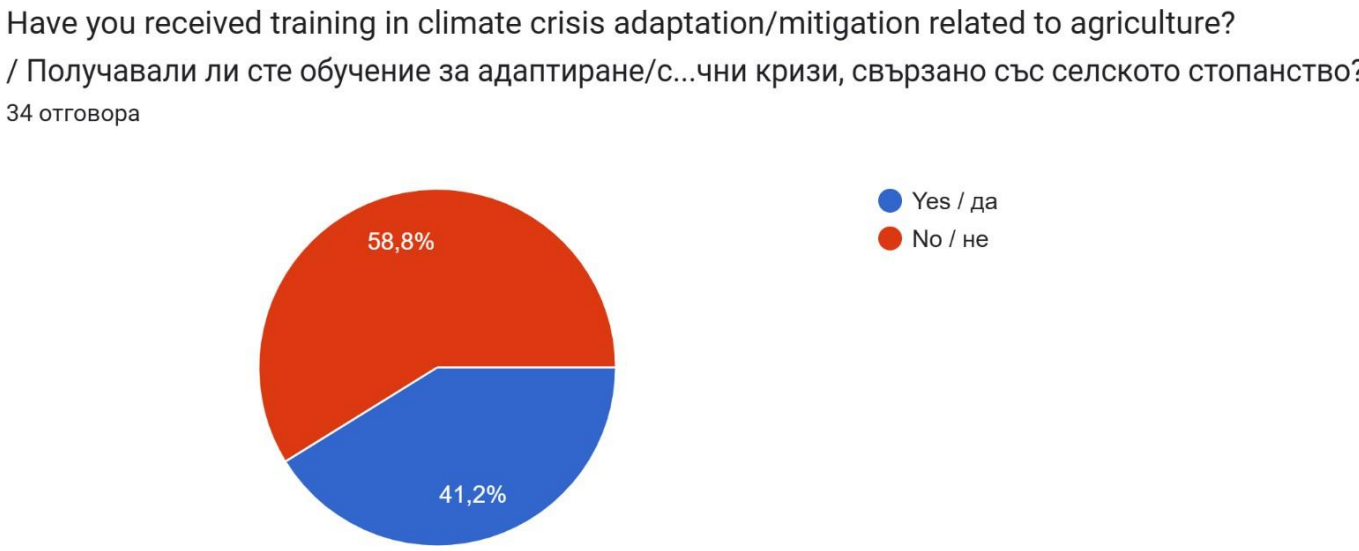

Figure 17 Background of educators

The interviewees are educators with various roles in agricultural education. The largest share among them are trainers who provide professional education in specific specialties and areas of knowledge. Their share amounts to 41%. The next largest group is the representatives of teachers. These are educators who provide comprehensive training on general agricultural topics and are university teachers. Their share is nearly 30%. The third group of educators covered in the study are consultants, providing training to address specific production and business problems. Their share is slightly more than ¼. This sample structure is defined as balanced, including representatives of the three roles in education. This provides an opportunity to correctly assess the provision of training in agriculture on topics related to climate change. The roles that the educators perform fully correspond to the types of educational institutions for which they work. The trainers are

representatives of professional training centers. The teachers work at a university. And the consultants are in independent practice. One teacher at a secondary vocational school in agriculture and one representative of a private consulting company also participated in the study. But, the last two types of institutions are not popular in Bulgaria and this determines their low weight in the study.

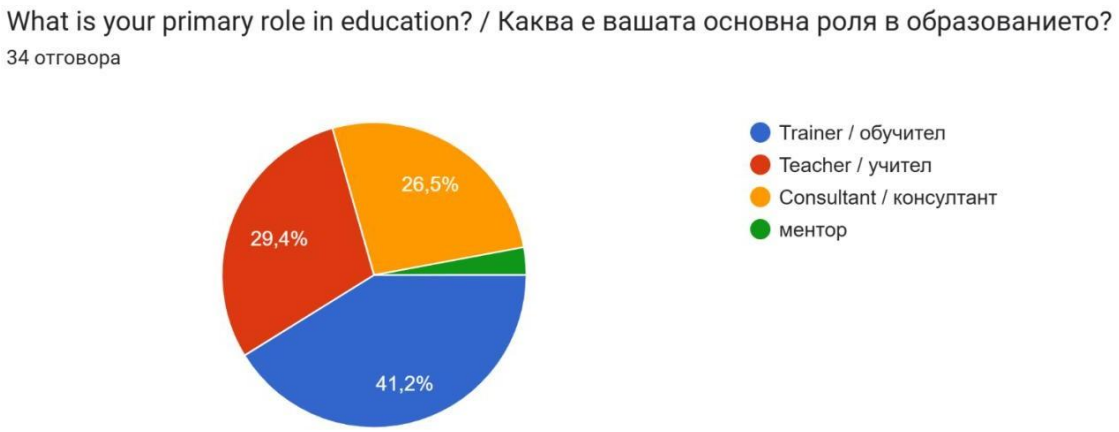

Figure 18 Professional Role

The roles that the educators perform fully correspond to the types of educational institutions for which they work. The trainers are representatives of professional training centers. The teachers work at a university. And the consultants are in independent practice. One teacher at a secondary vocational school in agriculture and one representative of a private consulting company also participated in the study. But, the last two types of institutions are not popular in Bulgaria and this determines their low weight in the study.

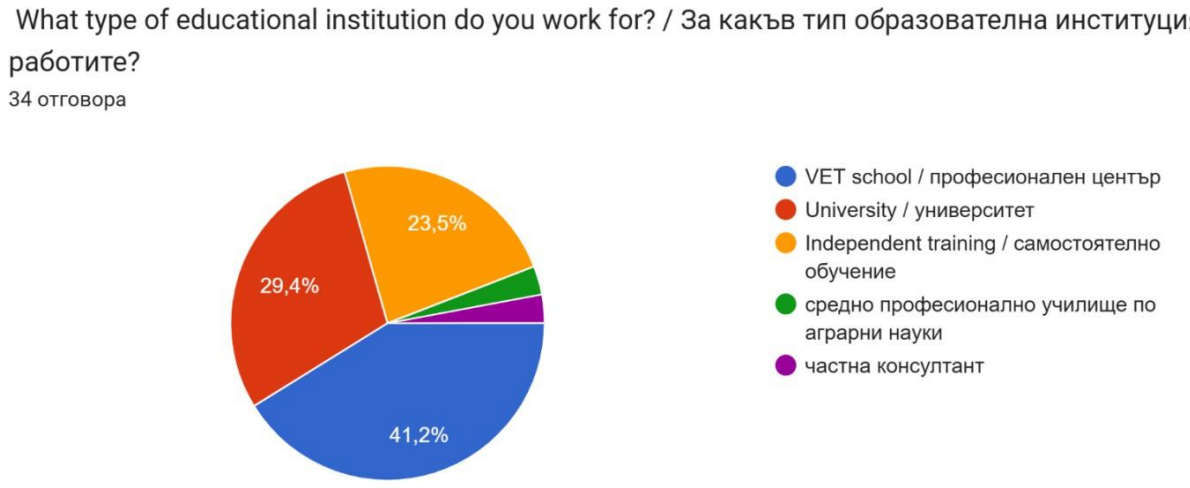

Figure 19 Institution Type

The survey includes people with different experience in agricultural education. The largest group is made up of educators with 5 to 10 years of experience. The smallest group is made up of those with up to 5 years of experience. The total share for both groups amounts to just over half of the surveyed people, and thus the survey determines a slight preponderance of people with less professional experience, but overall they are younger and it is expected that they are more interested in trends in modern agricultural education. Nearly 30% of the interviewees have between 11 and 20 years of experience in the field of education, which provides a larger basis for comparison of their training programs. Five of the interviewees have over 20 years of experience in education, and all of them are university lecturers and they give a more traditional character to their training programs.

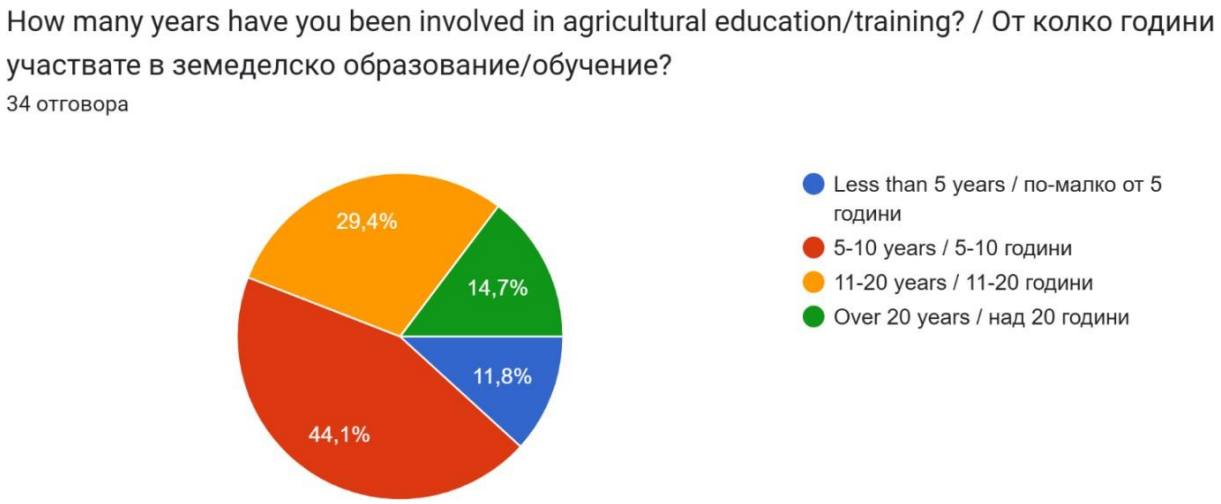

Figure 20 Years of Experience

In terms of the training formats offered, field demonstrations and farm visits are the most often used. This is true for over ¾ of the interviewees. The remaining three forms of training have similar results and show similar popularity. Their percentage shares are close to 50%, which defines them as significant. It should be noted that these forms are most often additional to the main form of field demonstrations and farm visits. In general, educators apply more than one form of training, which provides an opportunity for a more convincing presentation of the educational topics.

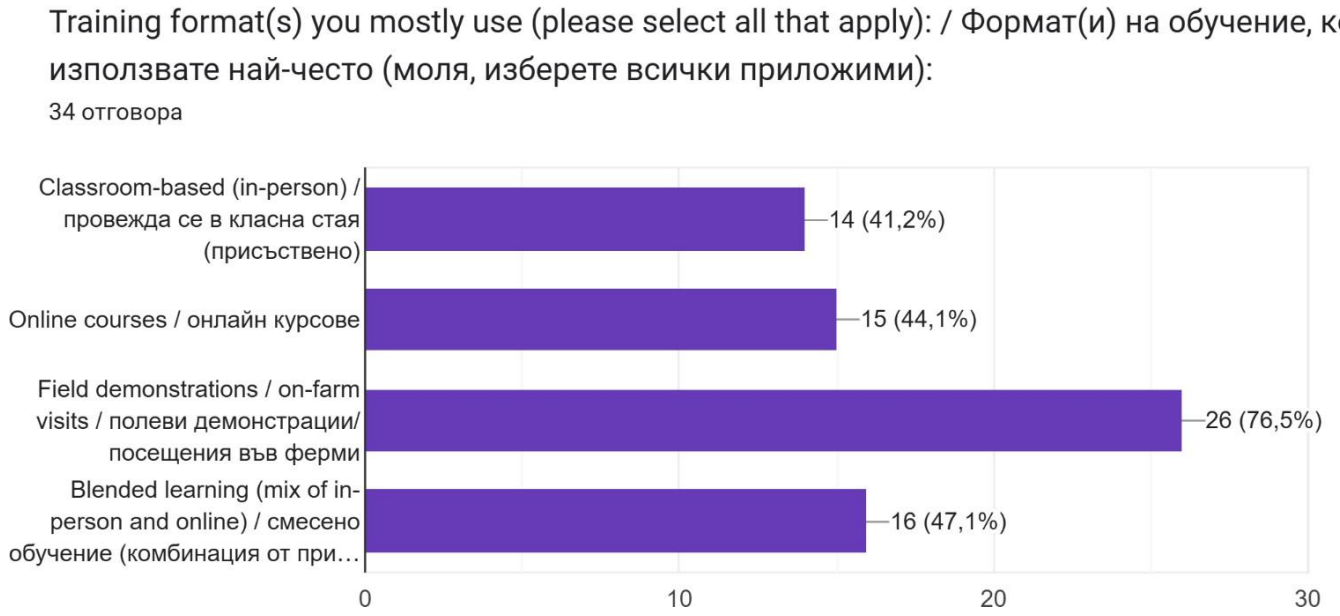

Figure 21 Training Formats Used

1. Climate Education in Current Practice

The interviewees categorically stated through their assessments that the training programs include topics related to the sustainability of agriculture and the implementation of practices for its maintenance. This gives grounds to determine that the issues of sustainable agricultural development are recognized as a necessity in modern agricultural education.

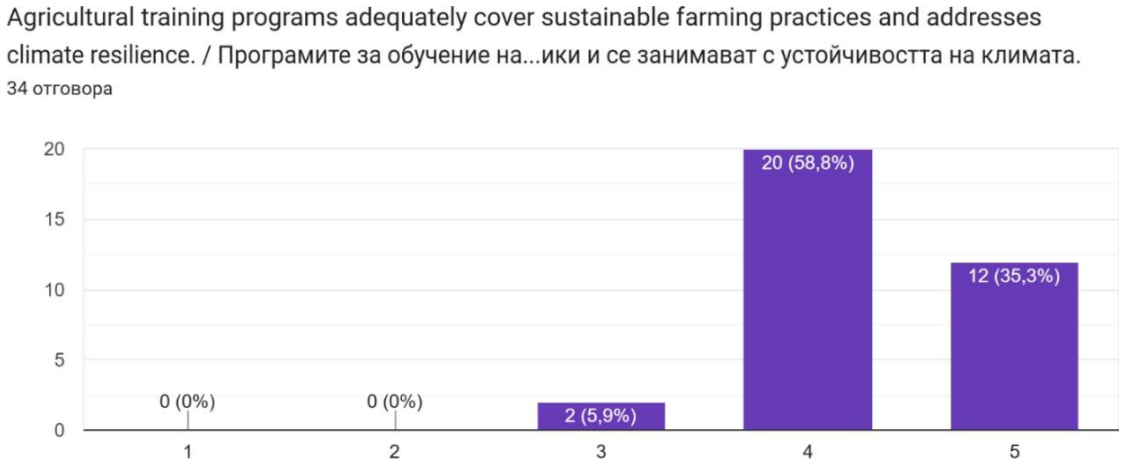

Figure 22 Curriculum Content

Although almost all educators state that sustainable agriculture is part of their educational programs, its importance as a priority is in a significantly lower percentage of respondents. Sustainable agriculture topics are a key part of the educational programs of 25 out of 34 trainers, or significantly lower than the distribution of answers to the previous question. This is normal given that the study covered educators on various professional topics, some of which have no direct connection to sustainable agricultural practices.

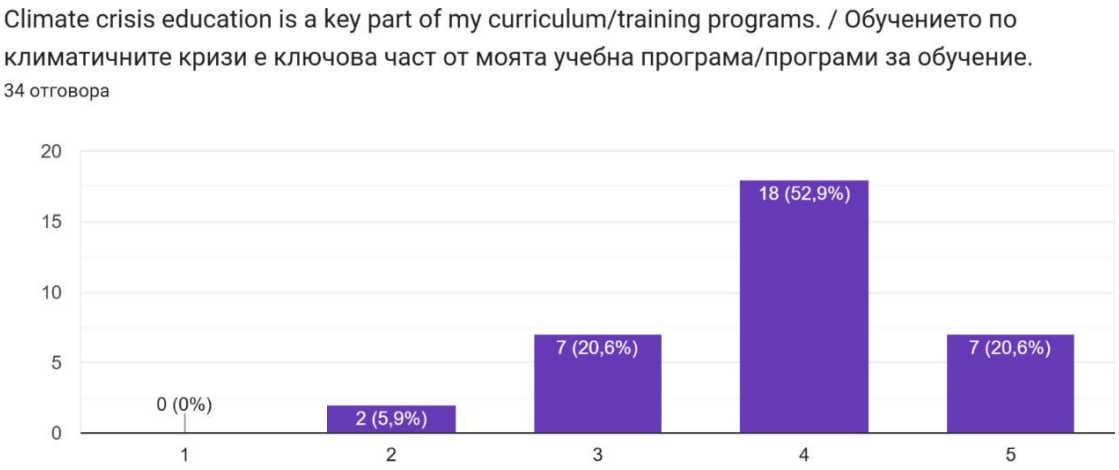

Figure 23 Curriculum Content

The difference in responses to the previous two questions is amplified in terms of educators' confidence in teaching topics related to climate crises and their impact on agriculture. Nearly 2/3 of the interviewees stated a high level of confidence in teaching such topics, giving a score of 4 or 5. As the structure of the responses worsens, a trend towards difficulties in providing training on topics related to climate crises is observed.

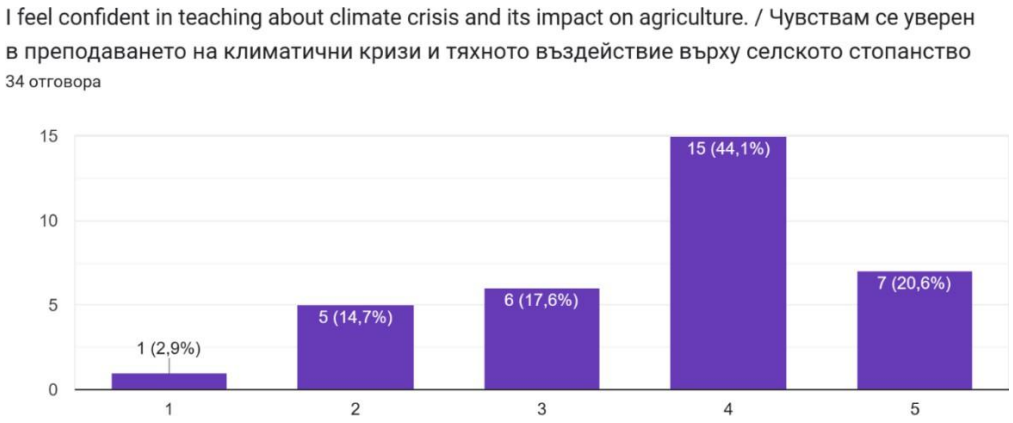

Figure 24 Educator Confidence

The lower level of confidence of educators stems from the fact that for most of them the available educational materials on topics related to climate impacts on agriculture are not sufficient. Based on these results, it can be said that there is potential for developing training of educators, as well as educational materials necessary for training on climate education in agriculture.

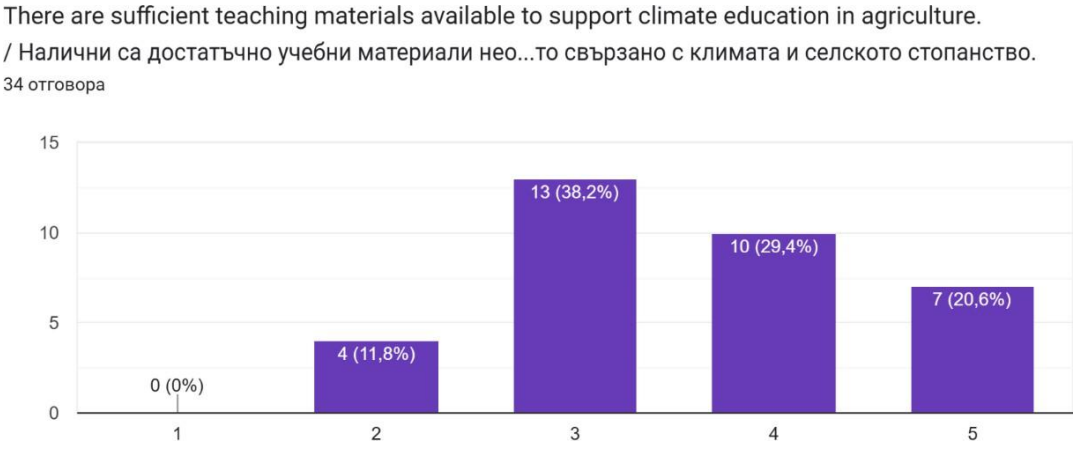

Figure 25 Institutional Support

In general, a significant proportion of the interviewees stated that they do not receive strong support from their institutions in developing educational topics on climate crises and their impact on agriculture. This is true for nearly 1/3 of them. Apparently, educational

institutions in Bulgaria themselves do not prioritize such education and rather adhere to traditional topics and approaches to agricultural production management.

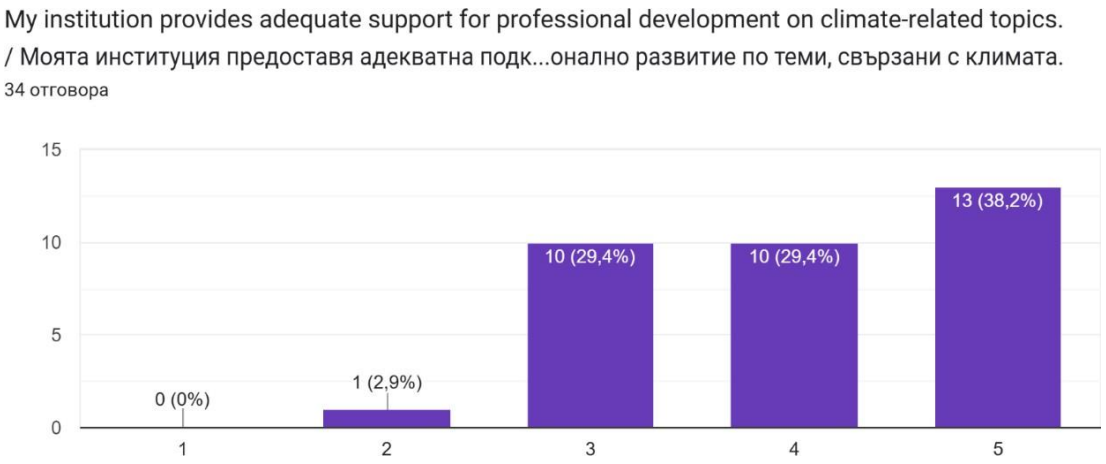

Figure 26 Institutional Support

The high percentage of interviewees who collaborate with farmers and stakeholders to better understand the problems of contemporary Bulgarian farmers is striking. This is a prerequisite for high quality training based on solving the specific problems of Bulgarian farmers.

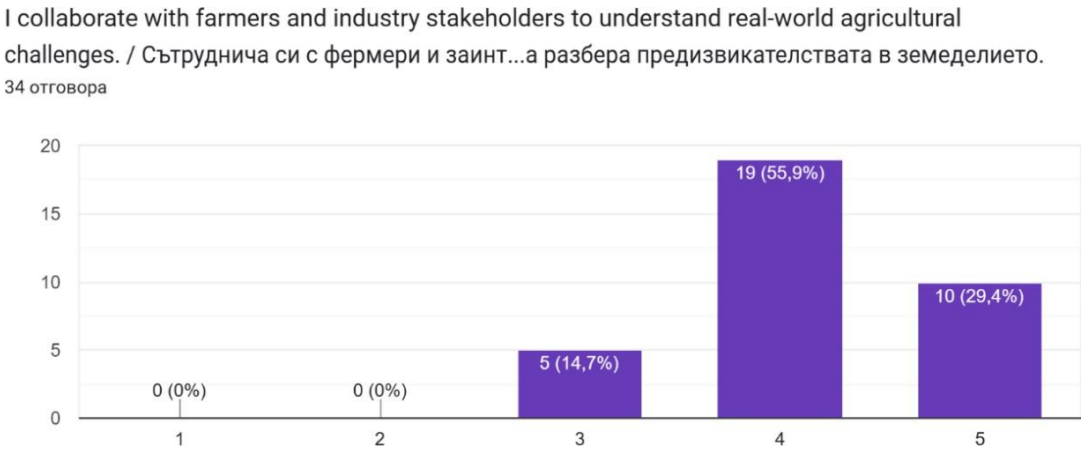

Figure 27 Institutional Support

2. Use of Tools and Innovation

In their teaching, nearly 2/3 of the trainers actively use digital platforms and technologies to present climate crises or adaptation strategies. This is evident from the high ratings they gave of 4 and 5. A significant share of trainers - 36% - give lower ratings, which is a sign that there is potential for popularizing existing digital technologies in training on climate change topics.

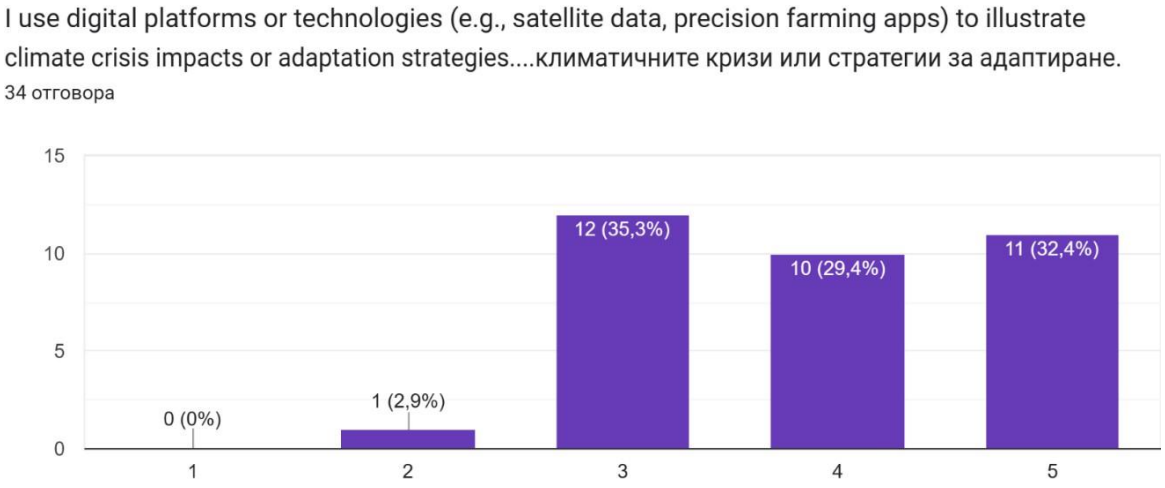

Figure 28 Digital Tools

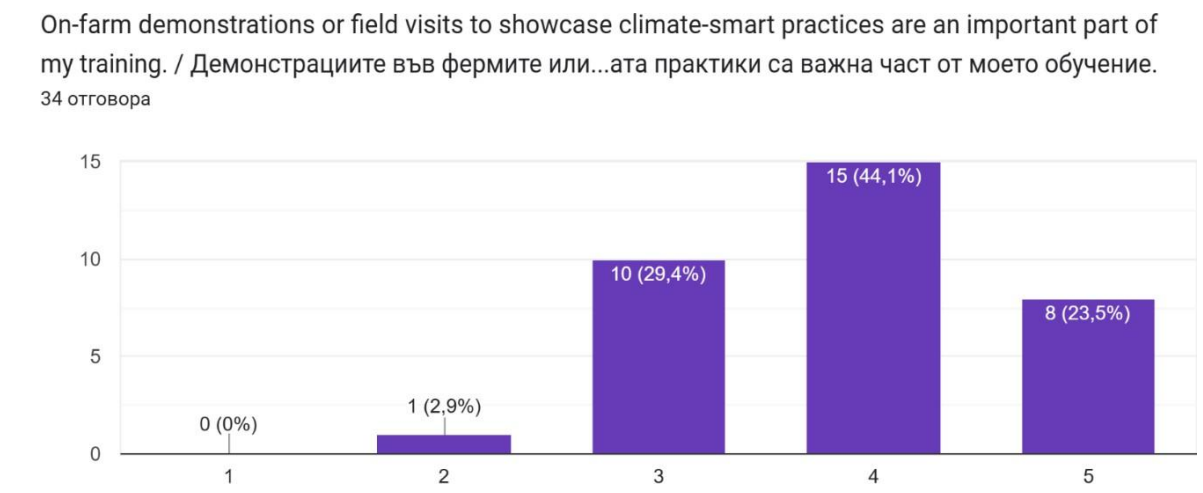

Figure 29 Practical Demonstrations

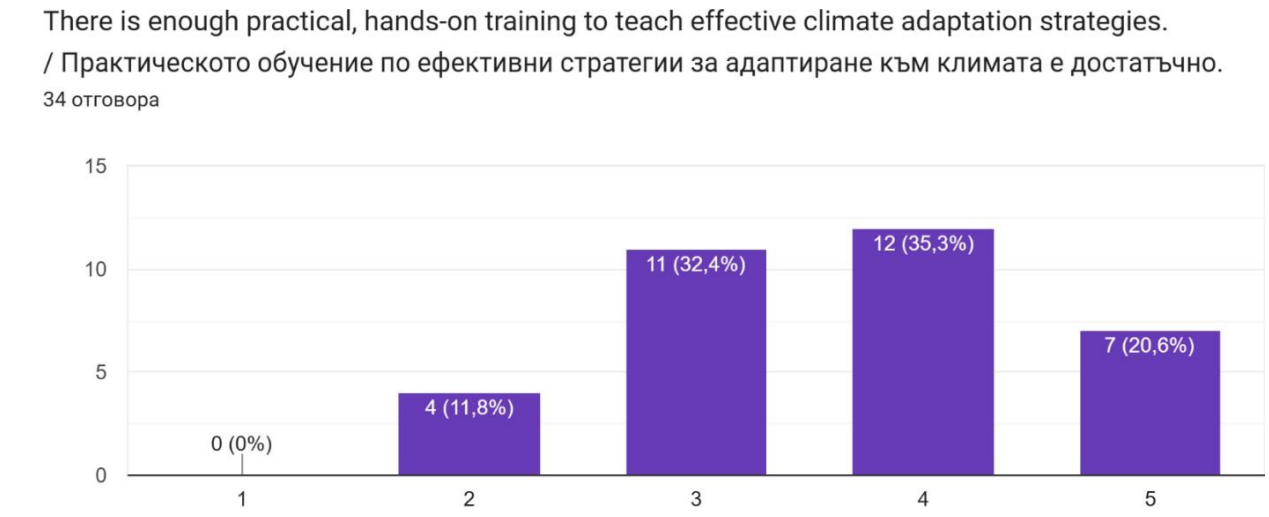

Figure 30 Practical Demonstrations

The inclusion of various stakeholders in the process of developing climate resilience curricula is at a high level, which is a prerequisite for a real understanding of the problems in this area.

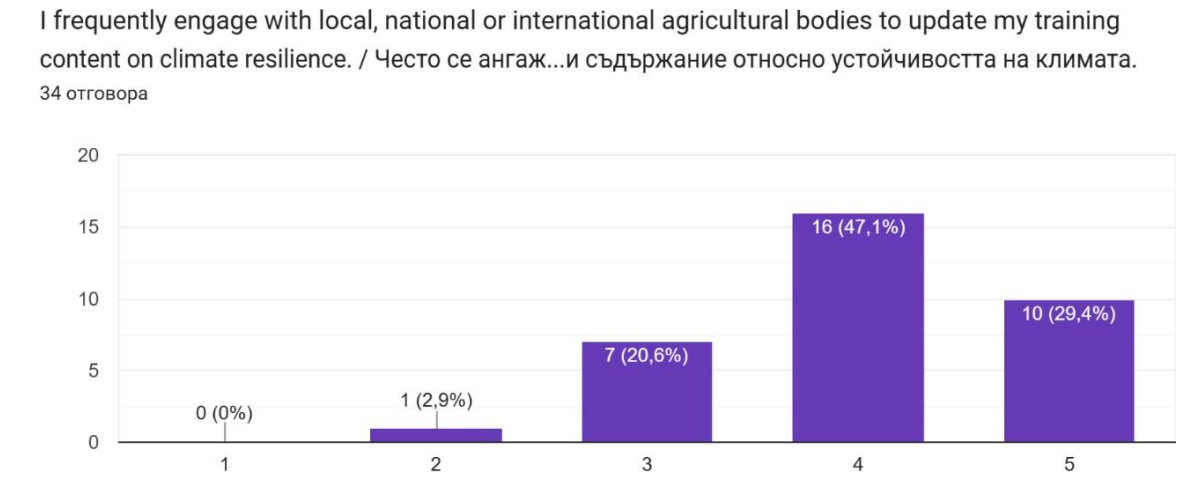

Figure 31 Stakeholder Engagement

3. Learner Engagement and Policy Support

According to the еакъьшдия, the trainees show a strong interest in topics related to sustainable agriculture and climate change. This is an incentive for improving the quality of training on these topics. The state also has an important role in this process, which through its policies can create conditions for successful training. The majority of interviewed educators stated that they are aware of public incentives that encourage farmers to adopt and implement practices to mitigate the impact of climate crises.

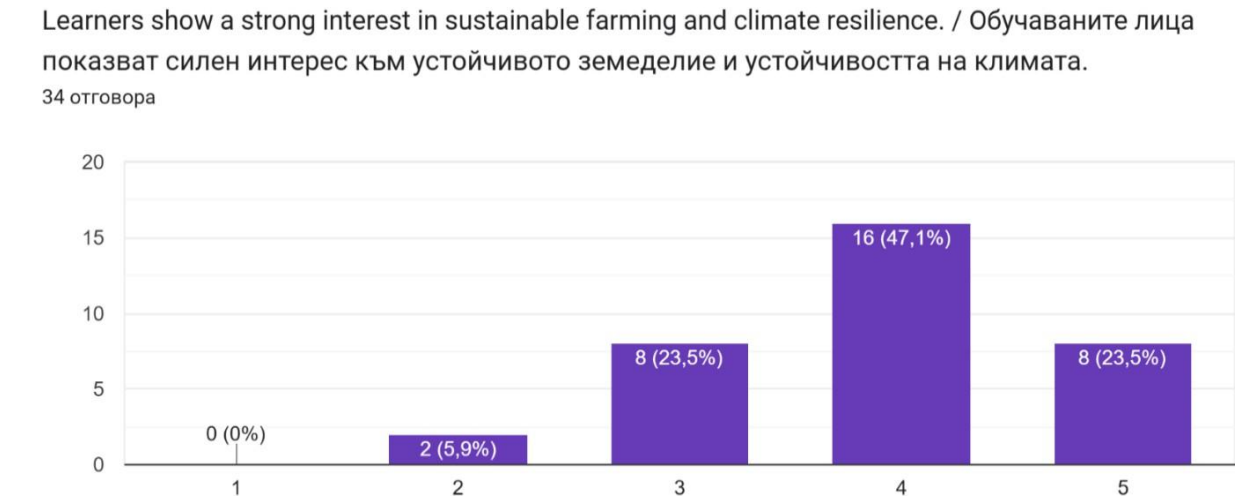

Figure 32 Learner Interest

Government policies support the integration of climate crisis topics into agricultural education.
/ Правителствените политики подкрепят интег...матичните кризи в земеделското образование.
34 отговора

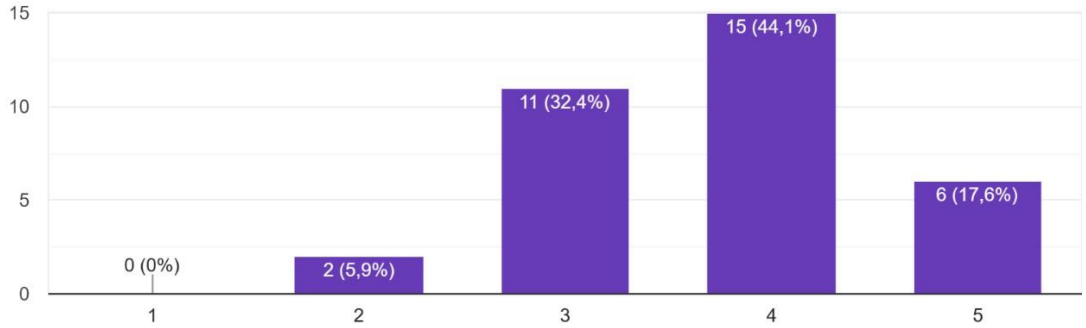

Figure 33 Policy Influence

I am aware of policy incentives or grants that encourage farmers to adopt climate-smart practices.
/ Запознат съм с политическите стимули или б...ъзприемат интелигентни за климата практики.
34 отговора

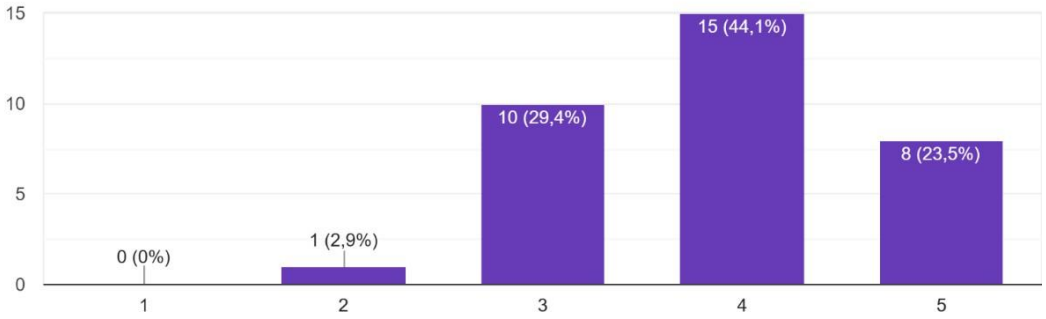

Figure 34 Policy Influenc

4. Priority Areas for Improvement

To assess preferences for future training and future needs, respondents answer questions related to areas in which it is important to provide training and what additional resources are needed for training in climate-resilient agriculture.

When identifying the most important aspects that need to be given greater attention when it comes to developing climate-resilient agriculture with fewer negative environmental impacts, respondents clearly prioritize four areas, namely: Soil Health & Regenerative Practices, Carbon Sequestration & Emission Reduction, Water Management & Conservation, Efficient Nutrient & Fertilizer Use. The areas with the lowest ratings are “Agroforestry and biodiversity enhancement” and “Policy, education and farmers’ empowerments.” The answers given are explained by the existing problems related to the protection of agricultural resources in Bulgaria and their use in the long-term perspective.

The need for training on specific topics was assessed through possible options. The strongest interest is in topics related to Precision Agriculture, Innovative Tools and Advanced Technologies, and Drought-Resistant Crop Varieties. All three topics are desired by more than 40% of respondents to receive additional training. Interest in the topic Policy Advocacy and Community driven Actions is the weakest, and the result can be explained by the apparent problems with agricultural resources in Bulgaria in general.

In the previous questions, answers were given about insufficient practical training on the topics of climate crises and the presentation of real examples from businesses to deal with their negative impacts. Therefore, the main resources that trainers need are “Funding or budget for training materials” and “Access to demonstration farms”. This will allow for practical workshops or visits to real farms to demonstrate the effects of the implemented good practices. Updating digital tools is also important for trainers to provide adequate training on climate resilience topics, as over 40% of respondents responded positively.

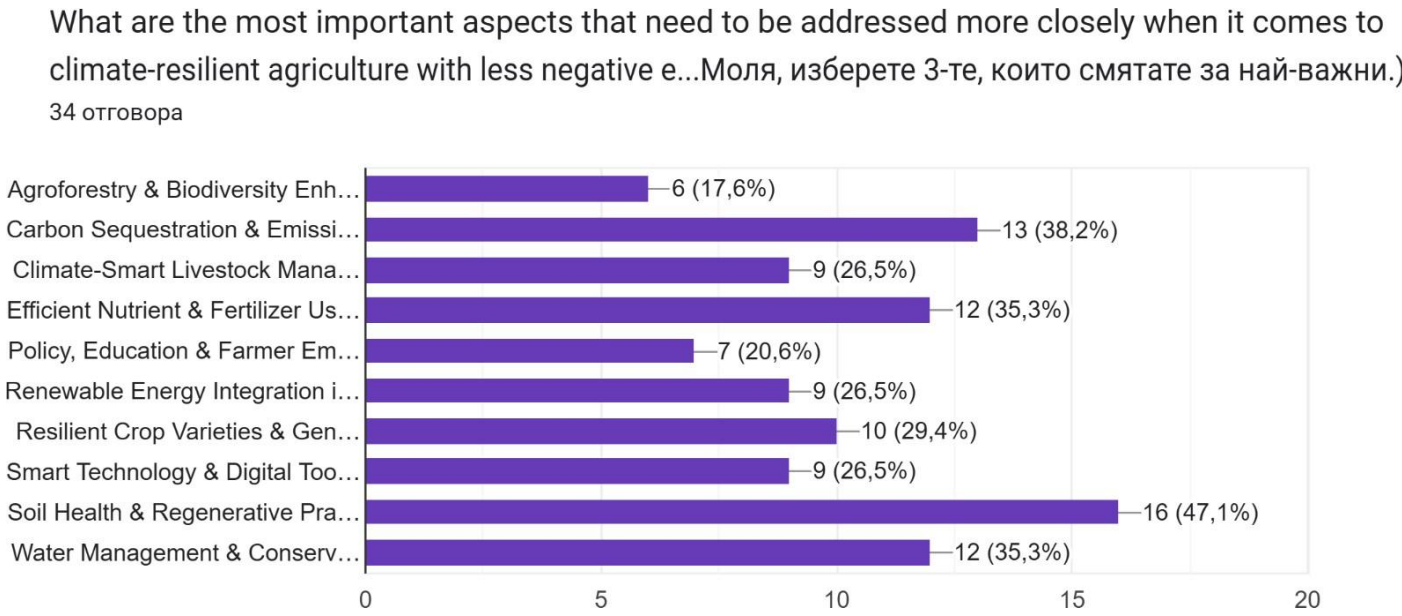

Figure 35 Key Topics for Training

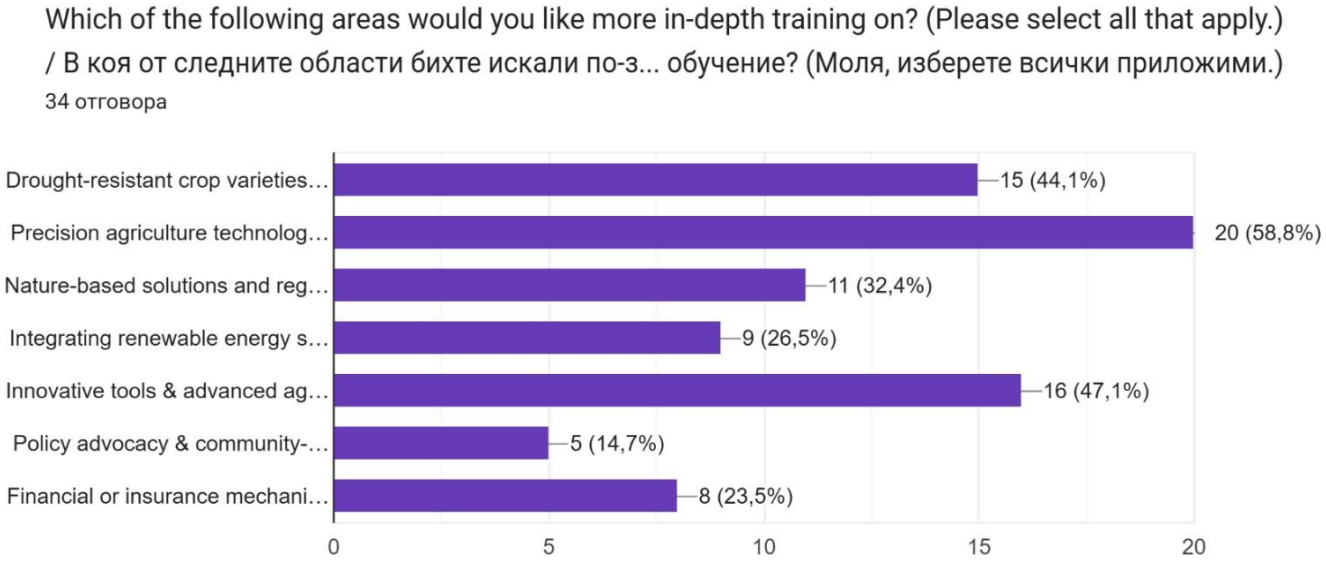

Figure 36 Key Topics for Training

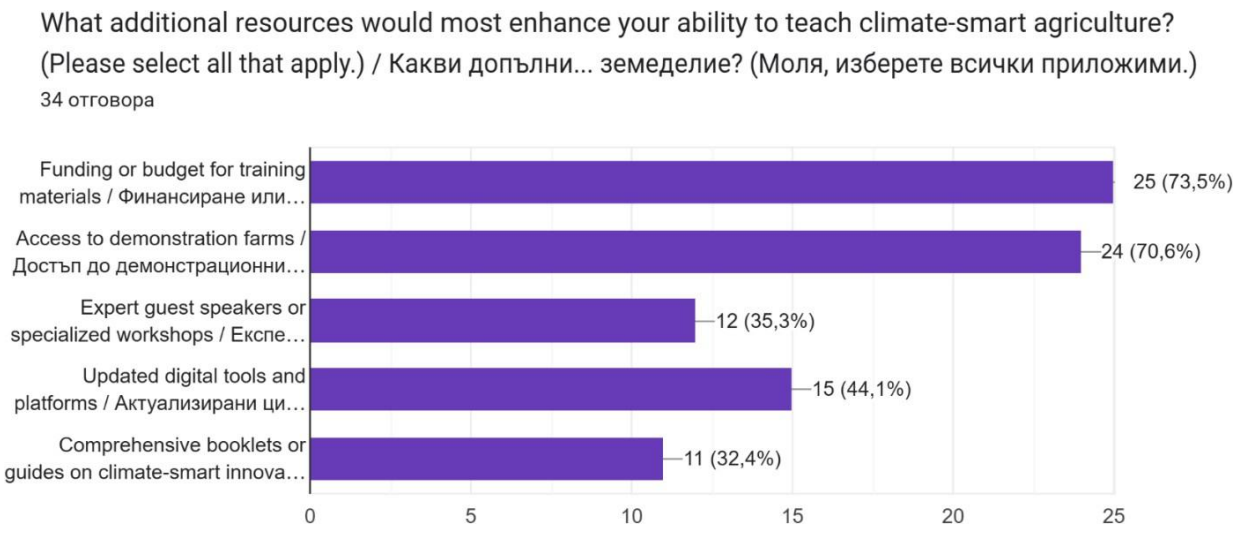

Figure 37 Requested Resources

5. Challenges and Barriers in teaching climate crisis and resilience farming practices in Bulgaria

Educator Challenges

According to the educators, teaching climate crisis and resilience farming practices involves the following main challenges:

1. **Complexity and Interdisciplinary**. The climate crisis intersects with ecology, economics, policy, and social systems, making it difficult to teach in a cohesive way. Farming resilience practices require understanding both science and local socio-economic conditions.
2. **Lack of Localized Content.** Many resources are generic or regionally irrelevant. What works in one climate zone or socio-political context may not apply elsewhere.
3. **Farmer Resistance to Change.** Farmers may be skeptical of new methods, especially when traditional practices are deeply rooted or when short-term gains are uncertain.
4. **Insufficient Teacher Training.** Educators may not have enough training or confidence to teach climate science or sustainable agriculture effectively.

Curricula may be outdated or influenced by industrial agriculture models, making integration of resilience farming difficult.

Educators identified some resources that would be helpful to boost teaching capability in climate-resilience agriculture:

1. **Localized Case Studies and Best Practices**. Real-world examples tailored to the local context (e.g., drought-resistant crops in dry zones, agroforestry in tropical regions). On-the-ground examples of resilience practices like cover cropping, composting, or permaculture systems.
2. **Interactive Digital Tools and Simulations**. Tools that allow learners to model climate scenarios or test farm management practices (e.g., FarmOS, Climate- smart agriculture tools). Platforms that bring together scientific research and traditional knowledge (e.g., participatory research networks). Infographics, videos, and translated guides make content more accessible, especially for learners with lower literacy levels.
3. **Teacher Training Programs**. Workshops, certification programs, or online modules on climate literacy and sustainable farming. Institutional backing for integrating these topics into mainstream curricula, plus funding for resource development and deployment.

Farmer Adoption Barriers

The biggest barrier preventing farmers from adopting climate-resilient techniques is often economic risk and uncertainty.

1. **Short-Term Costs vs. Long-Term Benefits**. Climate-resilient practices (e.g., cover cropping, crop rotation, agroforestry) may require initial investment in tools, seeds, or training, with benefits that only materialize over years. Without financial safety nets, farmers are understandably risk-averse when it comes to changing practices.
2. **Fear of Loss**. Farmers may fear that experimenting with new methods could lead to lower yields, especially in the first seasons. Conventional supply chains and buyers often prioritize uniformity, quantity, or speed, which discourages alternative practices that may be more sustainable but less standardized.
3. **Lack of Trust or Information**. Some farmers may be skeptical of new techniques, especially if promoted by external actors or based on unfamiliar science.

The educators suggest the following changes in training in order to overcome them:

Demonstrate Benefits. Training should highlight affordable techniques with immediate or visible benefits (e.g., mulching, composting, water

harvesting). Use case studies and on-farm trials to show increased yields, cost savings, or market premiums from sustainable practices. Customize training to the specific climate risks and cultural practices of each region to make solutions feel relevant and achievable.

1. **Promote Risk Management Tools**. Educate farmers on how to use crop insurance, savings groups, or climate advisories to reduce risk. Facilitate learning from other farmers who have successfully implemented resilient methods. Peer influence is often more powerful than external expertise. Rather than top-down instruction, include farmers in the research and development of climate-resilient practices. This builds ownership and trust.

Future Climate Concerns

Looking ahead 10 years, educators identified that agricultural training will need to adapt to a range of emerging and intensifying climate challenges. These challenges will likely be more complex, interconnected, and region-specific, demanding both technical and adaptive capacities from farmers. Here are the key climate challenges anticipated, along with implications for future agricultural training:

1. Rising Temperatures and Heat Stress. This will lead to crop yield declines, livestock stress, reduced soil moisture. The following training needs are determined: Heat-resilient crop varieties and livestock breeds. Microclimate management (e.g., agroforestry, shade nets). Efficient irrigation and cooling systems.

2. **Increased Water Scarcity and Droughts**. Training need to address this: Advanced water harvesting and storage (e.g., check dams, drip systems). Drought- tolerant crop planning. Soil moisture conservation techniques (e.g., mulching, minimal tillage).

3. **More Frequent and Extreme Weather Events** like **s**torms, floods, hail, and unseasonal frosts damaging crops. It will be need training in: Climate forecasting and early warning interpretation. Risk preparedness plans (e.g., diversification, off-farm income). Resilient infrastructure for farms (e.g., raised beds, drainage systems).

4. **Shifting Pests, Diseases, and Weeds.** New pests and diseases will appear in previously unaffected regions. The training needs will be: Integrated pest management (IPM) adapted to new patterns. Crop rotation and intercropping for biological control. Use of digital tools for real-time pest monitoring.

5. **Soil Degradation and Carbon Loss.** That leads to Declining soil fertility and structure; reduced carbon sequestration. The

training needs in that area will be: Soil regeneration (e.g., composting, cover crops, biochar). Training on carbon farming and potential revenue from carbon markets.

6. **Evolving Climate Policies and Compliance**. There are will be new regulations on emissions, deforestation, or subsidies. That will need training in: Education on climate policy, carbon accounting, and eco-certifications. Guidance on how to benefit from climate finance and green subsidies.

6. Recommendations and Insights

Key Themes

- “Climate Shifts in Agriculture”
- "Climate-Smart Technologies"
- "Nature-based Solutions for Farming"
- "Integrated Pest Management Strategies"
- "Regeneration Techniques in Farming"
- "Community-Driven Climate Action in Agriculture"

Strategic Actions

- Climate-smart extension programs tailored to local agroecological zones.
- Participatory approaches that co-design solutions with farmers.
- Data partnerships to improve forecast accuracy and relevance.
- Policy advocacy for supportive subsidies and infrastructure investments

Section 3 SURVEY ANALYSIS OF STAKEHOLDERS IN BULGARIA

The survey was conducted with 21 participants representing various stakeholders in the process of adapting Bulgarian agriculture to climate change. The aim was to capture more perspectives from the different positions that respondents hold in the agricultural sector.

The study presents five different types of organizations, thus achieving a high degree of comprehensiveness of the opinions expressed. The structure of the sample is balanced and represents the state of Bulgarian agriculture in terms of the institutions involved in its development. The main institutions, non-governmental organizations, agricultural associations and research institutions, are represented by an equal number of respondents, five, while state agencies are represented by four respondents. Cooperatives, which are not popular in Bulgaria as an organizational form, are represented by 2 respondents.

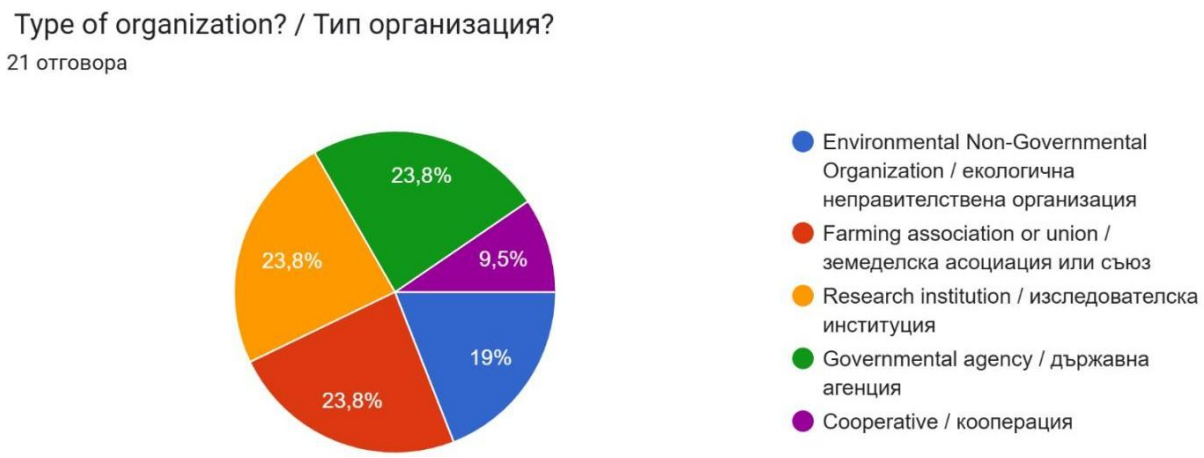

Figure 38 Organization Type

In terms of the experience of the surveyed institutions, those with extensive experience predominate, as they have been working in the sector for more than 20 years. Their share amounts to over 40% of the respondents. This is followed by institutions with experience in the sector between 11 and 20 years. And the smallest share is held by institutions new to the sector, which have fewer years of experience. This structured sample allows for an emphasis on the opinions of institutions with more experience while at the same time allowing for comparison with institutions with less experience.

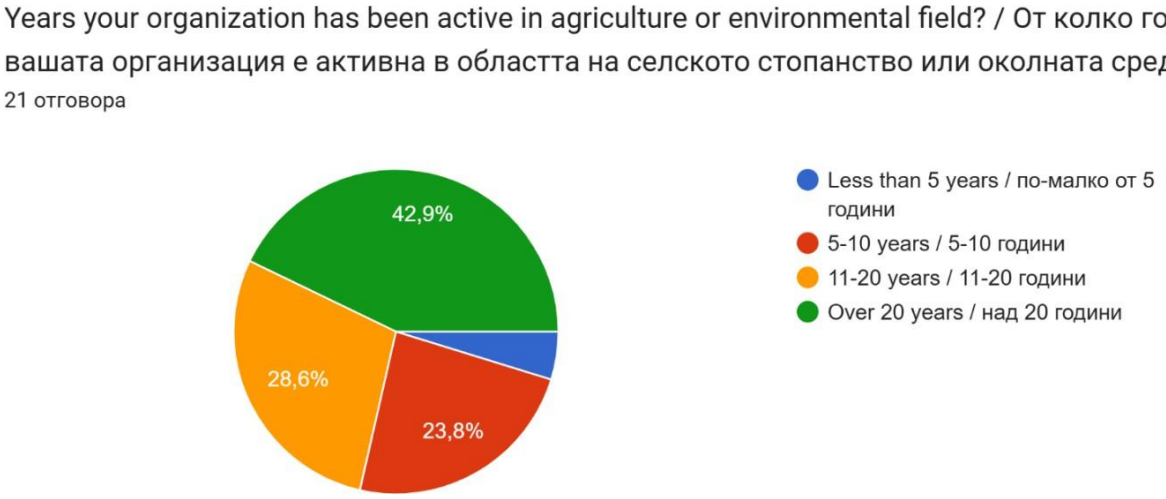

Figure 39 Years in Field

The commitment of the surveyed institutions to training on topics related to climate change and sustainable agriculture is high. Over ¾ of them offer or participate in such training, which is a criterion for recognizing the problems in the studied area.

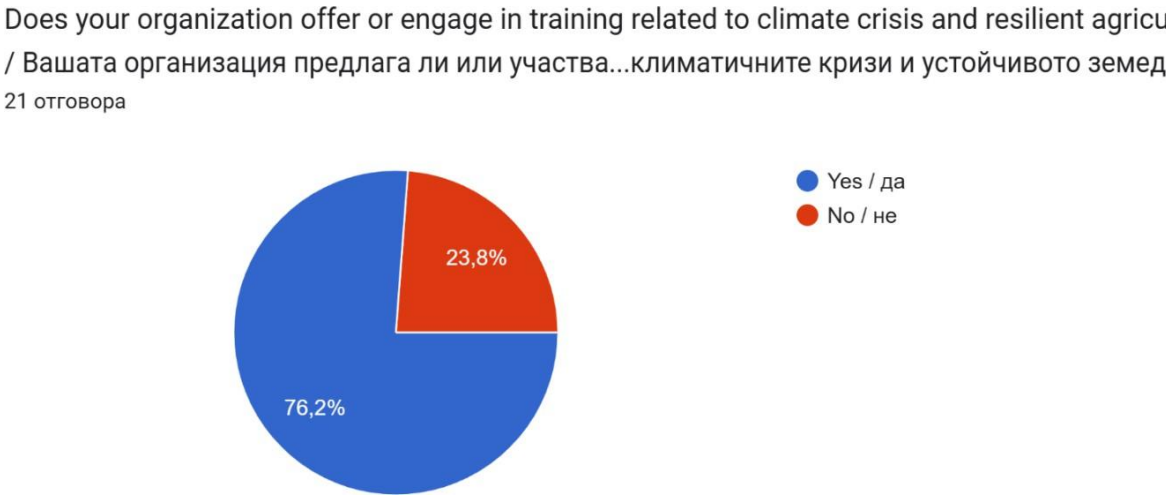

Figure 40 Role in Training

1. Perception of Climate Impacts

Respondents unanimously answered that climate crises have had a significant impact on agriculture in the regions they work in. This result confirms the relevance of the topic of climate resilience and makes training on such topics imperative.

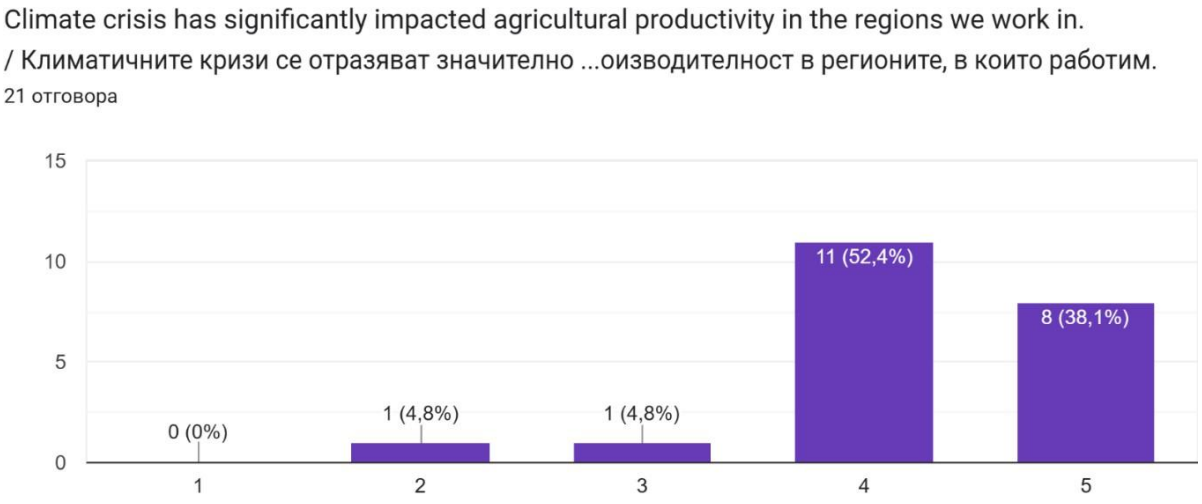

Figure 41 Regional Impact Observations

Similarly, respondents state their awareness of climate change and its consequences for agriculture. The high level of awareness shows that these institutions are aware of contemporary trends in the development of agriculture as an important sector of the society.

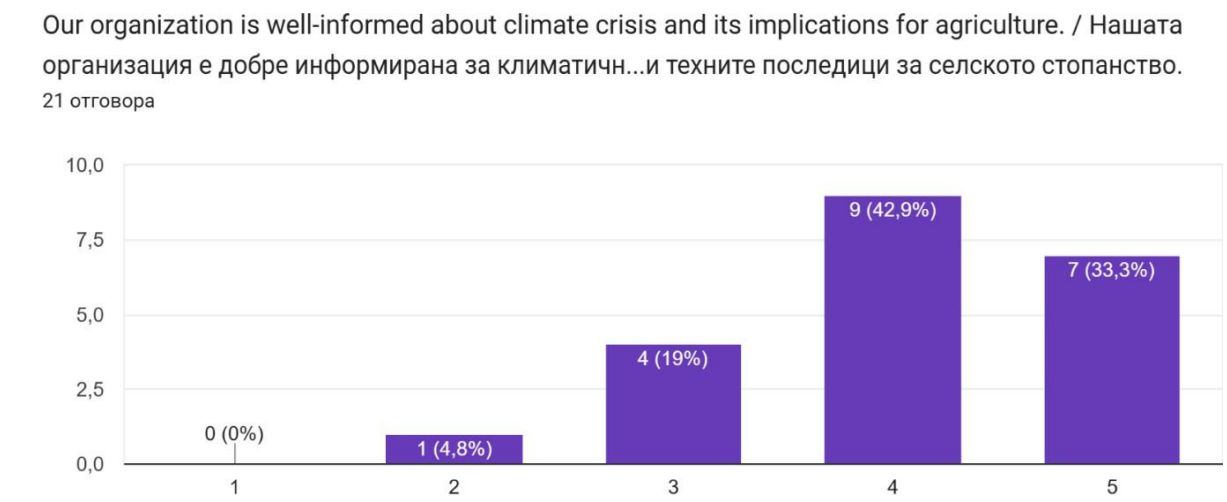

Figure 42 Climate Knowledge Level

For this reason, almost all of the surveyed institutions actively support the implementation of strategies for adapting agriculture to climate change. This gives us reason to define the obtained results as reliable in terms of real knowledge of the problems and approaches to dealing with them.

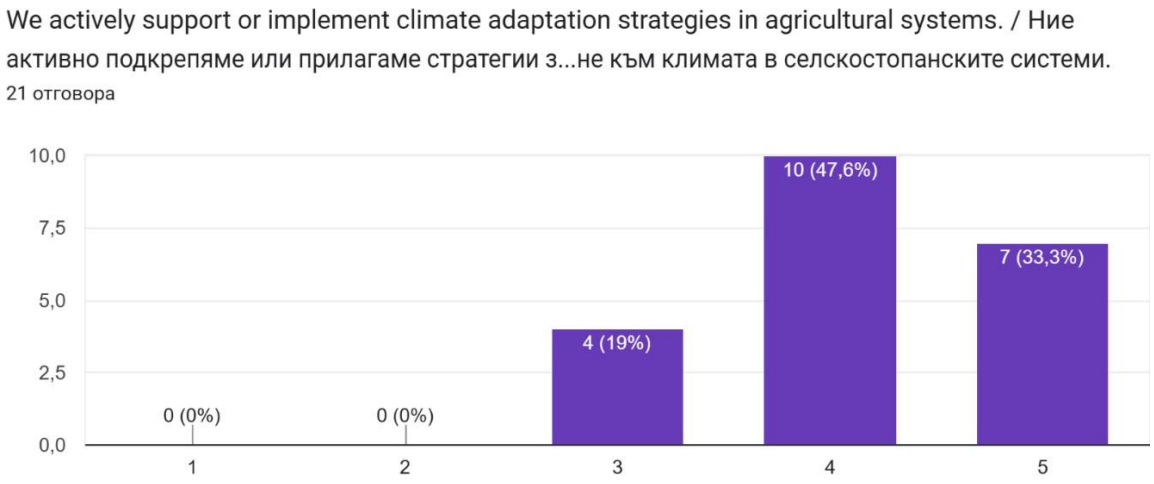

Figure 43 Climate Knowledge Level

2. Support Mechanisms and Collaboration

Over 70% of respondents stated that they have a high level of resources needed for sustainable agriculture training in agricultural communities. Only six institutions determined that they need more resources to improve the quality of their training.

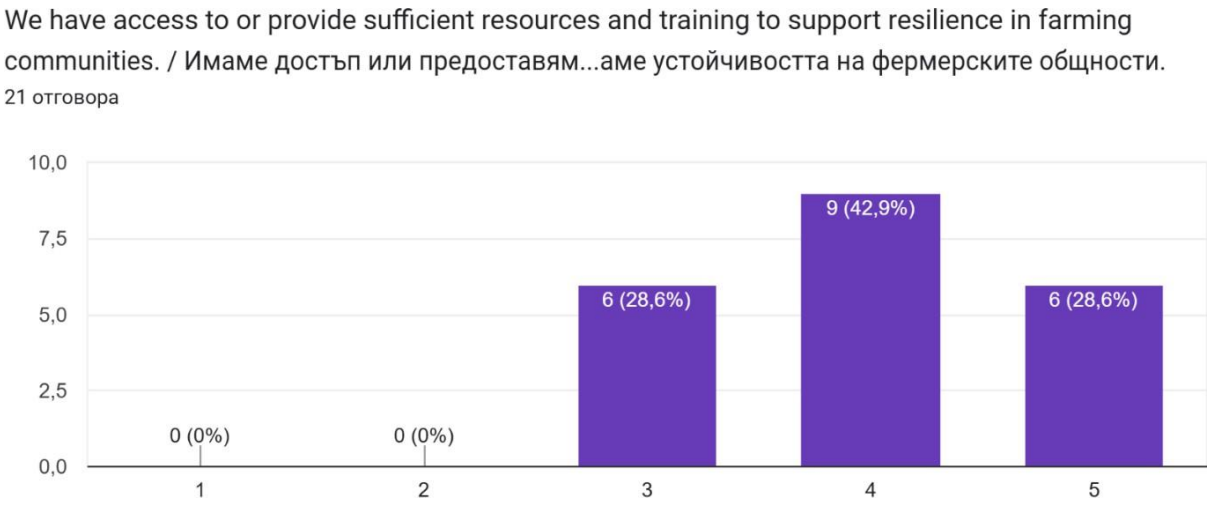

Figure 44 Resource Availability

Collaboration between different stakeholders – farmers, researchers, public and community sectors – is recognized as an extremely important prerequisite for dealing with the challenges caused by climate change. Which is a prerequisite for a real understanding of the problems in this area. Therefore, when planning strategies for adapting agriculture to climate change, it is imperative that everyone participates. This will improve the credibility of the strategies and their feasibility.

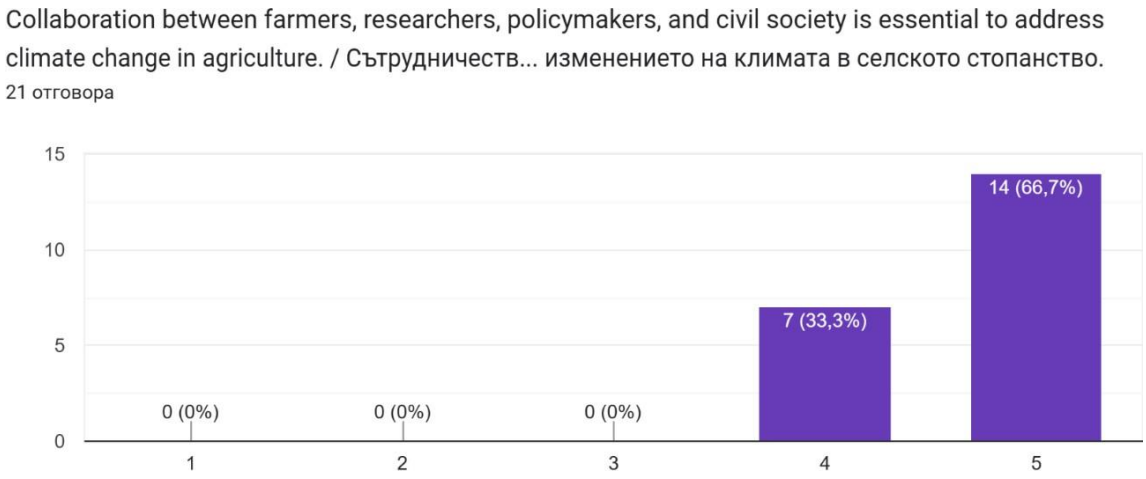

Figure 45 Collaborative Approaches

3. Current Activities and Advocacy

The level of recognition of the benefits of innovative adaptive techniques for mitigating climate impacts on agriculture is high. Only 3 institutions give a low score in terms of promoting such strategies through their activities. This is a sign of the high level of commitment of stakeholders to addressing the climate crises.

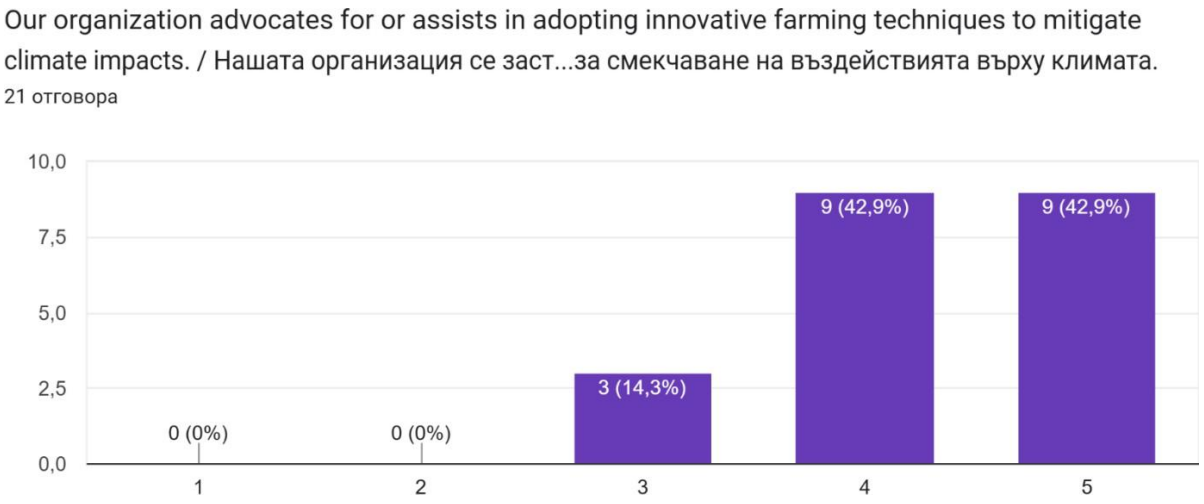

Figure 46 Innovative Practices

This active behavior of institutions is also confirmed by the stated use of digital tools for climate change adaptation.

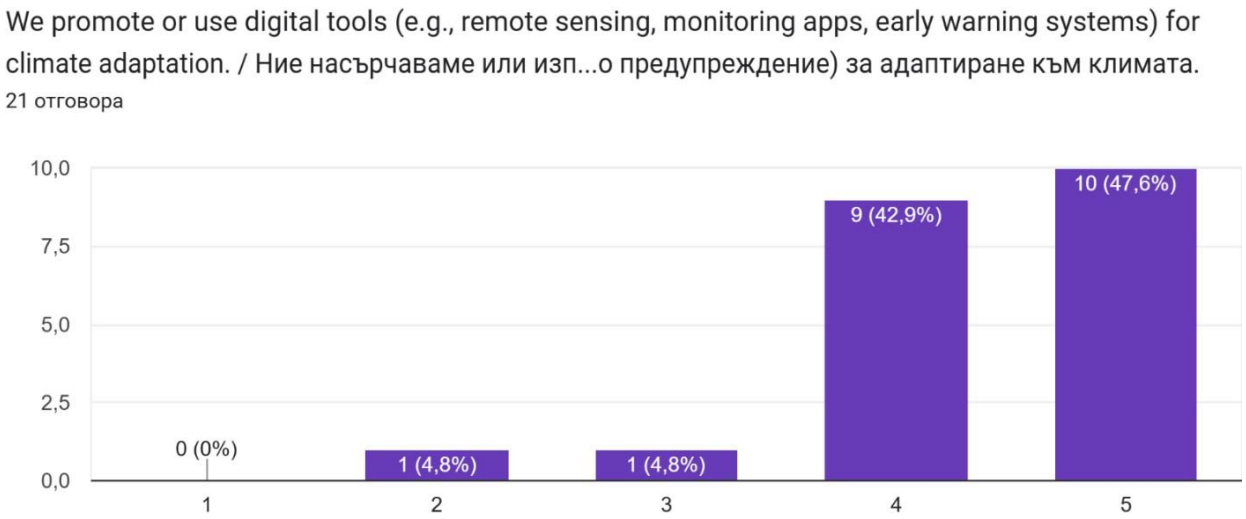

Figure 47 Digital tools

The responses of the respondents regarding the adequacy of the government policy to address climate challenges in agriculture are significantly more diverse. Here, opinions are roughly split in half, which indicates the need for their updating in line with the real needs of stakeholders in the sector.

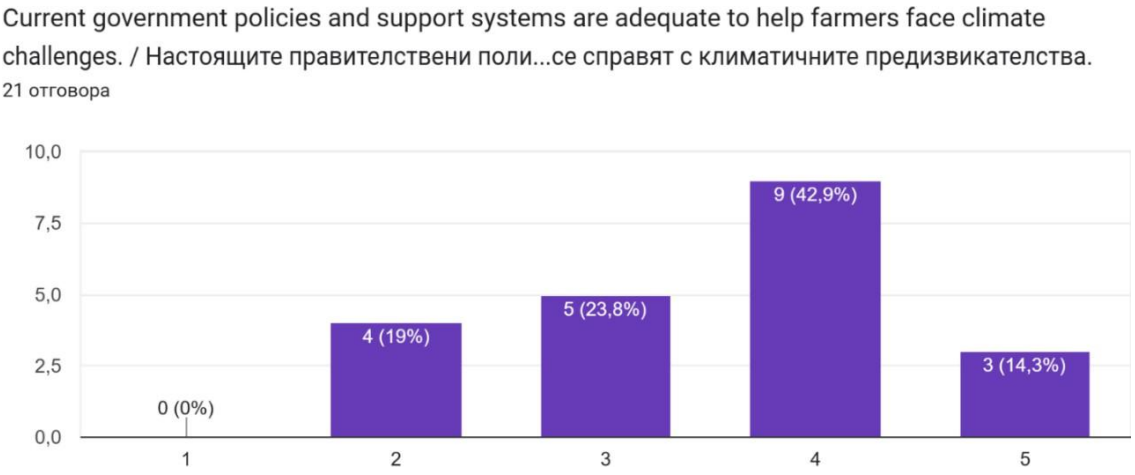

Figure 48 Policy Advocacy

4. Priority Areas and Capacity Building Needs

To assess preferences for future training and future needs, respondents answer questions related to areas in which it is important to provide training and what additional resources are needed for training in climate-resilient agriculture.

When identifying the most important aspects that need to be given greater attention when it comes to developing climate-resilient agriculture with fewer negative environmental impacts, respondents clearly prioritize two areas, namely “Water management and conservation” and “Soil health and regenerative practices.” The areas with the lowest ratings are "Renewable Energy" and "Policy, Education and Farmers' Rights". The answers given are explained by the existing problems related to the protection of agricultural resources in Bulgaria and their use in the long-term perspective.

Other surveys have reported insufficient practical training on climate crises and the presentation of real business examples of dealing with their negative impacts. Therefore, the main format preferred for training is conducting practical seminars or visits to real farms to demonstrate the effect of the applied good practices. Online resources and the use of digital tools are not recognized as effective tools and receive the approval of only 33% of respondents. There is the least interest in classroom training, which is natural given the subject matter studied.

In the previous questions, answers were given about insufficient practical training on the topics of climate crises and the presentation of real examples from businesses to deal with their negative impacts. Therefore, the main resources that trainers need are “Funding or budget for training materials” and “Access to demonstration farms”. This will provide an opportunity to conduct practical seminars or conduct visits to real farms to demonstrate the effects of the applied good practices. It is also appropriate to include well-known speakers at these events to share their experience in dealing with the climate crisis. Updating digital tools is also important for trainers to provide adequate training on climate resilience topics, as nearly half of the respondents responded positively.

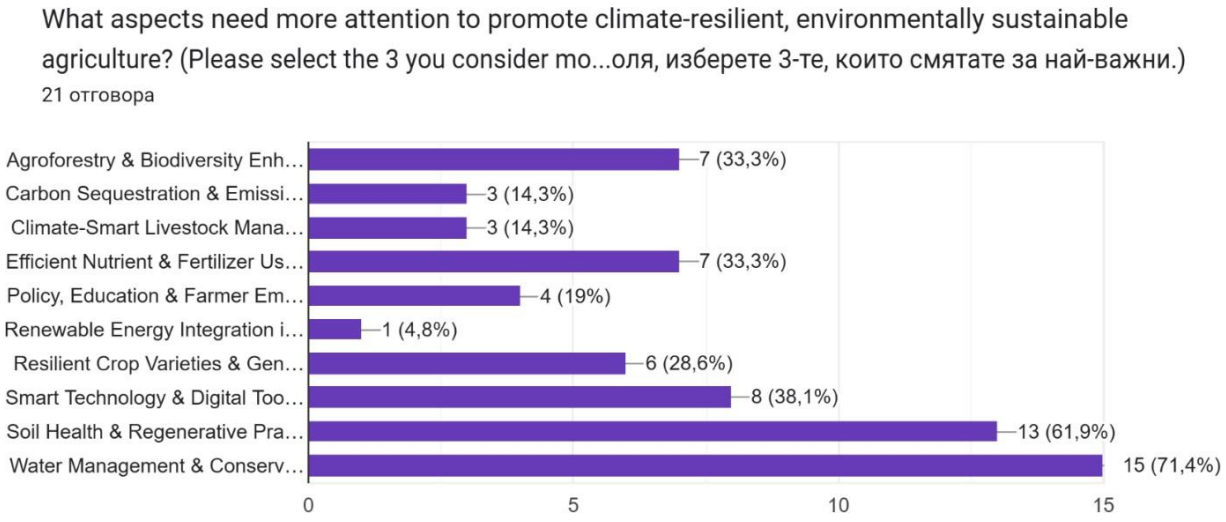

Figure 49 Training Topics

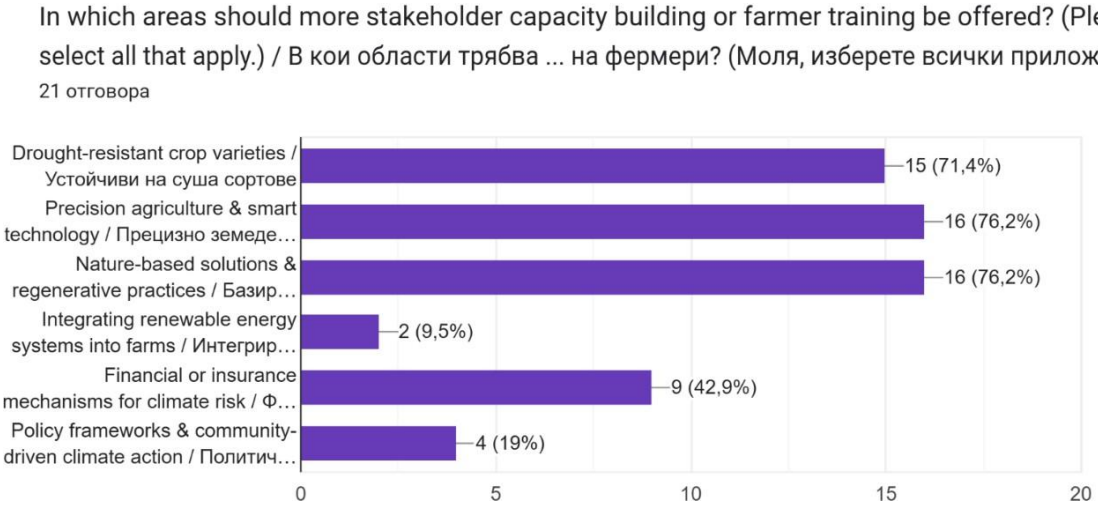

Figure 50 Training Topics

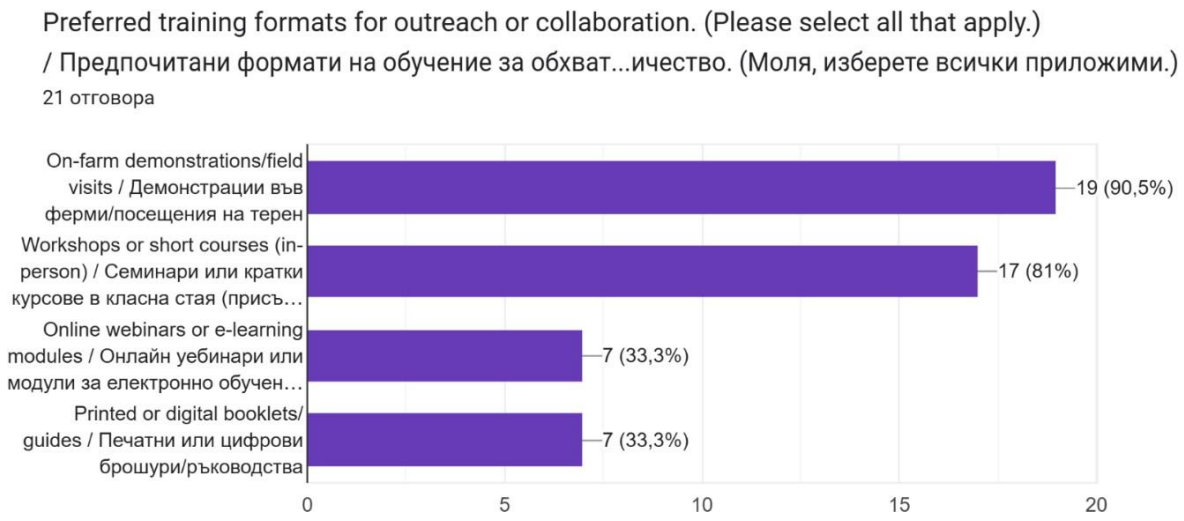

Figure 51 Preferred Formats

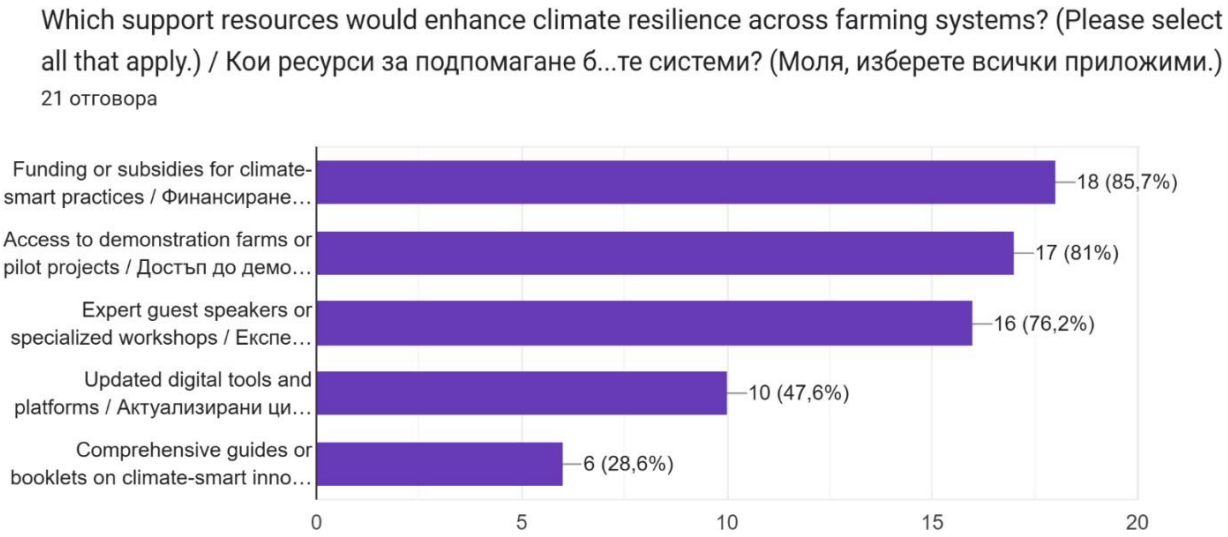

Figure 52 Resource Needs

5. Challenges and Best Practices

Farmer Support Barriers

The biggest challenges organizations typically face in helping farmers adapt to climate change fall into five key categories: economic, informational, institutional, behavioral, and environmental. Here's a detailed breakdown:

1. Economic Constraints. Many farmers, especially smallholders, lack capital to invest in adaptive technologies like irrigation systems, drought-tolerant seeds, or soil amendments. Resilient practices often require upfront investment and only show benefits over time, discouraging adoption. Without crop insurance or social protection, farmers are risk-averse and hesitant to change existing practices.

2. Lack of Accessible, Actionable Information. Localized, timely weather forecasts or seasonal predictions are often missing or unreliable. Even when digital tools are available, many farmers struggle to use them effectively. Farmers may distrust government or NGO recommendations, especially if they conflict with traditional knowledge or past experience.

3. Social and Behavioral Challenges. Resistance to Change - Farming is a cultural and intergenerational activity. Farmers may hesitate to shift from practices passed down for decades. **Inequity in Access to Resources -** youth, and marginalized groups often lack land ownership, access to credit, and training opportunities.

4. Environmental and Ecological Complexity. Farmers often face simultaneous challenges—like soil degradation, invasive pests, and erratic rainfall—which complicate solutions. Even the best adaptation strategies may not work under extreme variability or unprecedented events.

To overcome these barriers, organizations can working on:

Climate-smart extension programs tailored to local agroecological zones.

Participatory approaches that co-design solutions with farmers.

Data partnerships to improve forecast accuracy and relevance.

Policy advocacy for supportive subsidies and infrastructure investments.

Success Stories

Some organizations - NGOs, research institutions, and multilateral bodies have successfully supported or observed climate adaptation methods and technologies in agriculture. Below are three examples, with notes on what worked, what didn't, and why:

1. Farmer-Managed Natural Regeneration (FMNR). They imply **s**imple, low-cost technique involving pruning naturally regenerating trees on farmland. Improved soil fertility, increased crop yields, and enhanced drought resilience. It needs minimal input cost, based on local knowledge and strong farmer ownership and scalability through community networks.

But initial uptake was slow without demonstration plots and farmer champions.

2. Mobile Climate Advisory Services (e.g., *aWhere*, *Digital Green*, *mAgri*). It assures real-time weather forecasts and planting advice via SMS or apps. And boosted decision-making for planting, irrigation, and pest control. Strengths of it is low-barrier, scalable tech. High relevance when localized and in local languages.

But potential problem can be poor network access and digital literacy limited reach in remote areas. And also generic or delayed advice reduced trust in the system.

3. Drip Irrigation. It increases water-use efficiency; reduced dependency on erratic rainfall. It combines environmental and economic benefits. It need training and microcredit schemes supported adoption.

But high up-front costs and maintenance needs without access to finance or technical support.

Key Lessons Across All Examples:

What Worked	Why It Worked
Community participation	Builds ownership, ensures solutions are locally relevant
Bundled interventions	Combining practices often works better than single fixes
Supportive policy or institutional backing	Enables scale-up and integration
Capacity building and demonstration	Farmers trust what they see and do themselves
What Didn't Work	**Why It Failed**
Top-down approaches	Ignored local context, led to mistrust or low adoption
One-size-fits-all tech	Failed in diverse agro-ecological or cultural contexts
No long-term support	Practices stopped when projects or funding ended

Future Risks & Opportunities

Looking ahead 10 years, agricultural training will need to adapt to a range of emerging and intensifying climate challenges. These challenges will likely be more complex, interconnected, and region-specific, demanding both technical and adaptive capacities from farmers. Based on research the key climate

challenges anticipated, along with implications for future agricultural training are:

1. **Rising Temperatures and Heat Stress.** This will cause crop yield declines, livestock stress, reduced soil moisture. So there will be training needs in Heat-resilient crop varieties and livestock breeds. Microclimate management (e.g., agroforestry, shade nets). Efficient irrigation and cooling systems.

1. **Increased Water Scarcity and Droughts.** The impact will be greater competition for water; falling water tables. It needs training in advanced water harvesting and storage (e.g., check dams, drip systems), drought-tolerant crop planning and soil moisture conservation techniques (e.g., mulching, minimal tillage).

2. **More Frequent and Extreme Weather Events.** Will cause storms, floods, hail, and unseasonal frosts damaging crops. The t**raining needs** in climate forecasting and early warning interpretation. Risk preparedness plans (e.g., diversification, off-farm income). Resilient infrastructure for farms (e.g., raised beds, drainage systems).

3. **Shifting Pests, Diseases, and Weeds. It leads to n**ew pests and diseases in previously unaffected regions. So the training needs are in integrated pest management (IPM) adapted to new patterns, crop rotation and intercropping for biological control and use of digital tools for real-time pest monitoring.

4. **Soil Degradation and Carbon Loss.** Will cause declining soil fertility and structure; reduced carbon sequestration. There will be need of knowledge about **s**oil regeneration (e.g., composting, cover crops, biochar).

5. **Digital and Data Divide.** Farmers will need access to decision-support technologies. They will be trained in digital literacy (e.g., using apps for weather, markets, pest alerts), remote sensing and AI-based advisory systems.

6. **Evolving Climate Policies and Compliance.** New regulations on emissions, deforestation, or subsidies are expected. That will need training in education on climate policy, carbon accounting, and eco-certifications. Farmers will need guidance on how to benefit from climate finance and green subsidies.

6. Recommendations

Stakeholder Strategies

To effectively address the challenges farmers face in adapting to climate change, organizations need multi-level, cross-sectoral support and collaboration. Here's some key support types and how each can directly tackle those barriers:

1. **Policy Reform.** The purpose can be creation an enabling environment for climate- resilient agriculture. It needs reform input subsidies to encourage sustainable practices (e.g., subsidies for organic compost instead of synthetic fertilizers). Promote water governance reforms that support conservation and equitable access. Land tenure security for smallholders, women, and youth, enabling long-term investment in adaptation. Mandate climate-smart agricultural training in national extension systems.

2. **Training Programs.** In order to overcome knowledge gaps, low adoption, behavioral resistance can be build farmer and extension worker capacity in adaptation knowledge and skills. Can be established farmer Field Schools on climate-resilient practices (e.g., drought- resistant crops, agroforestry, water harvesting). Digital literacy programs to enable use of weather apps, market information, or remote diagnostics. Train-the-trainer models to scale expertise through local champions.

3. **Networking and Multi-Stakeholder Platforms.** It aims to share knowledge, scale solutions, and align stakeholders. It can be achieved by Farmer cooperatives and associations to increase collective bargaining, learning, and resilience. Cross-sector alliances (NGOs, government, research, private sector) to coordinate climate action. Regional adaptation networks to share climate data, best practices, and tools.

4. **Data and Technology Support.** It needs make adaptation data-driven and context- specific. It needs Invest in local climate data systems (weather stations, seasonal forecasts). Deploy advisory apps and SMS platforms in local languages. Use remote sensing and GIS tools for monitoring land degradation, water stress, or pest migration.

5. **Community-Led Approaches and Co-Design.** In order to make ground solutions in local realities and knowledge. Participatory research and design with farmers and indigenous communities. Cultural adaptation of practices to respect traditions and improve acceptance.

Summary Table:

Support Type	Main Challenges Addressed
Policy Reform	Misaligned incentives, land insecurity
Training Programs	Knowledge gaps, low adoption, behavioral inertia
Funding Mechanisms	Risk aversion, capital constraints
Networking	Isolation, knowledge silos, lack of trust
Tech & Data Support	Information gaps, poor forecasting
Community Co-Design	Resistance, inequity, lack of local relevance

Section 4 SURVEY ANALYSIS OF FARMERS IN BULGARIA

The focus group consisted of five young farmers, aged from 25 to 49. They come from five different agricultural productions: grain, livestock, vegetables, vineyards and rose production. All of the farms are small farms unless the grain producer. One of the farms is organically certified.

1. "How do you perceive the impact of climate change on agriculture in your region? Do you feel real changes on your farm and which?"

Grain Farmer:

"Over the past 10–15 years, the climate here has become noticeably drier. The winters are milder, and the spring rains that we used to rely on have become much less predictable. We're seeing more frequent droughts, which is a big concern for grain growers like me."

"The yield of wheat and barley has dropped in some years because of the lack of rainfall during key growth phases. We've started using drought-tolerant seed varieties and no-till farming methods to conserve moisture, but it's still a gamble every season."

Rose Grower:

"The traditional rhythm of seasons is changing. The spring comes earlier, and sometimes the roses bloom before the harvesting teams are even ready. On top of that, unexpected frosts in late spring can damage the rose buds."

"I've seen the quality of rose oil decline some years due to uneven flowering and weather extremes. Last year we had a heatwave during harvest, and it shortened the picking window, which hurt our production."

Vegetable Grower:

"It's harder to plan anything. Summers are getting hotter and longer, and water is becoming scarce. Some pests that weren't a problem before are now showing up more frequently, and diseases spread faster in the heat."

"My tomatoes and peppers require more irrigation than before. I've had to invest in drip systems and shading nets. Also, we're using more biological pest control because the chemical treatments aren't as effective anymore due to the fast-changing conditions."

Livestock Farmer:

"The pastures are drying out earlier in the summer, and that affects the availability of feed. The winter snow is also less than before, which affects the water supply from mountain springs."

"We have had to start buying hay earlier in the year and store more of it, which raises costs. The sheep don't have the same quality grazing as before, and that impacts milk yield and quality. It's a constant adjustment."

Vineyard Owner:

"We're seeing earlier ripening and sugar accumulation in the grapes, which changes the balance of the wine. While warmer weather can help with ripening, too much heat stresses the vines and affects acidity."

"The harvest dates have moved forward by nearly two weeks compared to 20 years ago. I've also noticed more irregular rain events that can cause mildew or rot. We've started experimenting with different grape varieties that are more heat-resistant."

These responses reflect the diverse ways climate change is affecting Bulgarian agriculture - ranging from crop quality to water stress and pest pressure depending on the region and type of farm.

1. **What climate-resilient farming practices (if any) have you already tried? What technological or natural solutions (e.g. precision agriculture, renewable energy, agroecology) do you see as promising on your farm? What were the results?**

Grain Farmer:

"We've been experimenting with no-till farming for the past few years to conserve soil moisture and reduce erosion. Additionally, we've adopted crop rotation and cover crops to improve soil health and reduce the need for chemical fertilizers."

"Precision agriculture seems very promising for us. We've started using GPS-guided tractors and soil sensors to apply fertilizers and water more efficiently. The result has been a more precise and economical use of resources, with better yields and less environmental impact. We're also looking into solar-powered irrigation systems, which could reduce our dependency on the grid."

Vegetable Grower:

"As an organic farmer, we've always prioritized soil health. We've been using composting and mulching for years to improve soil moisture retention and provide nutrients naturally. We also grow diverse crops to prevent the spread of diseases and pests, which has become more important with the changing weather patterns."

"Agroecology is the foundation of our approach. We're looking into integrating integrated pest management (IPM) techniques to combat pests more sustainably, reducing reliance on external inputs. Also, we're planning to install solar panels for electricity and rainwater harvesting systems for irrigation. We haven't fully implemented it yet, but we expect it will help us cope with both droughts and the rising cost of energy."

Vineyard Owner:

"In our vineyards, we've shifted to drip irrigation systems to conserve water and optimize its usage during dry spells. We've also started planting cover crops between the rows of vines to reduce soil erosion and improve water retention."

"Precision viticulture is something we've started to implement using drones to monitor vine health and soil moisture levels. It helps us make more informed decisions about irrigation and fertilization. The results so far are promising; we've seen more consistent grape quality and less waste of

resources. We're also exploring the possibility of installing solar panels for powering our vineyard operations."

Livestock Farmer:

"Due to the increasing temperatures and unpredictable rainfall, we've adjusted our grazing practices. We rotate pastures more frequently to allow the land to recover and have been planting drought-resistant grasses. We've also started using rainwater harvesting for livestock watering, which has reduced our reliance on municipal water supplies."

"We're looking into solar-powered water pumps and possibly integrating precision livestock farming technologies to monitor animal health, feed efficiency, and water usage more closely. I believe these innovations will help us save costs and be more sustainable. Early tests with the rainwater harvesting system have been good, and we're seeing reduced water costs and less stress on our animals."

Rose Grower:

"I've been using agroforestry practices, such as planting fruit trees alongside my crops to act as windbreaks and prevent soil erosion. The trees also help with carbon sequestration and can provide additional income. I've also been adopting mulching to keep the soil cool and moist during the summer."

"I see agroecology as the future of my farm. I've started practicing crop diversification to mitigate risks from pests and changing weather patterns. Renewable energy is also something I want to incorporate; I'm considering small solar-powered pumps for irrigation. The mulch and agroforestry practices have worked well so far, improving soil quality and reducing the effects of wind and heat stress on crops."

Each farmer's response reflects a unique combination of tried-and-tested practices as well as promising innovations they see as key to adapting to climate change in their region. These practices range from soil health management to solar energy solutions and precision technology to promote greater sustainability and resilience.

1. What do you think are the biggest obstacles for farmers in adopting climate resilient practices? (e.g. lack of knowledge, finances, habits, politics)

The farmers give the following statements about four main obstacles in adopting climate-resilient practices:

1. **Knowledge**. Climate-smart techniques promoted in one region may not work elsewhere without adaptation. If farmers don't see clear benefits – especially in the short term – they are unlikely to change practices. Pilot fatigue: Farmers are often "tested on" by short-term projects that disappear without scale-up. Farmers adopt what they trust – often based on peer experience, not outside claims. Many training programs are too technical, top-down, or not tailored to local contexts. Limited follow-up or on-farm

demonstrations means knowledge isn't retained or put into practice. Some farmers lack basic literacy or digital skills, limiting access to mobile tools or apps. Training must be hands-on, iterative, and embedded in community practices to succeed.

Finance. Climate-resilient practices (e.g., cover cropping, crop rotation, agroforestry) may require initial investment in tools, seeds, or training, with benefits that only materialize over years. Without financial safety nets, farmers are understandably risk- averse when it comes to changing practices. Farmers may fear that experimenting with new methods could lead to lower yields, especially in the first seasons. Conventional supply chains and buyers often prioritize uniformity, quantity, or speed, which discourages alternative practices that may be more sustainable but less standardized.

2. **Habits**. Some farmers may be skeptical of new techniques, especially if promoted by external actors or based on unfamiliar science. Long-standing traditions can conflict with recommended practices, like shifting planting calendars or diversifying away from staple crops. Youth may be excluded from leadership or decision-making, despite being key adopters of innovation. Ignoring social dynamics limits who adopts climate-smart farming and how quickly.
3. **Politics**. Government subsidies often still favor unsustainable practices (e.g., chemical inputs, water-intensive crops). Market demand for climate-smart products (like organic produce or carbon-sequestering grains) may be underdeveloped. Lack of infrastructure (like cold storage, processing units) discourages adoption of value-added practices. Without policy and market support, farmers have few incentives to change.

2. What type of training or support would you most benefit from? How would you like to receive information (e.g. field days, online courses, visits to other farms)?

To effectively address the challenges of adapting a farm to climate change, the most helpful support would come from a combination of policy, training, financial aid, and community involvement. Here's how each element could make a meaningful difference:

Policy Support. *Incentives for sustainable practices*: Subsidies or tax breaks for adopting climate-smart agriculture (e.g., cover crops, no-till farming, renewable energy). *Water and land-use regulations*: Clear, fair policies that ensure long-term resource sustainability without overly burdening farmers. *Insurance reform*: Crop insurance that covers climate-related risks more effectively, such as droughts or floods. *Long-term planning frameworks*: National or regional climate adaptation plans that include farming and offer guidance for local strategies.

Training and Technical Assistance: *Practical, on-the-ground training*: Demonstrations and workshops on adaptive techniques like water-saving irrigation, soil health, and integrated pest management. *Digital and technical literacy*: Help using precision agriculture tools, mobile apps, or data platforms for informed decision-making.

Financial Support: *Access to low-interest loans or grants:* For infrastructure improvements like better irrigation systems, greenhouses, or storage facilities. *Funding for diversification:* Help transitioning to more resilient crops, livestock, or income sources (e.g., agrotourism). *Disaster recovery aid:* Fast and fair compensation after climate-related damage to prevent financial collapse.

Community Involvement and Local Collaboration. *Knowledge-sharing networks:* Farmer-to-farmer groups, online forums, or field days for exchanging best practices and

innovations. *Local climate resilience committees:* Groups that bring together farmers, scientists, and policymakers to co-develop solutions suited to local conditions.

Most Effective Combination

In practice, **integrated support is most effective** – for example, a government-funded program that provides training and financial aid, backed by local advisory services and peer support.

1. Are the existing support measures, subsidies or policy programs that promote climate change mitigation in agriculture accessible and effective for you?

Support measures, subsidies, or policy programs are often designed to help farmers adopt practices that mitigate climate change, such as reducing emissions or improving land use. However, access to these programs can be limited by factors such as geographical location, awareness, and eligibility criteria. If these programs are not well-publicized or available to all farmers, they may not be fully accessible.

The effectiveness of these programs depends on how well they are tailored to local needs and how easy it is for farmers to adopt climate-friendly practices. If the subsidies or programs do not align with the actual challenges faced by farmers (e.g., financial constraints, lack of knowledge, or inadequate infrastructure), their impact may be limited.

If the existing support measures are well-targeted, easy

to access, and aligned with the actual needs of the farming community, they can be both accessible and effective. However, if there are barriers such as limited knowledge, poor outreach, or mismatched support, they might be less effective. The current support measures, subsidies, and policy programs may not be fully accessible or effective for everyone involved in agriculture. While some programs are designed to incentivize climate change mitigation, farmers often face challenges such as complex application processes, inadequate financial support, or a lack of tailored guidance. In many cases, small-scale or resource-limited farmers may struggle to meet the program's requirements or may not even be aware of these opportunities.

While some subsidies or programs exist to promote climate mitigation, their accessibility and effectiveness depend on factors like awareness, eligibility, and local relevance. If these factors are addressed, the programs can be more impactful for farmers. Many farmers may find it difficult to access climate-related programs due to bureaucratic hurdles, limited outreach, or program criteria that don't fit their needs. As a result, these support measures might not be as effective in encouraging widespread adoption of climate-friendly practices.

2. What do you think good collaboration between farmers, scientists, educational institutions and government authorities should look like to achieve climate resilience?

- **Interdisciplinary Partnerships and Knowledge Sharing**

Good collaboration should involve scientists, farmers, educational institutions, and government authorities working together in an interdisciplinary way. Scientists can offer research-based insights into climate resilience, while farmers provide real-world experiences and challenges. Educational institutions can help in spreading knowledge, and governments can offer policies that foster collaboration. Regular meetings and open communication channels would ensure the sharing of ideas and strategies that are both practical and scientifically sound. This approach emphasizes the need for two-way communication. Each group contributes its expertise, and they work together to co-create solutions based on both scientific evidence and practical experience.

- **Clear and Supportive Policy Framework**

Collaboration should be anchored in a clear and supportive policy framework that sets the stage for cooperation. Governments should

create policies that incentivize farmers to adopt sustainable practices while making it easier for scientists to research and develop new technologies. Farmers and educational institutions should be directly involved in policy development to ensure the policies address actual needs and are feasible on the ground.

This answer focuses on the importance of government action in enabling collaboration. A strong, supportive policy infrastructure is crucial to ensure that all stakeholders have the necessary resources and incentives to engage in collaborative efforts.

- **Community-Led Climate Solutions**

Good collaboration should empower local farming communities to lead the way in developing climate-resilient practices. Scientists can provide technical support and research, while educational institutions can offer training and resources. Government authorities should focus on supporting local initiatives and ensuring that policies are flexible enough to account for local conditions. By prioritizing grassroots engagement, this collaboration can be both effective and tailored to the specific needs of farming communities.

This approach emphasizes community empowerment and grassroots solutions, with an understanding that local knowledge and needs should drive the direction of collaboration. Scientists and governments should support, not dictate, these efforts.

- **Long-Term, Structured Research and Development**

A good collaboration should focus on long-term, structured research and development (R&D) that addresses climate change in agriculture. Universities and research institutions can partner with farmers to test climate-resilient techniques and share findings with the public. Governments should fund these R&D efforts and ensure that the results are accessible to all farmers, with a focus on scalable solutions. Education systems should prepare future generations of farmers to be part of this evolving process.

This answer highlights the importance of ongoing R&D to develop adaptable and scalable climate resilience solutions, with the long-term goal of providing farmers with tools that evolve alongside changing conditions.

- **Practical, Action-Oriented Collaboration**

Effective collaboration should be practical and action-oriented, focusing on real-world climate resilience strategies. Scientists can develop and share actionable insights, while farmers implement these strategies on the ground. Educational institutions can train farmers in climate- smart techniques, and government authorities should provide funding and technical assistance to scale these solutions. The key is to focus on tangible outcomes, such as increased crop yields or improved water management practices, rather than just theoretical concepts.