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Capacity Development for Green Agriculture in Armenia: An AKIS-Based Assessment and Strategic Roadmap

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ABSTRACT

This study contributes to the European Union›s Green Agriculture Initiative in Armenia (EU-GAIA), a development project aimed at fostering sustainable, inclusive, and market-oriented agribusiness in the northern regions of Armenia. Implemented by the Austrian Development Agency, the project supports the transition to green agriculture (GA) through capacity building, policy development, and stakeholder engagement. Employing the Agricultural Knowledge and Innovation System (AKIS) framework, this research identifies capacity needs, institutional challenges, and knowledge gaps among key stakeholders. The study combines a systematic review with 68 in-depth stakeholder interviews and a tailored questionnaire-based self-assessment to develop a capacity development roadmap. Findings reveal critical weaknesses in research collaboration, extension services, market incentives, and policy enforcement. The paper presents a detailed strategy for short- and long-term capacity building, including the establishment of Centres of Excellence, curriculum reforms, legal frameworks, and stakeholder networking mechanisms. The results offer actionable insights for policymakers, development agencies, and academic institutions committed to sustainable agricultural transformation.

Introduction

Green agriculture (GA) is a transformative approach that aims to reconcile food production with environmental sustainability and rural development. It emphasizes resource-efficient practices, emissions reduction, and improved soil health, while contributing to climate resilience and economic inclusiveness. Armenia's agricultural sector, characterized by smallholder dominance and regional disparities, faces mounting challenges related to soil degradation, limited innovation, and market inefficiencies. The EU-GAIA project seeks to address these challenges by enabling systemic change in the sector through capacity development, institutional alignment, and multi-stakeholder collaboration. This paper presents the findings of a comprehensive capacity needs assessment, with the aim of designing a coherent capacity development strategy based on the AKIS framework.

Background on the Armenian Agricultural Sector

The agricultural sector in Armenia is regarded as one of the most important sectors of the economy, contributing about 15% to the country's GDP and employing approximately 40% of the population (FAO, 2020). Agriculture is also the main source of economic activity in rural areas and is significantly female-driven, with nearly 56% of farmers being women. The farm structure in Armenia, like in many other countries in the region, is dominated by a large number of small-scale farms with fragmented land holdings. The average farm size is about 1.48 hectares (ICARE and IFOAM, 2017). According to 2014 census data, the 317,346 family farms contribute to more than 97% of total agricultural output.

Despite its economic and social importance, the sector remains at a low level of development, facing challenges such as geographic isolation, being landlocked with limited access to export markets, and a dependency on the Russian market. Key areas for improvement include the need for innovation, production efficiency, and a clearer legal framework. These limitations hinder sustainable development and resilience in the sector.

The Case for Green Agriculture in Armenia

In response to environmental degradation and climate challenges, the concept of Green Agriculture (GA) has been proposed to ensure food security while preserving ecosystem services for current and future generations (ICARE and IFOAM, 2017). The Republic of Armenia has favorable geographic and natural conditions conducive to GA. Recognizing this, the Ministry of Economy has prioritized GA through its integration into governmental policy and regulatory frameworks.

GA is often used interchangeably with terms such as sustainable agriculture or sustainable food systems. According to the HLPE (2014), a sustainable food system "delivers food security and nutrition for all in such a way that the economic, social and environmental bases to generate food security and nutrition for future generations are not compromised." The European Environment Agency (EEA, 2027) similarly emphasizes that sustainability must ensure both human and ecosystem health. GA draws upon principles from organic, ecological, biodynamic, and conservation agriculture. The FAO defines organic agriculture as a system that sustains the health of soils, ecosystems, and people by relying on ecological processes and biodiversity rather than external inputs (FAO, 2009; Gomiero, et al., 2011).

In summary, Green Agriculture can be defined as the production of sufficient, healthy, and high-quality food without depleting natural resources, using farming practices that conserve resources, reduce emissions and waste, and improve soil quality.

Materials and methods

Conceptual Framework

The Agricultural Knowledge and Innovation System (AKIS) framework provides a structured approach to assess and enhance interactions among education, research, advisory services, and market actors. It is increasingly adopted in the EU and its partner countries as a guiding concept for aligning agricultural innovation with societal goals.

Agricultural Knowledge ա Innovation System

The concepts of AKIS are used in this study to 1) identify and assess the capacity needs revealing the existing capacity needs, challenges and knowledge gaps of relevant stakeholders in terms of green, sustainable agriculture and 2) to develop a plan for a capacity development strategy, identifying both short and long-term requirements of relevant stakeholders.

AKIS is a useful concept to describe a system of innovation, with emphasis on the organizations and stakeholders involved, the links and interactions between them, the institutional infrastructure with its incentives and budget mechanisms (SCAR AKIS, 2012, 2016, 2019). AKIS is the combined organization and knowledge flows between persons, organizations and institutions who use and produce knowledge for agriculture and interrelated fields (Figure 1).

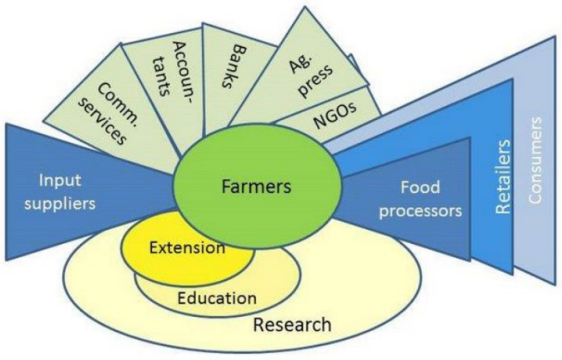


Figure 1. Visualization of the Agricultural Knowledge and Innovation System. *Source:* SCAR-AKIS.org.

AKIS actors use and produce knowledge for agriculture and interrelated fields (value chains, rural actors, consumers, etc.). Although different components of AKIS, extension/ advise, education and research, are often stressed, it is important to realize that there are many more actors in the food chain which directly influence the decision making of farmers and their innovations (Figure 2).

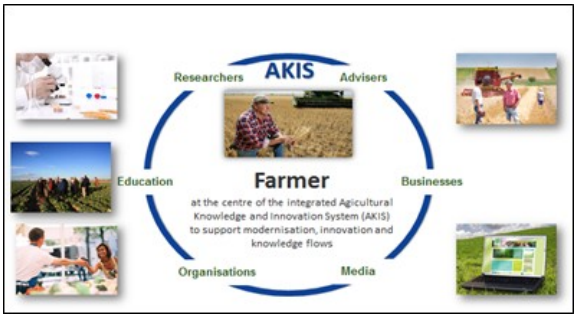


Figure 2. Relations and interaction between AKIS actors. *Source: AKIS, 2019.*

Seven key functions for AKIS

In particularly, when developing capacity development strategy, the 7 key functions for AKIS framework is utilised (Table).

Research Design and Data Collection

The study was conducted from November 2020 to March 2021 in Armenia. It involved five main components:

- Stakeholder mapping and identification (124 stakeholders including ministries, NGOs, universities, and the private sector)
- Development of tailored self-assessment questionnaires
- Review of relevant literature, including the EU Green Deal and CAP policy documents
- Conducting 68 semi-structured interviews (24% women-led organizations)
- Qualitative coding and synthesis of data into capacity themes

Results and discussions

Interviews

The interviews were conducted through phone calls, using online platforms or organizing personal meetings. Personal meetings took place mainly in regions, taking into consideration several factors: availability of internet and knowledge of online platforms, willingness of stakeholders as well as their business life. The tailor-

Table. Seven key functions for AKIS*

Education, technical training, research and data collection	Fundamental to the transformation process and involves the learning processes related to developing and utilizing new knowledge of a technology or set of practices. The development of new knowledge can occur through formal research (e.g. at universities and governmental and non-governmental research centers), the private sector (e.g. agri-business) or at the individual level (e.g. farmers).
Knowledge diffusion through networks	The exchange of information through networks, where research and development (R&D) meets government and markets. Policy decisions should be guided by the latest technological research, and R&D agendas should be adapted to changing environmental, market and social conditions.
Development of a vision for the agricultural sector	Refers to the creation of a vision for the AKIS and mobilization of incentive structures to promote that vision. Incentive structures may change in response to factor prices and regulatory pressures (e.g. product prices, taxes and subsidies), expectations in market growth potential, new knowledge, expression of interest by customers, cultural changes and external events.
Entrepreneurial activities	Turn the potential of new knowledge, networks and markets into concrete actions to develop and capitalize business opportunities.
Market formation	Is about creating demand for the outputs of the development process. New technologies or practices often have difficulty competing with the status quo, so a market must be created via institutional change. Market creation can occur through changes in regulation and taxes and/or investment in infrastructure complimentary to the innovation.
Creation of legitimacy	It is necessary to overcome resistance to a new technology or set of practices from the existing production, trade and consumption systems. It must be considered appropriate and desirable by incumbent actors for resources to be mobilized rather than blocked.
Resource mobilization	Is closely linked to the creation of legitimacy and concerns financing investment in innovation in the form of access to credit, seed funding, venture capital, investment in human and social capital and the development of complementary products, services, infrastructure, etc.

**Source: Sixt ա Poppe, 2019.*

made questionnaires with open-ended questions have been used during the interviews, creating a basis for detailed discussion and expression of views without any limitations. In average, interviews took around 1 hour, though sometimes it extended to two hours. During interviews respondents were asked to evaluate and answer questions from their personal and organizational perspectives, having in mind their needs and development perspectives. The interviews involved all types of stakeholders. The private sector respondents and respondents presenting their own organization (for example NGOs) answered to the questions mainly from their personal perspective. Other respondents tried to differentiate their personal and organizational needs/issues, which, not always was successful. The number of interviews per stakeholder group is as follows (Figure 3):

- State bodies (Ministries and other state institutions) - 11
- Regional authorities - 5
- Education and Research institutions/colleges - 15
- Extension services/advisors - 9
- Non-Governmental organizations - 7
- Associations/unions - 5
- International Organizations - 5
- Private sector organizations/farmers - 10
- Local organic certification provider - 1

41% of the interviewed stakeholders are in regions of Armenia.

Analysis of the Seven AKIS Functions for Green Agriculture

The Armenian agricultural sector is characterized by structural weaknesses, which hinder the development of GA. Major gaps include limited alignment between education/training and sectoral needs, weak public extension services, low engagement of smallholders, and fragmented vision among stakeholders. This section assesses Armenia's AKIS performance using the seven-function framework (see Table 1), based on interviews and literature.

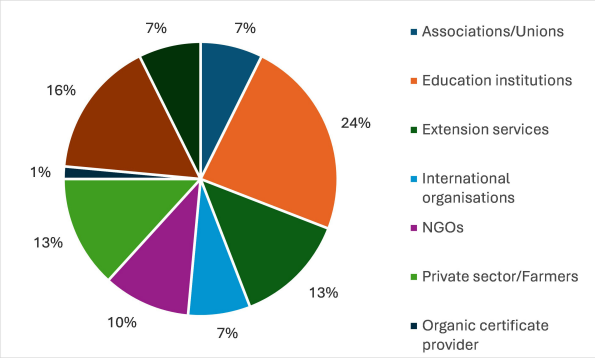


Figure 3. Legal forms of interviewed stakeholders

1. Education, Training, and Research

Current education and research systems do not adequately support GA development. Agricultural education is unattractive to youth due to outdated methods, weak sector development, and limited profitability. Key challenges include:

- *Weak Coordination:* Limited collaboration between universities, research institutes, NGOs, and the private sector leads to duplication and inefficiencies. NGOs are the most active in knowledge transfer, often driven by donor-funded projects, while government involvement remains low.
- *Misaligned research agendas:* Public research institutions are poorly connected to farmer needs. There is a lack of systematic transfer of sector challenges into research priorities and back into practice. Though demo plots (e.g. by ANAU) exist, scaling innovations remains a challenge for smallholder-dominated agriculture.
- *Underdeveloped capacity and Infrastructure:* Extension services lack GA expertise and quality monitoring mechanisms. Most extension staff have limited knowledge of international programs and innovative farming practices. Education programs lack digital platforms (e.g., MOOC/Moodle) and data analytics integration.

Curricula need redesign to integrate sustainability principles across subjects. Enhanced collaboration with the private sector is needed to update training content and delivery. Investments are required in demonstration facilities, tech parks, and innovative laboratories to support hands-on learning. Advisory services need systemic upgrades through continuous training, peer learning, performance-based incentives, and stronger linkages with education and research institutions.

2. Knowledge Diffusio

Knowledge diffusion in Armenia's agricultural sector remains limited and fragmented, posing a barrier to the advancement of GA. Three key challenges were identified:

- Weak stakeholder collaboration: Existing multi-stakeholder platforms (e.g., regional alliances, public councils, donor-funded working groups) are underutilized for GA promotion. Stakeholder engagement, particularly from government institutions,

remains limited, and the institutional capacity of associations and sectoral unions to advocate for GA is weak. Increased cooperation, peer learning, and capacity-building initiatives are needed.

- *Lack of a centralized GA knowledge hub:* There is no integrated system for collecting and disseminating GA-related knowledge. A centralized knowledge platform (e.g., website or offline depository) is needed to aggregate research, best practices, regional data, and innovation examples. It could also serve to connect stakeholder networks. Armenia's Digital Agriculture Strategy offers a potential entry point for this development.
- *Limited public awareness and visibility:* Awareness of GA remains low among farmers, communities, and local authorities. Media campaigns, educational programs, school-based environmental activities, and demonstration sites could help build broader understanding. Local authorities should be empowered to act as GA ambassadors, promoting sustainable practices at the community level.

3. Development of a Common Vision on Green Agriculture

Armenia lacks a unified national vision for GA. Fragmented priorities among public institutions, weak coordination with private actors, and the absence of organized leadership hinder the sector's strategic direction. Conflicting goals and limited information exchange further constrain the development of GA.

A shared, long-term vision is needed—one that aligns public, private, and civil society actors. Key recommendations include:

- Inclusive stakeholder engagement through continuous dialogue (e.g., forums, working groups), with a leading institution coordinating the process—potentially the Ministry of Economy after the EU-GAIA project.
- Clarity on GA definitions and principles, emphasizing environmental protection and sustainability (e.g., "less harm, more value recovery").
- Local government involvement in developing region-specific strategies for natural resource protection.
- Integration of GA into national strategies, such as the 2020–2030 agricultural development policy, alongside the development of a dedicated GA strategy. A phased approach—starting with a letter of intent—can help build momentum and commitment.

4. Entrepreneurial Activities

The Armenian agricultural sector lacks a strong culture of innovation, due to both internal (institutional and capacity-related) and external (regional instability) factors. Farmers and entrepreneurs tend to be risk-averse and require incentives to adopt GA practices. These may include financial support, guaranteed markets for green products, and simplified procedures. Private sector engagement in GA depends on profitability, visible success stories, and a supportive regulatory environment. Currently, public-private partnerships (PPPs) are underdeveloped, though they hold potential for facilitating the transition to GA if adequately financed and structured.

5. Creation of Legitimacy

Establishing legitimacy for GA in Armenia requires a clear legal framework. Respondents emphasized the need for GA to be integrated into national agricultural strategies and supported by regional action plans. Legislative updates are needed across multiple areas, including environmental standards, enforcement mechanisms, and incentives for sustainable practices. The lack of enforcement of existing laws—such as those regulating organic labeling and residue burning—undermines trust and progress. The development of comprehensive GA legislation, supported by the findings of the 2020 EU-GAIA policy review, is a critical step forward.

6. Market Formation

Market development is vital for GA adoption. Export opportunities are limited due to compliance issues with international standards. Farmers and businesses require state support to understand and access these markets. Policy instruments such as tax incentives, quality-based subsidies, and labeling regulations can stimulate market demand for green products. Branding, certification, and targeted marketing strategies are essential tools for promoting consumer awareness and creating value chains based on sustainability principles.

7. Resource Mobilization

Sustainable resource mobilization is currently inadequate. There is limited public financing for GA, and private sector engagement in training or innovation support is minimal. Key gaps include the absence of data systems for climate and market intelligence and limited integration of research, extension, and education. Innovation hubs such as Living Labs or Centers of Excellence could fill this void, fostering collaboration and knowledge exchange. However, these require significant investment and capacity development, particularly among educators and researchers, to bridge the knowledge gap with the private sector.

Conclusion

Armenia's transition toward Green Agriculture (GA) is challenged by structural weaknesses across its Agricultural Knowledge and Innovation System (AKIS). These include misaligned education and research agendas, under-resourced extension services, fragmented stakeholder collaboration, and limited policy and market support. A lack of entrepreneurial culture and an underdeveloped legal and institutional framework further constrain progress. Resource mobilization remains inadequate, and there is no unified national vision to guide transformation.

Despite these challenges, positive developments are emerging. Stakeholder awareness of sustainability is growing, supported by EU-funded initiatives like the GAIA project, which have initiated policy dialogue, demonstration activities, and capacity-building. Armenia's Digital Agriculture Strategy provides a promising platform for centralized knowledge sharing. Efforts to modernize curricula, expand demonstration plots, and promote branding and certification of green products show early signs of momentum. There is also increasing recognition of the value of public-private partnerships and innovation hubs such as Living Labs and Centers of Excellence.

To build on these foundations, Armenia must continue to align education, research, and extension systems with sectoral needs, promote stakeholder coordination, invest in infrastructure and training, and establish a coherent legal and strategic framework for GA. Strengthening market incentives and resource mobilization—through supportive policies and institutional leadership—will be essential for enabling a sustainable agricultural transition.

Below, we present a set of short-term and long-term recommendations to guide future action. The highlighted recommendations can be considered as the main building blocks for further implementation of the GA capacity building in Armenia.

Short-Term Measures

Centre of Excellence: Establish a dedicated Centre of Excellence to raise awareness and showcase GA progress. It can host demonstrations, school activities, and public campaigns. This center would serve as a hub for capacity building and outreach.

GA Curriculum: Integrate GA principles into educational programs, not only in agriculture but also in business, environmental, and ecological studies. Close cooperation with the private sector is essential to update curricula and align professions with evolving sector needs.

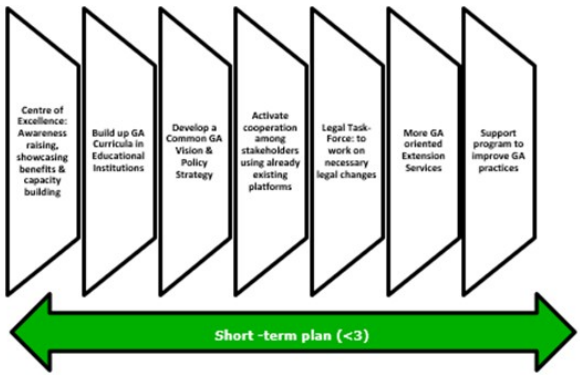
Common Vision and policies: Develop a shared national GA vision supported by clear policies and market incentives—such as green labelling, tax benefits, or subsidies—to build public commitment and demonstrate government leadership.

Stakeholder Cooperation: Strengthen collaboration through existing platforms like working groups or public councils. Facilitate joint action among farmers, researchers, and extension services, with strong government involvement.

Extension Services Reform: Reorient extension services to support GA through new performance indicators, regular advisor training, and adoption of international best practices. Services must offer timely, tailored, and practical guidance to farmers.

Legal Taskforce: Establish a taskforce to revise laws and prioritize GA-related legal reforms. Many existing regulations are outdated, unenforced, or not aligned with GA needs.

Support Program for GA Adoption: Launch a state-funded program to stimulate GA through incentives for producers, export readiness support, and consumer awareness (e.g., food safety as part of green branding). Special focus should be placed on empowering youth and women through targeted capacity building.



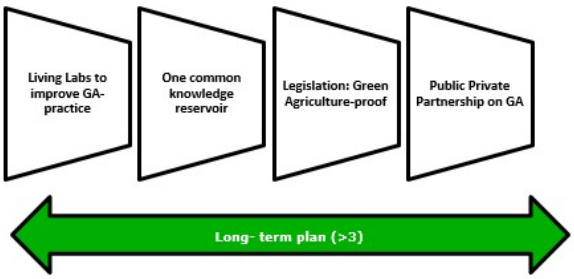
Long-Term Measures

Living Labs for GA: Evolve the Centre of Excellence into Living Labs to test, refine, and promote practical GA solutions. This includes strengthening laboratory facilities in research and educational institutions.

Central Knowledge Hub: Create a national GA knowledge platform with three key functions: (1) centralizing tools, research, and materials; (2) offering an open-source agricultural innovation database; and (3) connecting existing stakeholder networks. This hub could be developed under the Ministry of Economy's digital infrastructure.

GA-Aligned Legislation: Complete and enforce the work of the Legal Taskforce by integrating GA provisions into relevant laws and ensuring effective implementation and compliance mechanisms.

Public–Private Partnerships (PPPs): Establish PPPs to sustain awareness-raising efforts, encourage innovation, and engage farmers and youth in shaping the future of agriculture. These partnerships can serve as platforms for dialogue and adaptation to sectoral changes.



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Declarations of interest

The authors declare no conflict of interest concerning the research, authorship, and/or publication of this article.

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