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VALUE CHAIN ANALYSIS OF APRICOT, PEACHES, RASPBERRY AND WALNUT IN ARMENIA

FINAL REPORT

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giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

OECD BETTER POLICIES FOR BETTER LIVES

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ABBREVIATIONS

ADA	Austrian Development Agency
AMD	Armenian dram
ANAU	Armenian National Agrarian University
ARMNAB	Armenian National Accreditation Body
ATC	Agribusiness Teaching Center
BMUV	The Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection
CENS	Center for Ecological-Noosphere Studies of the National Academy of Sciences of the Republic of Armenia
CJSC	Closed joint-stock company
CSA	Climate-smart agriculture
FAO	The Food and Agriculture Organization of the United Nations
FSIB	Food safety inspection body of the Republic of Armenia
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GoA	Government of Armenia
ICARE	International Center for Agribusiness Research and Education
IPM/IDPM	Integrated Pest Management / Integrated Disease and Pest Management
LLC	Limited liability company
MoE	Ministry of Economy of the Republic of Armenia
NGO	Non-governmental organisation
PROGRESS	“Promoting Green Deal Readiness in the Eastern Partnership Countries” project
RA	Republic of Armenia
SC	Statistical Committee of the RA
SNCO	State non-commercial organisation
SSP	State support program
U.S./USA	United States of America
USAID	U.S. Agency for International Development
VCA	Value chain analysis
WB	World Bank
WFP	World Food Programme
WUA	Water Users Associations

1 INTRODUCTION

1.1 BACKGROUND

AMPERA LLC conducted value chain analysis of apricot, peaches, raspberry and walnut in the Republic of Armenia (RA). The assignment is being carried out within the "Promoting Green Deal Readiness in the Eastern Partnership Countries" (PROGRESS) project which is implemented by the consortium led by the GIZ and funded by the BMUV. This is a short report of the value chain analysis where hey components are provided. The main report includes more detailed information.

PROGRESS supports the countries of the Eastern Partnership in their transition to climate-oriented, resilient, and green economic development. It aims to improve the conditions for the transformation of selected agricultural and related industrial food value chains. It promotes the introduction of innovative technologies, tools and methodologies that provide a significant impetus for a transition to greater sustainability, climate resilience and long-term Greenhouse Gas mitigation, accompanied by improved enabling framework conditions.

1.2 METHODOLOGY APPLIED

The implementation of the VCA consisted of three major phases:

1) Information Collection:

Secondary Data Review: Collection of existing data from relevant state authorities and secondary sources such as statistical reports, market studies, project evaluation reports, and trade statistics. This included data on production volumes, orchard areas, typical yields, farm sizes, sales channels, employment, and geographical coverage.

Primary Data Collection: Conducting focus group discussions and key informant interviews with various stakeholders, including state officials, project implementers, service providers, input suppliers, consultants, researchers, and farmers. Relevant and advanced informants have been selected to ensure the collection of valuable and useful information.

2) Data Processing and Analysis:

Data Validation and Triangulation: Cross-checking and validation of the collected data have been conducted to ensure accuracy and reliability. This involved systemizing the data and performing initial analyses to draft narrative analytical texts.

Data Storage: All collected information has been stored in specially designed electronic databases to facilitate data processing and analysis.

3) Compilation and Reporting:

Analytical Synthesis: Conclusions and findings have been derived as a result of conducting thorough comparison, collation, and analysis of the initially prepared materials. The structure of the VCA report has been drafted in accordance with the GIZ ValueLinks2.0[1] guidance and discussed with the PROGRESS Armenia Team.

For the purpose this analysis the following classification of orchard sizes has been used:

Table 1 - Orchard classification in the context of the analysis

Type	Orchard size (ha)		
	Small	Medium	Large
Apricot	1 - 5	5-30	30>100
Peach	1 - 5	5-30	30>100
Walnut	1 - 5	5-30	30>200
Raspberry	<0.5	0.5 - 1	1>10

[1] ValueLinks 2.0

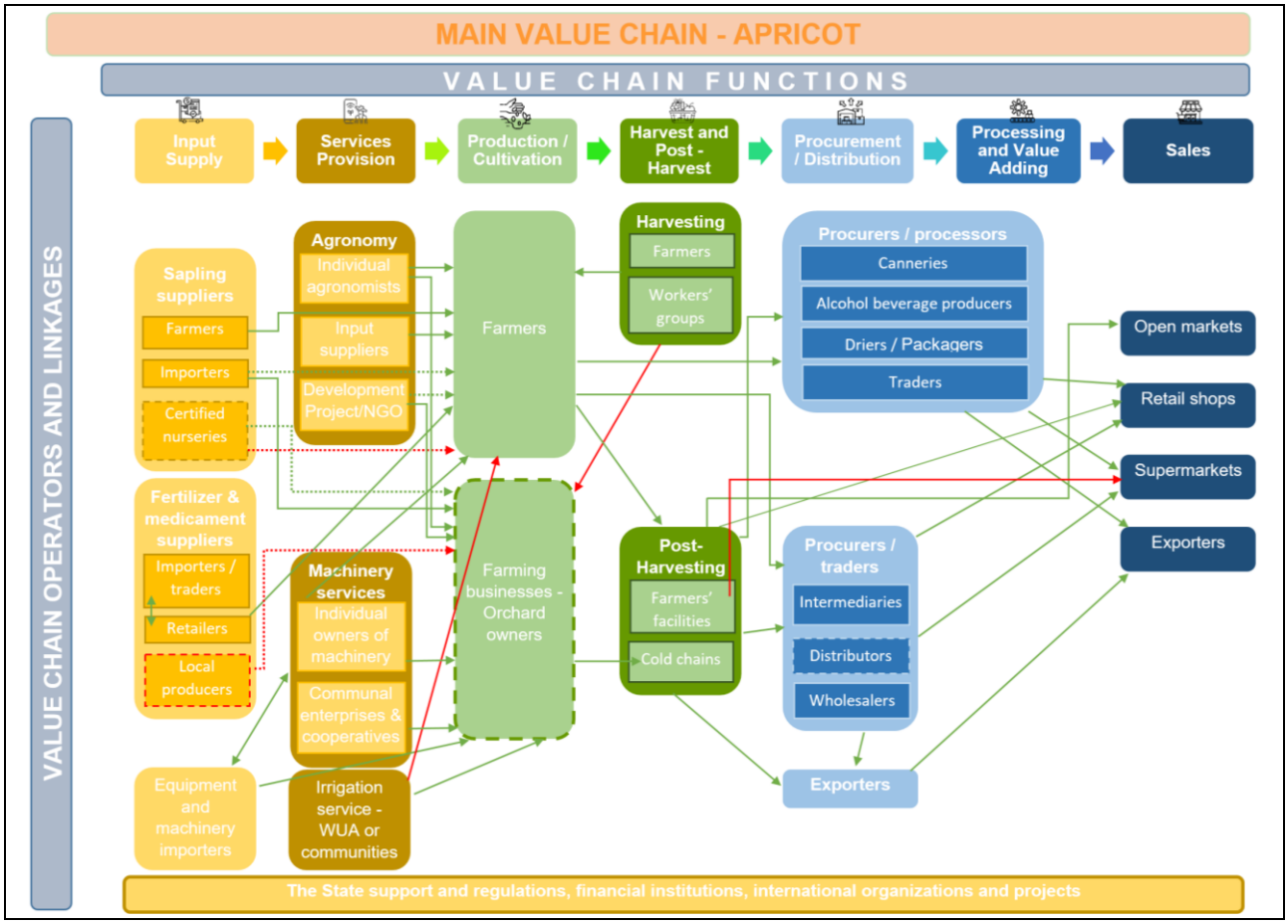
2 VALUE CHAIN ANALYSIS (APRICOT)

2.1 GENERAL INTRODUCTION TO THE VALUE CHAIN

Apricot trees produce stone, edible and versatile fruits. The trees are deciduous. Apricot belongs to the *Rosaceae* family - genus *Prunus*, and the commercial varieties are classified in the *Prunus Armeniaca* species.

2.2 VALUE CHAIN VISUALIZATION

The visualization of the Armenian apricot value chain (sub-sectoral map) reveals the major trends of apricot production and sales in the country, including the existing main functions and operators implementing those. Visualization of the VC is presented below.



Where:

Borders and arrows	Explanation
Solid line	Usual operators, commonly available, appearing in the VC often
Ordinary dashed line	Randomly met operators. Insufficiency of those is a hindering factor in the VC
Red dashed line	Randomly met operators. Insufficiency of those is a hindering factor in the VC. Only red color means insufficiency.
Solid green arrow	Business relations and transformation functions between various actors of the VC, which happen regularly

Solid red arrow →	Business relations and transformation functions between various actors of the VC, which almost do not happen, which is a serious hindering factor
Dotted green arrow ⇢	Business relations and transformation functions between various actors of the VC, which happen rarely, but not hindering processes
Dotted green arrow ⇢	Business relations and transformation functions between various actors of the VC, which happen rarely, and hindering processes

2.3 VALUE CHAIN INFORMATION

2.3.1 Geographical coverage

In the Republic of Armenia (hereinafter referred to as the RA), apricot is mainly cultivated in Ararat, Armavir, Kotayk, and Aragatsotn provinces. It is less common in the rest of provinces the RA and has no industrial significance. Approximately 65 % of apricot orchards are concentrated in the Ararat Valley (Armavir and Ararat provinces), about 15 % in the lowest part of foothill regions (Aragatsotn and Kotayk), and about 17 % in the remaining provinces of the RA[2].

2.3.2 Orchards' age and typical yield

Overall, about 150 variates of apricots are known in Armenia. However, less than 50 of them can be found in orchards including both industrial plantations and small gardens managed by small farming households[3]. The most demanded varieties are "Yerevani" (Shalakh), "Sateni", "Spitak", "Vaghahas Vardaguin" and "Masis". About 80-85 % of all cultivated varieties are the "Yerevani" variety. In recent years, some imported varieties, such as like "Goldcot", "Bora", "Tornado", "Lunafull", have been introduced to diversify production, enhance yields, and meet specific market demands. These varieties are primarily grown in modern orchards and are mainly cultivated for export. While the typical industrial lifespan of an apricot orchard is around 25 years, there are numerous old orchards in Armenia that were established 30-40 years ago.

According to the Ministry of Economy (MoE) 130.1 ha of apricot intensive orchards were established within state support programs in the period of 2019-2023. Majority of these orchards are located in Armavir province (90.5ha), followed by Ararat (12ha), Kotayk (12ha), Aragatsotn (10ha) and Syunik (0.7ha) provinces.

2.3.3 Production statistics

In Armenia, there are over 13,300 ha of apricot orchards with production volume of 1,135 thousand centners in 2022[4]. Compared to 2018, the production volume increased by more than 60%, while the orchard areas increased by only 6%. Despite a decline registered in 2020, overall, apricot production has shown a growing tendency, with an annual average growth rate of 24% from 2019 to 2022. Ararat, Armavir, and Aragatsotn provinces are the main apricot growing provinces in Armenia.

2.3.4 Employment

In the apricot value chain, employment dynamics vary based on the size of the orchard. In small farms, the cultivation and maintenance of the orchards are typically managed by family members. This includes all activities from planting to harvesting.

[2] Ara Hovhannisyan, Armen Zakaryan: *Fruit Growing*, 2022, https://drive.google.com/file/d/1PPr9TJ3ClBR8ML9CmLukPGlFp_CiexIk/view
[3] Apricot Value Chain in Armenia, Shen NGO, 2012
[4] Data for 2023 were not published at the time of preparation of the report. The total figure includes also new planted orchards that are not under production yet.

Medium-sized orchards present a slightly different employment structure. While family members still play a significant role in the cultivation and maintenance of the orchards, these farms usually hire 2-3 additional employees who primarily handle maintenance-related tasks. During the harvest period, the need for additional labour force intensifies and owners employ around up to 10 seasonal workers.

Large orchards (vast majority of which are practicing intensive cultivation), depending on the orchard's size, hire between 10 to 30 full time employees. These employees are involved in various aspects of orchard management, including cultivation, agronomical work, and operational roles in financial, marketing, logistics and sales departments.

In medium and large farms, more than 70% of the employees, including seasonal workers, are female. Women are involved especially in tasks that relates to sorting and packaging.

2.3.5 Sales channels and marketing

Usually, after the harvest the fruits are sorted by grades. In 2024 the first-grade apricots were being sold for AMD 300 - 600 per kg (EUR 0.7 – 1.4); second grade – 100 - 200 AMD/kg (EUR 0.2 – 0.5); and third grade 0-100 AMD/kg (EUR 0 – 0.2)[5].

There are different sales channels for apricot harvested in Armenia:

- ***Exporters*** play a crucial role in the apricot value chain in Armenia, predominantly targeting the Russian market. These exporters are often large apricot orchard owners who not only export their own produce but also act as aggregators, collecting apricots from smaller farmers.
- Mainly middlemen operate in ***wholesale*** markets of Armenia. Two main approaches are applied: middleman who aggregates apricot from villages and sales to middlemen operating in wholesale markets, and wholesalers who collect apricot from villages and sell in the wholesale markets themselves. On average wholesalers add 20-30% to the farmers gate price. No food safety procedures are observed in the wholesale market. Moreover, in many cases no cold storages exist, and fresh product is sold in markets without cooling.
- ***Retail sales*** include sales: (i) in the small retail shops and chain stores, (ii) in fruits and vegetables booths in the residential quarters, or (iii) on the highways. As a rule, the middlemen are those who supply fruits to the retail shops. However, in fewer cases purchaser agents of the shops go and purchase fruits from the wholesale markets. In case of the booths, the situation is vice versa, most of the booth's owners go and purchase fruits from the wholesale markets and fewer are supplied by the middlemen.
- ***Processing:*** Processing of the apricots mainly includes: (i) making jams, preserves and compotes, (ii) drying, and (iii) making fruit vodka. For different processed products different grades and qualities of apricots are used.

For the dried apricots all the grades and qualities are used – first grade fruits for the premium quality and high value dried fruits, second grade for medium quality and price, and the third grade – for making some fruits candies after grinding and mixing with other ingredients. For making preserves and compotes usually second grade apricots are used. The third-grade fruits are used for making jams or fruits vodka.

[5] Grading criteria are provided in the main report

2.4 CULTIVATION PRACTICES

2.4.1 Current Situation

Apricot is a drought-resistant plant and is not very demanding on soil type. It thrives in various soil compositions, including light-textured sandy loam, loam, and even stony, carbonate-rich soils. However, heavy clay soils are not suitable for apricot cultivation. In the recent years, the areas of dense apricot plantations, known as “intensive orchards”, have been expanding in Armenia.

In terms of productivity, modern (intensive) apricot orchards differ significantly from conventional gardens. While the crop yield may not be vastly superior to that of conventional gardens, the profitability is notably higher. This is primarily attributed to superior orchard management practices, such as effective pruning, improved pest control, easier harvesting methods, and a greater proportion of high-quality fruits in the harvest. More details about differences of conventional and intensive apricot orchards can be found in the main report.

2.4.2 Input supplies

Saplings: In conventional orchards, only traditional planting materials are used, which are obtained from seed plants. Traditional apricot saplings are produced using apricot seeds as the rootstock, onto which local varieties are subsequently grafted. Conventional seedling-based orchards typically start bearing fruit in the 4th year after planting, enter full production by the 8th year, and continue to yield abundant fruit for up to 20-25 years. Apricot saplings are quite easy to find in the market, as it is considered a traditional crop and is grown almost in all nurseries running in RA. Saplings for intensive orchards are mainly imported.

Fertilization: Organic and mineral fertilization are mainly used in conventional apricot orchards. The predominant part of organic fertilizers (mainly semi-rotted manure, rarely compost) is given in the autumn, at the end of the vegetation period at the near-root space of the trees. In addition to manure and compost, most farmers also rely on mineral fertilization. Knowledgeable farmers usually utilize a comprehensive range of macronutrients, including nitrogen, potassium, and phosphorus. Over the past 15 years, foliar fertilization (extra-root fertilization) has become increasingly popular in conventional orchards. Farmers have recognized that even small doses of foliar fertilizers can notably enhance the appearance of products and the storage capacity of fruits.

Plant protection: The majority of conventional farms lack plant protection specialists, resulting in orchard treatment measures being conducted based on advice from neighbour farmers and local input suppliers. Such advice is often inaccurate as it does not consider the specific conditions of each case. Farmers frequently rely on pesticide sellers, presenting damaged branches or leaves from the infected trees for diagnosis. To address pest management concerns, intensive orchard owners typically engage local and/or foreign specialists who conduct regular monitoring of the orchards and develop appropriate pest management plans, specifying pesticides, timing, and dosages.

In terms of *Disaster Risk Management*, conventional orchards typically have a straightforward structure, often lacking the sophisticated measures to mitigate the adverse impacts of hail, frost, strong winds, drought and other harmful factors. Only the negative effect of late spring and early autumn frosts can be partially extinguished. Nearly all intensive apricot orchards are equipped with hail protection nets, effectively protecting the crop from hail damage. However, anti-hail nets are only feasible for dwarf and semi-dwarf tree orchards. Protection against late spring frosts primarily involves the use of smoking heaps like in conventional orchards. Rarely, specialized frost-fighting machines known as “Frost-busters” are employed in intensive orchards.

Pollination: A limited number of fruit-producing farms use pollination advanced technologies like Bumblebee pollination. Usually, farmers use one special beehive for each 1000 sq.m. of orchard. Recently some farmers started to use special substance like Active FLOWER™ pollen process stimulator[6], which enhances pollen development, anther dehiscence, pollen hydration, and production of fruits.

Irrigation: In the most conventional orchards furrow, tree basin, and flood irrigation methods prevail. While tree basin irrigation is primarily employed in small gardens and lacks industrial significance, flood irrigation is predominantly practiced in orchards with a cover crop system. In the case of furrow irrigation, a huge volume of water is required, which is on average 800 - 900 m^3 per hectare for one time irrigation.

Modern apricot intensive orchards predominantly rely on drip irrigation systems. However, there are exceptions, notably in semi-dwarf tree orchards featuring Armenian varieties, which tend to be smaller in size and often utilize traditional furrow irrigation methods. In contrast, classic high-density orchards typically have separate water reservoirs and well-developed drip irrigation systems.

2.4.3 Harvesting and post-harvesting/handling (cold storing, etc.)

The harvesting season of apricots in Armenia starts in the second half of May. In the small conventional orchards, the harvesting is usually organized by the farmers jointly with their family members. Farmers having large orchards hire seasonal workers that are mainly women. In general, no specific postharvest handling procedures are observed by farmers. Most of the small and part of medium-sized farmers don't have cold storages and sale the fruit directly to wholesalers and exporters from the farm gate.

2.4.4 Services

Extension: In general, conventional orchard owners acquire practical skills and knowledge on the specifics of apricot cultivation from elders and other experienced and well-known producers, as well as through available online sources (such as YouTube channels, Facebook, WhatsApp or Viber groups, etc.) However, the knowledge and skills they acquire not always is effective (due to differences in many factors) and by no way can substitute professional extensions services. In contrast, intensive orchard owners typically hire highly qualified (including international) agronomists and experts.

Machinery: As a rule, various simple agricultural machinery and equipment are predominantly utilized in conventional apricot orchards. Up to 80 horsepower tractors, notably some models of "Belarus" tractors, are commonly employed for tasks such as soil cultivation of inter-row spaces, and pest control measures. In intensive orchards, alongside with the conventional agricultural stuff, specialized machinery and equipment are used, including mobile harvesting platforms, high-efficiency garden sprayers, soil tillers, small tractors, and crop transporters.

Tree training and pruning: Observations indicate that small farmers cultivating conventional orchards often lack adequate knowledge, leading to insufficient and improper apricot pruning practices. Consequently, excessively dense, opaque, and poorly ventilated canopies develop, escalating the negative effects of diseases and pests while diminishing fruit quality. Normally, specific training and pruning systems are used in the intensive orchards. The most common training approaches are different types of Central Leader (vertical axis) systems like Tall Spindle.

[6] https://activeagriscience.com/product/active-flower/

2.5 HINDERING FACTORS AND RECOMMENDATIONS

2.5.1 Hindering factors

The analysis revealed several hindering factors affecting apricot cultivation in both conventional and intensive orchards:

- ***Lack of professional knowledge and experience***: the primary obstacle for the development of the sub-sector is the lack of professional knowledge and experience among farmers. Some local and international organizations, including the Armenian National Agrarian University (ANAU), partially address this issue through training courses or consultancy to interested farmers. However, despite of these initiatives farmers' professional knowledge remains insufficient.
- ***Climate related issues:*** Apricot growers face various climatic challenges, including frost, drought and hail, which are significantly affecting yields. Despite the presence of anti-hail systems, their effectiveness is limited, necessitating improvements in installation and operation. Another factor negatively affecting production volumes is late spring and early autumn frosts.
- ***Absence of certified planting materials:*** Almost all the nurseries have limited capacities and need both professional and financial support to meet rapidly growing requirements. The main issue is the absence of nurseries producing certified planting material. Purchasing seedlings from local nurseries carries the risk that the product may not meet the standards of the specified species and variety. Another problem is disease and pest infestation. Plants from most of the uncertified nurseries are more likely to be infested with diseases and pests, which can spread to other plants and reduce crop yields.
- ***Irrigation:*** Despite having all the necessary technical capabilities, farmers often struggle to utilize irrigation systems efficiently. Instead of organizing the irrigation process based on the information from soil sensors, farmers typically commence orchard irrigation when the soil surface appears dry. Another issue linked to irrigation is late irrigation. Very often Water Users Association (WUA) opens irrigation season in late April or early May, leading to water shortages during the crucial cultivation periods. Non-flexibility of WUAs in providing irrigation water out of irrigation season, whenever necessary for protection against frost, results in loss of yield.
- ***Improper fertilization of dense orchards***: In most cases, farmers use only the macronutrients (Nitrogen, Phosphorus, and Potassium) for the fertilization of intensive orchards. They often overlook pH regulators, micronutrients, and precise calculations required for optimal fertilizer application rates.
- ***Lack or poor quality of training and pruning***: Training and pruning of fruit trees are major issues in both conventional and intensive orchards. Small businesses and individuals offering pruning and training services exist in horticultural regions such as Armavir, Ararat, Kotayk, Aragatsotn, Tavush and Vayots Dzor provinces. However, the quality of these services generally does not meet the minimum standards of the fruit-growing subsector.
- ***Labour shortages and inefficient harvesting techniques:*** One of the challenges of the apricot value chain is the shortage of labour. This shortage often leads to delays in harvesting, resulting in overripe or damaged fruit that is unsuitable for market sale. Another challenge is the use of inadequate harvesting techniques. The harvesting techniques employed are often inefficient and do not adhere to the best practices, leading to considerable wastage of fruit.

More hindering factors affecting apricot value chain are described in the main report.

2.5.2 Recommendations

To enhance the export potential, profitability and to adapt to climate change in the apricot value chain it is recommended to:

- ***Promote better harvesting practices***: To improve harvesting efficiency, it is essential to provide better training/practical consultancy for seasonal workers. Training programs should focus on teaching farmers and workers who are usually involved in harvesting how to pick and handle the fruit gently and efficiently to minimize damage and waste.
- ***Support in improvement of post-harvest infrastructure:*** Improving access to cold storage can extend the shelf-life of fresh apricots, allowing farmers to sell their produce at better prices. Additionally, upgrading rural and field roads to ensure smoother transportation can reduce the physical damage to apricots during transit. Training of farmers and logistic service providers on proper storing practices for each crop can further protect the fruit from spoilage, maintaining its quality and market value.
- ***Support in installing frost protection systems***: In addition to traditional irrigation methods, there are other specialized frost protection systems such as overhead sprinklers designed specifically for frost mitigation. This system works by utilizing the principle of latent heat released during the phase change of water. Compared to other frost protection methods, overhead sprinklers are relatively cost-effective to install and operate, especially when considering the potential yield savings. **It is recommended to pilot this approach in one of the intensive orchards with anti-hail nets.**
- ***Technological integration***: Introducing mobile apps for farm management can help farmers monitor and manage their operations more effectively. Mobile apps and relevant tools for farm management offer a wide range of functionalities that can significantly improve the efficiency and effectiveness of farming operations.
- ***Recommendations to the Government of Armenia***: One of the critical issues raised by farmers relate to irrigation system and operation of WUAs. There are several recommendations to the Government of Armenia (GoA), implementation of which could improve productivity of orchards and mitigation of apricot trees to early and late frosts.
    - *amending irrigation regulations*: update the regulations governing WUAs to include provisions for emergency water delivery during frost periods. This could involve creating a legal framework that prioritizes water allocation for frost protection in orchard regions when frost forecasts are issued.
    - *creating a frost response plan*: develop and implement a comprehensive frost response plan that outlines the specific actions to be taken by WUAs and farmers when a frost warning is issued.
    - *adding flexibility in operations of the WUAs*: there is need for more flexibility in activating irrigation systems and ensuring timely water delivery based on weather conditions and agricultural needs per each region and, preferably, per each community.
    - *introducing agricultural insurance system for apricot*: Given the economic importance of apricots and their vulnerability to environmental risks, including them in the agricultural insurance system would provide crucial protection for farmers, promote investment in the sector, and contribute to the overall stability and growth of Armenia's agricultural economy.
- ***Support in introduction of early warning systems***: Early warning systems based on meteorological data collection and analysis can be set up in the orchards to foresee a timely and precise implementation of plant protection and monitoring measures. For instance, the Dutch company called “RIMpro” is specialized on provision of plant protection advisory services. The

meteo-stations installed in the orchard periodically provide data to the “RIMpro” system. The system is processing the forecasted meteorological data and provides data on exact dates for insects’ mating, hatching, larva stages and flight periods of adults. These help to detect the most sensitive stage of insect and implement pest control on proper and exact periods and avoid additional, non-effective sprayings and reduce overuse of chemicals and pollution of the environment.

- ***Integrated Pest Management / Integrated Disease and Pest Management***:
    - prepare and disseminate widely educational video-materials or social advertisements on the principles and techniques of IPM/IDPM, focusing on biological pest control,
    - implement IPM pilot projects that include the use of predators/entomophagy such as mites, lacewings, ladybugs as well use of pheromone traps, and trap crops. Support the purchase of pheromone traps and other IPM/IDPM-related tools and supplies.

2.6 PRIMARY PRODUCTION FINANCIALS

Total costs and expected income for 1 ha of yielding orchard:

Intensive orchard		**Conventional orchard**	
Main directions	**Amount in AMD**	**Main directions**	**Amount in AMD**
Orchard establishment costs	21,462,000	Orchard establishment costs	1,842,400
Industrial yielding orchard cultivation costs	3,930,680	Industrial yielding orchard cultivation costs	2,858,000
Estimated marketable yield, t/ha	19*	Estimated marketable yield, t/ha	12**
Estimated low-quality yield, t/ha	4	Estimated low-quality yield, t/ha	6
Estimated yield, t/ha	23	Estimated yield, t/ha	18
Average sales price of the crop, AMD/kg	350	Average sales price of the crop, AMD/kg	350
Average sales price of low-quality crops, AMD/kg	100	Average sales price of low-quality crops, AMD/kg	100
Income from marketable crops, AMD	6,650,000	Income from marketable crops, AMD	4,200,000
Income from low-quality crops, AMD	400,000	Income from low-quality crops, AMD	600,000
Total income from 1 ha	**AMD 7,050,000 EUR 16,588**	Total income from 1 ha	**AMD 4,800,000 EUR 11,294**

*Full yield on 4th year

**Full yield on 8-9th year

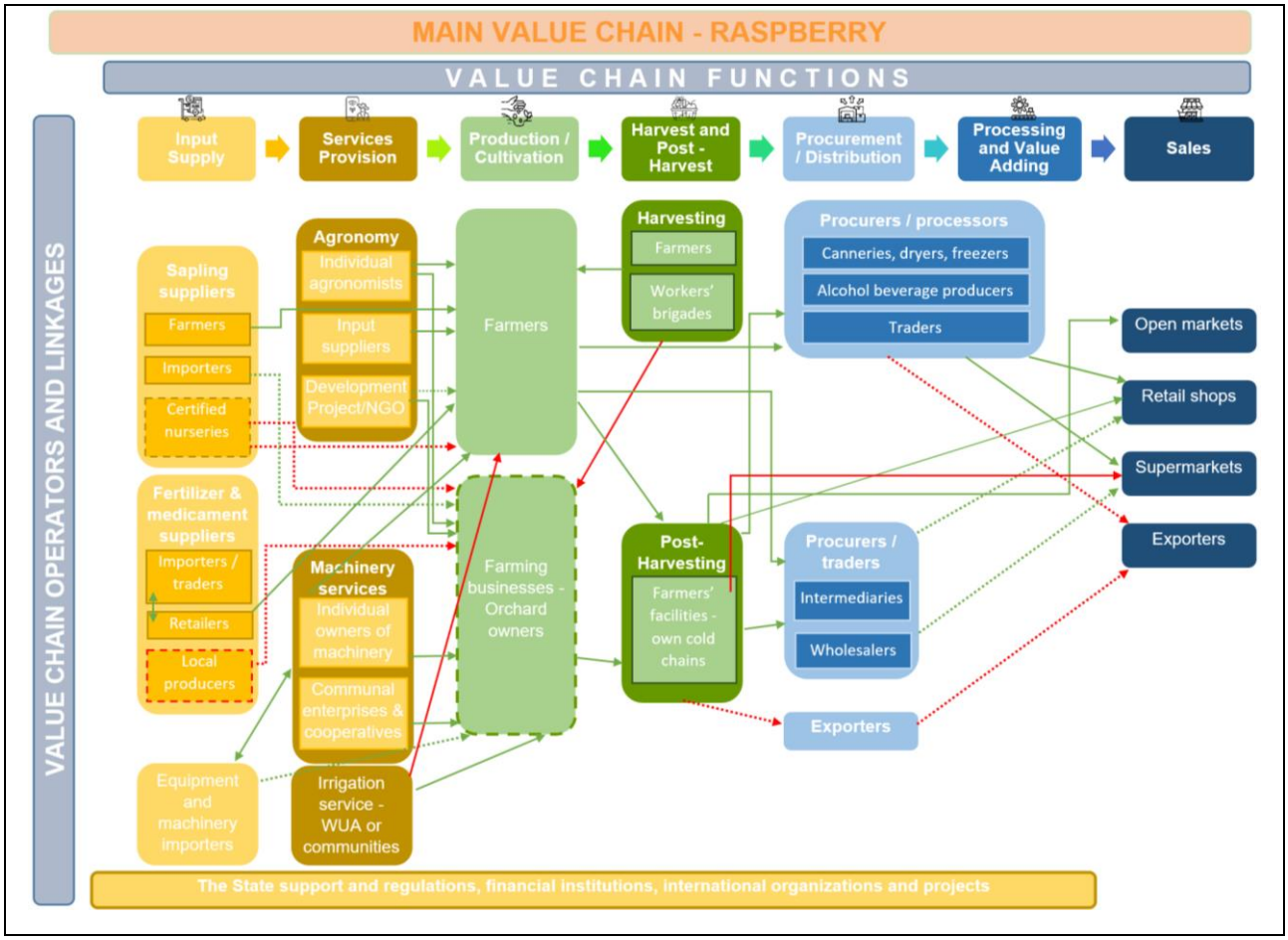
3 VALUE CHAIN ANALYSIS (RASPBERRY)

3.1 GENERAL INTRODUCTION TO THE VALUE CHAIN

Raspberry production is a significant agricultural activity in various regions around the world. The world's top raspberry producers include countries such as Russia, the United States, Poland, Serbia, and Mexico. Many raspberry-producing countries are engaged in international trade, exporting fresh and processed raspberries to markets worldwide. Major export destinations for raspberries include European countries, the United States, Canada, and Asian markets.

3.2 VALUE CHAIN VISUALIZATION

Raspberry value chain is actually very similar to those of fruits, but still is distinguished. Visualization of the VC is presented below.



3.3 VALUE CHAIN INFORMATION

3.3.1 Geographical coverage

Armenia benefits from favourable climatic conditions conducive to raspberry production. Unfortunately, it currently trails behind neighbouring countries in terms of production volumes. However, raspberry cultivation in Armenia is gradually gaining attraction, particularly in Aragatsotn, Gegharkunik, Kotayk, Lori, Syunik and Tavush.

3.3.2 Orchards' age and typical yield

Raspberry production in Armenia is typically carried out on a smaller scale compared to other crops. Many raspberry farms are operated by small-scale growers or family-owned enterprises, often cultivating raspberries alongside other crops. Additionally, as demand for raspberries and raspberry products rises both domestically and internationally, there is potential for further expansion of raspberry cultivation areas and increased production volumes in Armenia in the coming years.

According to the information received from the MoE, in total 67.6 ha of new established raspberry plantations received a support from the Government in the form of subsidies or reimbursement of expenses from 2019 to 2023. Majority of these producers are located in Kotayk province followed by Lori and Armavir provinces.

The two raspberry varieties widely recognized and grown by raspberry producers in Armenia are *Polka* and *Zyugana*. They proved to be the best ones adapted to Armenian climate conditions.

3.3.3 Production statistics

Unfortunately, the Statistical Committee (SC) of the RA does not provide separated statistics on raspberry grown areas, production and productivity level. The only statistics the SC provides relates to berry production, which includes not only raspberry but other berries as well (blackberry, blueberry, strawberry, etc.)

3.3.4 Employment

The production of raspberries is mostly family business where all members of family are directly involved in the business. Usually, men are mostly involved in all production and marketing cycles ensuring proper cultivation, plant protection and daily sales activities, while women mostly support their husbands during the harvesting period coordinating the women-collectors' daily activities. However, all producers of raspberry involve seasonal collectors/workers during berry fruit harvesting months. Depending on scale of production it may vary from 7-10 workers/collectors per hectare. These workers/collectors are mostly women.

3.3.5 Sales channels

The raspberries producers mostly sell their raspberry yield through retail and wholesale grocery markets. They cooperate with a middleman who ensures sales of the whole yield of raspberry during the year. Generally, the producers organize daily harvesting of raspberry yield and daily sales. On average small and medium sized producers may sell daily from 100 to 200kg of raspberries through middleman either on farm-gate terms or delivering the collected yield to middleman in Yerevan. The payment is made by middlemen in cash against each delivered/sold part of yields. In most cases there is no contractual relationship between producers of raspberries and middlemen.

Big producers are selling their raspberry produce under the brand. There are certain recognized brands in the fresh berry markets: ArmBerry, STEPBERRY, Rubi, Freezy Breezy and others.

3.4 CULTIVATION PRACTICES

3.4.1 Current Situation

During the Soviet period, raspberries were cultivated in almost all provinces of Armenia but did not have much industrial scale. Today, raspberry orchards are established by using new approaches and advanced technologies. These orchards are called modern or intensive and are more effective and profitable.

Raspberries are a high-value crop, and one hectare can provide up to AMD 10 million (around EUR 23,529) of annual income. However, the potential to provide such a large income also carries several challenges. In particular:

- a large financial investment is needed to establish a raspberry orchard,
- the raspberry production volume in Armenia is increasing rapidly, making it challenging to sell the crop in the local market,
- in the future, challenges may arise regarding the export of processed raspberry products,
- berries cannot be stored for a long time.

More details about differences of conventional and intensive raspberry plantations can be found in the main report.

Agricultural techniques, plant training, and pruning systems

In conventional raspberry orchards, no trellis system is used. Modern orchards are typically trained into a trellis system to support the canes and improve airflow, which reduces the risk of disease. There are several common training systems used for raspberries, including the V-trellis, T-trellis, and umbrella trellis. Pruning is usually done in late winter or early spring while the plants are dormant. In general, pruning of raspberries in both conventional and modern orchards follows similar principles and techniques.

Climate resilient practices

Anti-hail nets are often used to protect raspberry orchards from damage caused by hailstorms. The nets also protect the berries from the intensive insulation during the warm season. The nets can be used in two ways, covering the entire orchard area (horizontally), and covering rows vertically from the right and left sides. In both cases, nets are supported by sturdy structures such as poles or wires.

3.4.2 Input supplies

Planting material: Raspberries are propagated vegetatively, which makes the process of propagation and obtaining rootstocks much easier. Each hectare of a fully productive raspberry garden can yield tens of thousands of high-quality rootstocks. The large-scale producers are used to import the planting materials/varieties from Europe, Georgia and Ukraine and further reproduce by themselves.
Fertilization: Raspberries are very sensitive to soil quality and grow well in humus-rich, fertile, moist soils. Basically, all small and medium and even some of the big producers of raspberries use a combination of organic (compost or manure) and mineral fertilizers to improve soil fertility. The combined mineral fertilizers (N10 P10 K10) are mostly applied once per year before starting the cultivation season.
Farmers usually fertilize the orchards with semi-rotted manure once every 2-3 years. In addition, during the vegetation period, advanced farmers apply mineral fertilizers as well. The scenario is a little different in modern orchards, where fertilization is systematized.

Plant protection: Compared to many crops, in Armenia, raspberries are less affected by diseases and pests. That is the reason why many farmers can grow a raspberry with limited use of treatments. This fact allows many farmers to practice green agriculture and even certify their raspberry orchards as organic. However, most of the producers of raspberries use chemical pesticides to fight main pests and diseases.

Irrigation: Irrigation of conventional raspberry orchards is mainly carried out by furrow irrigation. This is primarily attributed to the challenges faced by small-scale and non-industrial farms in making additional investments, as well as the narrow inter-row spaces, which complicate garden cultivation and management, including installation of drip irrigation system. Irrigation in modern orchards is predominantly conducted using the drip irrigation method, although traditional irrigation methods are still used in some of them.

3.4.3 Harvesting and post-harvesting/handling

The harvesting of raspberries in Armenia is organized by manually. During the harvesting season, producers/owners engage 7-12 workers/harvesters per hectare of raspberry plantation who are mostly women. For one day women harvesters can harvest up to 40 kg. After the harvesting, before delivering to middlemen, the harvested raspberries are stored for some hours in the basement or cooling storage to keep the freshness of the produce.

In general, producers sell their produce in plastic boxes/packages of 1kg during the high harvesting season, but at the retailers' demand they may also pack the produce in 150-250gr boxes. Producers use also zipping polyethylene big packs of 3, 5 or 10kg when it is supplied to big processors/wineries or confectionery factories for processing.

3.4.4 Services

Extension

In general, raspberry producers get practical skills and knowledge on the specifics of raspberry cultivation from their friends and peers. Since currently in Armenia raspberry producers mostly cultivate imported/international varieties of raspberry, there is a lack of academic or advisory knowledge and skills at the local level. Therefore, the main source of practical knowledge is the Internet or knowledge/practice exchange with other peer-experienced and well-known producers.

Machinery

The level of mechanization used in raspberry orchards mainly depends on the region and the size of the orchard. The mechanization level is minimal in small non-industrial plantations. The level of mechanization of works in modern orchards is higher. Various tasks including inter-row space cultivation, spraying, crop transportation, etc., are facilitated by specialized machinery.

3.5 HINDERING FACTORS AND RECOMMENDATIONS

3.5.1 Hindering factors

Based on meetings and interviews with different producers, processors and traders, several hindering factors have been identified in the raspberry value chain. These challenges can be grouped as follows:

- ***Climate-related challenges:*** Raspberry producers have reported significant issues caused by climate-related events such as hail and late spring and early fall frosts. Hail can severely damage

raspberry plants, delaying the harvesting period as the plants need time to recover. These adverse conditions have a drastic impact on the overall yield and quality of the raspberries, making it difficult for producers to maintain consistent production levels.

- ***Water scarcity:*** Another significant challenge faced by raspberry producers is the scarcity of irrigation water, particularly during hot and drought seasons. Raspberry plants require a substantial amount of water, and during peak cultivation periods, nearly 100 tons of water per week is needed for a planting area of one hectare. Water scarcity not only limits the growth potential of the raspberry plants but also affects the overall health and yield of the crops.
- ***Logistical problems:*** Transportation issues often cause physical damage to the berry-fruit, reducing its market value. Additionally, cold storage facilities at cargo terminals often do not maintain the ideal temperature required for preserving raspberries. In summary, the inadequate storage conditions and poor handling procedures at cargo terminals negatively impact the quality and market value of raspberries, posing a significant obstacle to their export.
- ***Quality of planting material:*** Producers often face problems with the quality and health of the raspberry saplings they purchase. There is a lack of transparency and assurance regarding the quality of planting material, making it difficult for farmers to ensure they purchase healthy, disease-free plants.

More hindering factors affecting raspberry value chain are described in the main report.

3.5.2 Recommendations

To address these challenges and promote sustainable agriculture and agri-processing practices within the raspberry sector, a number of recommendations has been developed.

- ***Climate-smart agricultural practices:*** Extreme weather events such as hail, spring and fall frosts pose significant challenges to raspberry producers, delaying harvest and reducing yields. To address these issues, farmers should adopt climate-smart agricultural practices, including agroforestry, intercropping, mulching and cover cropping which in result will increase biodiversity and enhance resilience to climate variability. Thus, it is recommended to conduct training for raspberry producers on climate-smart agricultural practices.
- ***Diversifying crop varieties*****:** Another solution to mitigate climate-related risks is diversifying crop varieties by introducing and cultivating raspberry varieties that are more resilient to local climatic conditions. It is recommended to collaborate with relevant research institutions to identify and promote varieties that can withstand specific local climate challenges.
- ***Rainwater harvesting and storage:*** Water scarcity is a significant challenge for raspberry producers, particularly during hot and drought seasons. Installing rainwater harvesting systems to capture and store rainwater for irrigation during dry periods can mitigate this issue.
- ***Water management training*****:** It is recommended to provide training to farmers on water management techniques and the importance of scheduling irrigation to optimize water usage and improve crop productivity. Training can cover topics such as soil moisture monitoring, efficient irrigation methods, and water-saving practices.
- ***Investing in automated harvesting technologies*****:** Investing in automated harvesting technologies, such as robotic pickers, can reduce dependency on manual labour and, consequently, decrease the costs and harvest losses.
- ***Investing in cold chain logistics*****:** Developing a cold chain logistics system, including refrigerated trucks and cold storage facilities, is essential to maintain the quality and freshness of raspberries during transportation and storage.
- ***Promoting new technologies in preserving raspberries:*** There are different raspberry freezing methods, which can be used to prolong shelf-life of harvested products. For preserving

raspberries while maintaining their taste and flavour, shock freezing, cryogenic freezing and vacuum freezing (freeze drying) offer superior quality preservation. Fluidized bed freezing and blast freezing are also methods, commonly used to produce high-quality frozen raspberries. Deep freezing method could be widely used for delivering raspberries to processing companies and bakeries off-season.

- ***Establishing certified nurseries**:* Establishing certified nurseries that provide high-quality, disease-free raspberry seedlings to farmers can address this issue. It is recommended to support the Ministry of Economy in effective implementation of nursery certification system by providing relevant consultancy and advice.
- ***Pilot Freeze-drying / Lyophilisation practice in Armenia***: To boost preservation and marketability, it is recommended to implement a pilot project by establishing freeze-drying facilities with advanced technology and setting up mobile units or local centers for farmers. This activity could include provision of training and raising awareness on freeze-drying practices and benefits, offer grants for equipment to assist small-scale producers, facilitate collaboration between facilities and local markets to streamline distribution. GIZ could also consider providing support to initiatives that will promote raspberry processing technologies, such as preparation of natural teas, raspberry powder etc.[7]

3.6 PRIMARY PRODUCTION FINANCIALS

Total costs and expected income are calculated for 1 ha of yielding orchard.

Intensive orchard		**Conventional orchard**	
Main directions	**Amount in AMD**	**Main directions**	**Amount in AMD**
Orchard establishment costs	11,311,000	Orchard establishment costs	5,986,000
Industrial yielding orchard cultivation costs	5,767,200	Industrial yielding orchard cultivation costs	4,938,000
Estimated marketable yield, t/ha	7	Estimated marketable yield, t/ha	6
Estimated low-quality yield, t/ha	6	Estimated low-quality yield, t/ha	4
Estimated yield, t/ha	13	Estimated yield, t/ha	10
Average sales price of the crop, AMD/kg	1,000	Average sales price of the crop, AMD/kg	1,000
Average sales price of low-quality crops, AMD/kg	600	Average sales price of low-quality crops, AMD/kg	600
Income from marketable crops, AMD	7,000,000	Income from marketable crops, AMD	6,000,000
Income from low-quality crops, AMD	3,600,000	Income from low-quality crops, AMD	2,400,000
Total income from 1 ha	**AMD 10,600,000 EUR 24,941**	**Total income from 1 ha**	**AMD 8,400,000 EUR 19,765**

[7] Some examples of these practices can be found here: https://rabbits.world/en/produit/lyophilized-raspberries/; https://nuts.com/driedfruit/red-raspberries/premium.html; https://www.driedmushrooms.eu/product/lyophilized-raspberries/;

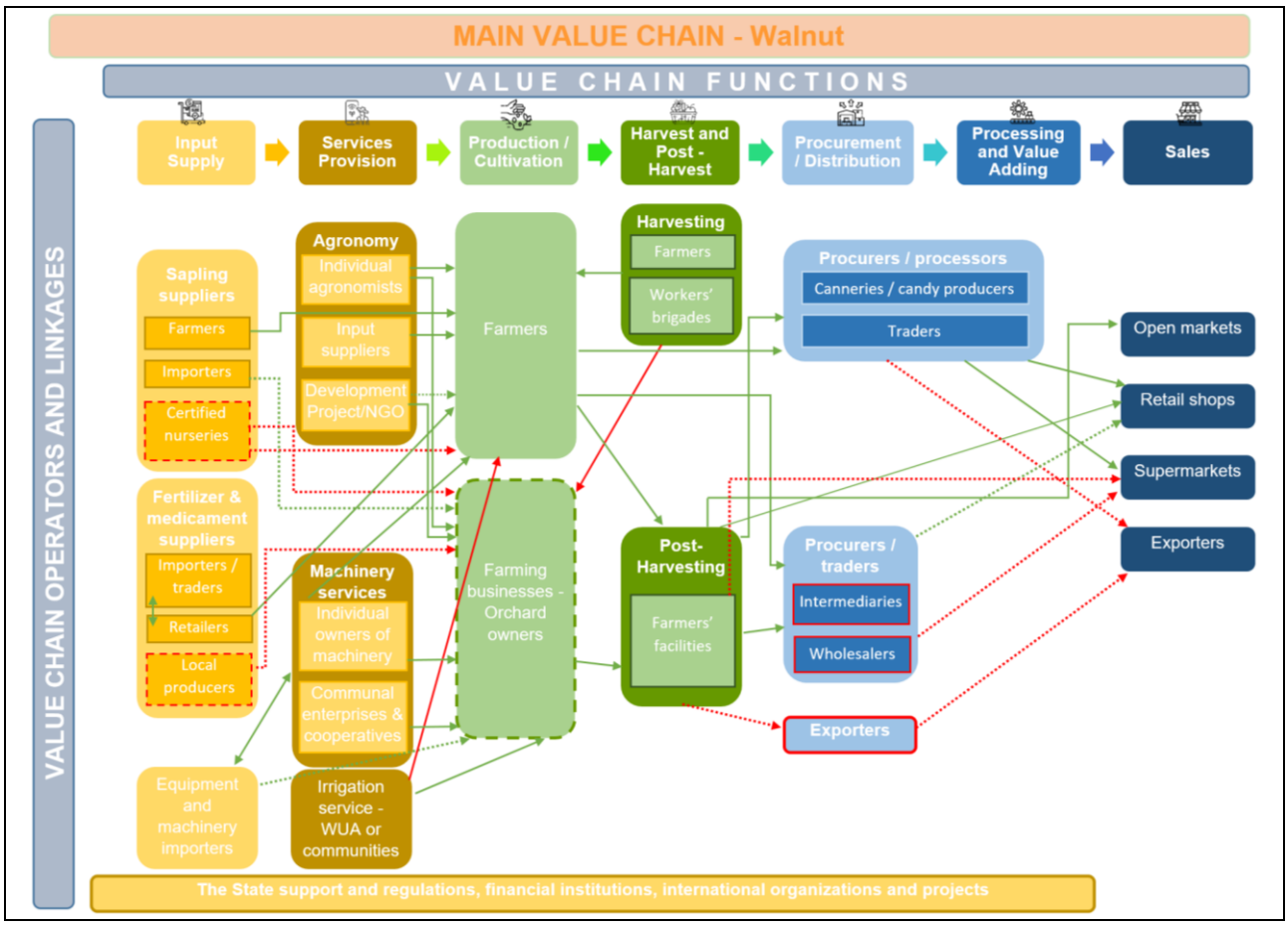
4 VALUE CHAIN ANALYSIS (WALNUT)

4.1 GENERAL INTRODUCTION TO THE VALUE CHAIN

Walnuts are among the oldest and most widely cultivated nuts globally, valued for their high-quality crop. Its cultivation area continues to expand both in Armenia and worldwide. According to statistical data provided by the FAO, fewer than 60 countries produce walnuts on an industrial scale. The leading producers include China, the USA, and Chile, among others.

4.2 VALUE CHAIN VISUALIZATION

Details on visualization are presented below.



4.3 VALUE CHAIN INFORMATION

4.3.1 Geographical coverage

Walnut production areas continuously grew in the period 2019-2022, reaching 2,239 hectares in 2022. Unlike apricot and peach production, walnut production is practiced in almost all provinces of Armenia. Orchard areas are almost equal across provinces. In Armenia, the establishment of industrial-sized walnut orchards is a relatively recent development and becoming more or less large-scale production only in the past several years. Most of these orchards are from 10 to 20 hectares.

4.3.2 Orchards' age and typical yield

Numerous walnut varieties are being cultivated in Armenia, including favourites like "Artashati," "Ideal," "Fernor," "Franquette," "Chandler," and "Lara." In Armenia also numerous other walnut varieties are grown, often unidentifiable due to being imported and propagated at the amateur level without accompanying variety information.

4.3.3 Production statistics

The highest amount of walnut production was recorded in 2015 - 5,424 tons. The areas occupied by walnut orchards have changed little over the last years and have increased from 2000ha in 2019 up to 2200 ha in 2022. In general, the demand for walnuts is increasing, which is mainly determined by their high price in the market, as well as the increase in the availability of new cultivation technologies.

Considering the walnut grow potential the GoA introduced a program supporting growth of orchards of non-traditional agricultural crops. According to the information received from the MoE of the RA in total 199.2 ha of new established walnut orchards received a support from the Government in the form of subsidies or reimbursement of expenses from 2019 to 2023.

4.3.4 Employment

In the walnut value chain, employment dynamics vary significantly based on the size of the orchard. Conventional walnut orchards in Armenia are typically small and managed entirely by family members. These family-run operations include all activities, from planting to harvesting, without involving any external workforce.

Medium-sized walnut orchards have different employment structure. While family members continue to play a significant role in cultivation and maintenance, these orchards typically hire 2-3 additional employees to handle year-round maintenance tasks.

Large walnut orchards have more complex employment structure and require a broader range of skills and labour. These orchards typically hire around 10 full-time employees who are involved in various aspects of orchard management. During the harvest season, the need for additional labour intensifies, and approximately 50 seasonal workers are employed.

4.3.5 Sales channels and marketing

The **exporters** are predominantly large walnut orchard owners who not only export their own produce but also produce of smaller orchard owners and act as aggregators. Overall, shelled walnut is distributed/delivered in different vacuumed polyethylene packages from 1kg to 30kg depending on buyers' preference. The packed shelled walnut is shipped to international markets via air in case of small quantity, and through roads/trucks in case of big volumes.

Mainly **middlemen** operate in the wholesale markets. Usually, middlemen collect walnuts from large walnut orchard owners or small producers in the villages and sell them either in the wholesale market or deliver to retail shops.

Processing: Processing of the walnuts includes making preserves (from unripe green walnuts) and using the kernels in confectionery. Different quality walnut kernels are used for different confectionary products.

4.4 CULTIVATION PRACTICES

4.4.1 Current Situation

Compared to traditional large trees, semi-dwarf walnut tree varieties gain popularity faster among farmers due to their earlier fruit-bearing capabilities and easier cultivation. For this reason, almost all newly planted walnut orchards are planted with semi-dwarf trees. In addition, they can be both trees grafted on clonal rootstocks or seedlings, as well as complete seed plants. For optimal growth of walnut trees, the soil pH should ideally be neutral to slightly acidic. Walnuts need moderate levels of light and warm, displaying a moderate level of sensitivity. However, insufficient heat and light can have adverse effects on yield and growth.

4.4.2 Input supplies

Saplings: During the last 15 years, semi-dwarf walnut saplings have become more popular among Armenian farmers. Now, it is even easier to find semi-dwarf trees of any imported variety in nurseries than vigorous seedlings of the local variety. However, real high-quality virus free planting materials/saplings can still be obtained only from companies importing trees from Europe, Georgia or Türkiye.

Fertilization: Most conventional walnut orchards are situated on homestead farms, where proper fertilization practices are often neglected. Typically, only semi-rotted manure is applied around the base of trees. In addition to manure and compost, some farmers also use mineral fertilization. In rare cases experienced farmers employ a balanced mix of macronutrients, including nitrogen, potassium, and phosphorus.

Fertilization principles used in intensive walnut orchards are significantly different. In modern orchards, half-rotted manure is applied in autumn, with mineral fertilizers (NPK) added in spring and early summer. All necessary activities, including fertilization, pest management, irrigation, etc., are planned by agronomists, often hired from Europe, and heavily rely on advanced technologies. In some orchards advanced farmers use water-soluble mineral nutrients delivered through the irrigation system.

Plant protection: Compared to other tree species like apricot, peach, apples, etc., walnuts are more resistant to some pests and diseases. This is the reason why most conventional gardens are not subjected to monitoring, preventive measures and treatment works at all. Unlike conventional orchards, intensive gardens are fully controlled against diseases and pests. Most often, treatments are carried out against fungal diseases.

Pollination: Usually, in intensive orchards other varieties that are used for pollination are planted together with growing variety on each 11 rows of planted trees. These pollinator varieties are also bearing fruit similarly to the main growing walnut variety. In conventional orchards no such practice exists, the people rely on bees and wind.

Irrigation: Absolutely all conventional walnut orchards are irrigated traditionally by using furrows. Considering that the walnut is a very large tree, it has a powerful root system that penetrates deep into the soil, drip irrigation method cannot meet the water requirements of large trees. For this reason, even most semi-dwarf walnut tree orchards are irrigated in the traditional way. The super-intensive plantation system requires the provision of supplemental quantities of water, both through furrows or by using drip irrigation and sprinkling systems.

4.4.3 Harvesting and post-harvesting/handling

Harvesting of walnut differs in conventional and intensive orchards. In conventional orchards usually family members are involved in collecting walnuts that are fallen from the tree because of shaking. Shaking is usually done by a specialized person, who climbs on the branches of the tree and shakes them.

In the intensive orchards this practice is not used. As the trees are semi-dwarf there is no need to involve a specialized person for shaking. Shaking could be done also by using specialised machinery. The large orchard owners keep walnut and its kernel in cold storages. In traditional cases not cold storages are used and crops are kept mainly in underground facilities.

4.4.4 Services

Extension: As agricultural extension services are underdeveloped in Armenia, small farmers usually lack skills in horticulture practices. The gap in advisory structures is partially filled by the consultancy provided by input suppliers (for instance pesticide sellers). This advice sometimes is approximate and totally incomplete. Extension services especially for walnut production, cultivation and pest management are not sufficient, there is a lack of knowledge and specialists.
Machinery: The level of use of agricultural machinery during walnut production in conventional orchards is minimal. Farm machines are used only for inter-row soil cultivation. Intensive orchards employ a wider range of agricultural machinery, which enhances work efficiency. Owners of intensive orchards typically invest in a comprehensive array of equipment tailored for horticulture. This often includes machinery such as tractors, mobile harvesting platforms, high-efficiency garden sprayers, soil tillers, crop transporters, and more.
Pruning service: In conventional walnut orchards, farmers often neglect tree pruning. Many are unaware that walnut trees require pruning, similar to other fruit trees. Even if farmers acknowledge the necessity of pruning, they may struggle to do so due to the trees' considerable height. Unlike conventional walnut orchards, farmers in modern orchards practice annual tree pruning.

4.5 HINDERING FACTORS AND RECOMMENDATIONS

4.5.1 Hindering factors

- ***Lack of knowledge and skills in industrial production*:** Despite the long-standing tradition of walnut production in Armenia, transition to industrial scale production is relatively recent. This stage of industrial walnut farming has exposed a significant gap in knowledge and skills related to the establishment, cultivation, and management of large-scale walnut orchards. Farmers and producers often lack the technical expertise required for modern agricultural practices. This deficit in knowledge hinders the optimization of yield and quality, affecting the competitiveness of Armenian walnuts in the global market.
- ***Challenges in establishing business linkages*:** Walnut producers in Armenia face considerable challenges in establishing business linkages, particularly in foreign markets. Many producers lack the necessary support and resources to effectively market their products and connect with international partners. There is a need for government's and relevant local and international organizations' active role and support to fill this gap. Providing access to market information, facilitating trade connections, and assisting in marketing efforts are critical steps that

can help Armenian walnut producers enter foreign markets and ensure the development of the sector.

- ***Inadequate laboratory infrastructure*:** Comprehensive laboratory analyses are crucial for ensuring that walnut/kernel meets international quality and safety standards. Currently, most walnut orchard owners send the samples of soil and water to laboratories in Italy, the Netherlands, or other European countries for testing. Establishing state-of-the-art accredited laboratories in Armenia, capable of providing accurate and internationally compatible testing services, is essential to support the local walnut industry.
- ***Insufficient post-harvest infrastructure***: In Armenia, there is a lack of facilities for efficient drying, storage, and processing of walnuts. This brings to post-harvest losses, reduced quality, and reduced market value of the product. Investments in modern post-harvest infrastructure, including drying units, storage facilities, and processing plants, are important to minimize losses and ensure that walnuts meet the quality standards required for export markets.
- ***Fragmented supply chain and coordination issues***: The walnut value chain in Armenia suffers from fragmentation and lack of coordination among stakeholders. Small-scale producers often operate independently, leading to inefficiencies in production, quality, and supply. There is a need for better coordination and cooperation among producers, processors, and other stakeholders to create a cohesive and efficient value chain.

More hindering factors affecting walnut value chain are described in the main report.

4.5.2 Recommendations

To address these issues several recommendations have been formulated.

- ***Knowledge gap in industrial walnut production:*** It is essential to establish comprehensive training and extension services tailored to walnut cultivation. These actions could include workshops, field demonstrations, and the development of educational materials covering all aspects of walnut farming, from planting and pest management to harvesting and processing.
- ***Support in establishing business linkages:*** It is recommended to support relevant institutions in developing a comprehensive market access program. This program would support participation in international trade fairs, organise business matchmaking events, and provide marketing and branding assistance.
- ***Support in creating laboratory capacities:*** The lack of relevant laboratory services in Armenia strengthens the necessity of establishment of accredited laboratories equipped with state-of-the-art technology for comprehensive quality and safety analyses. Additionally, training local laboratory technicians to maintain high testing standards and procedures is crucial.
- ***Support in improving post-harvest infrastructure:*** It is recommended to establish modern post-harvest infrastructures including drying units, storage facilities, and processing plants (e.g. for peeling, calibrating, cracking, packing or processing shells and green skin). Improved infrastructure will reduce post-harvest losses, enhance walnut quality, and enable value addition, increasing profitability and foreign market entrance perspectives.
- ***Support in implementation of sustainable practices***: Sustainable production practices in walnut value chain are important not only for environmental considerations, but also for ensuring access to foreign markets and adding value to products. In this regard it is recommended to develop and conduct training programs for farmers on the benefits and techniques of sustainable orchard floor management, nitrogen management, and integrated pest management. Establishing a monitoring system to evaluate the effectiveness of implemented green practices and collecting and analysing data will help continuously improve and adapt strategies for sustainable walnut production.

4.6 PRIMARY PRODUCTION FINANCIALS

Total costs and expected income are calculated for 1 ha of yielding orchard.

Intensive orchard		Conventional orchard	
Main directions	**Amount in AMD**	**Main directions**	**Amount in AMD**
Orchard establishment costs	6,530,400	Orchard establishment costs	1,888,600
Industrial yielding orchard cultivation costs	2,455,800	Industrial yielding orchard cultivation costs	1,607,500
Estimated yield, t/ha	6*	Estimated yield, t/ha	3**
Average sales price of the crop, AMD/kg	1,200	Average sales price of the crop, AMD/kg	1,200
Total income from 1 ha	**AMD 7,200,000 EUR 16,941**	**Total income from 1 ha**	**AMD 3,600,000 EUR 8,471**

*Full yield on 5th year

**Full yield on 13-14th years

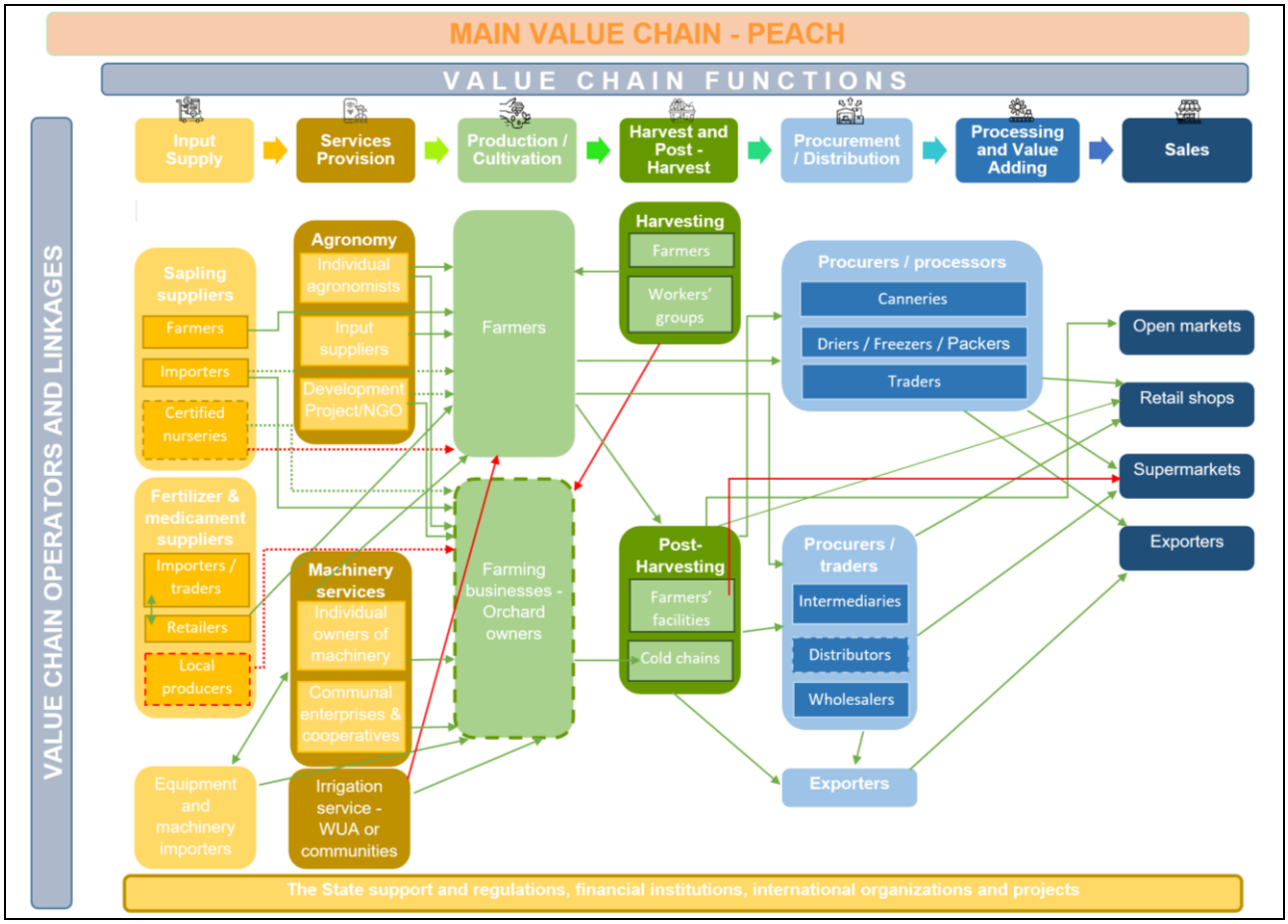
5 VALUE CHAIN ANALYSIS (PEACH)

5.1 GENERAL INTRODUCTION TO THE VALUE CHAIN

In Armenia, peaches and nectarines are mainly cultivated in Ararat, Armavir, Kotayk, Aragatsotn, Tavush, Lori, and Vayots Dzor provinces. It is less common in other provinces of Armenia and has no industrial significance. It is worth mentioning that due to climate change, peach trees are now being grown by hobbyists even in high-altitude areas like the Gegharkunik and Shirak provinces.

5.2 VALUE CHAIN VISUALIZATION

The visualization of the peach value chain is very much similar (almost identical) to the one of apricot. Similarities start from the very inception of the value chain and continue till the final stages of processing, exports and consumption. Details on visualization are presented below.



5.3 VALUE CHAIN INFORMATION

5.3.1 Geographical coverage

The main peach-producing provinces are Ararat and Armavir, where 75% of orchards are located according to the official data from 2022. Aragatsotn, Tavush, and Vayots Dzor provinces have almost equal areas of peach orchards, with shares of 8%, 7%, and 5% respectively. Generally, the orchard areas in these provinces have not changed over the past four years.

5.3.2 Orchards' age and typical yield

Numerous peach varieties are being cultivated in Armenia, including favourites like "Narnji Vaghahas", "Narnji Mijahas", "Narnji Ushahas", "Limoni", "Zafrani", "Lodz Shertavor", "Chughuri", "Uspekh", "Royal Summer", "Baby Gold", "Spring Lady", "Maycrest", "Springcrest", and "Golden Jubilee". Additionally, "Fantasia", "Red gold", "Sunglo", "Nectarose", "Big Top", "Venus", "Stark Red Gold" and others are popular nectarine varieties cultivated in the country.

Conventional orchards still make up the majority of peach plantations in Armenia, but there has been a rapid rise in semi-dwarf and dwarf tree orchards in recent years. According to the information received from the MoE of the RA in total 128.6 ha of new established peach orchards received a support from the Government in the form of subsidies or reimbursement of expenses from 2019 to 2023. Majority of these orchards are located in Aragatsotn province.

5.3.3 Production statistics

In 2022 there were 5,598 hectares of peach orchards in Armenia, almost half the size of apricot orchards, with a production volume of 497.1 thousand centners. Compared to 2019, the production volumes decreased by around 21%, though the orchard areas remained almost the same. However, over the four years, the peach orchard areas varied significantly, increasing by 300 hectares in 2021 compared to 2020, but declining by 138 hectares in 2022 compared to 2021.

5.3.4 Employment

In the peach value chain, employment dynamics vary based on the size of the orchard. In small farms, the cultivation and maintenance of the orchards are typically managed by family members. However, depending on the type of activities, seasonal workers are involved as well. Medium-sized orchards present a slightly different employment structure. While family members still play a significant role in the cultivation and maintenance of the orchards, these farms usually hire 2-3 additional employees who primarily handle maintenance-related tasks. During the harvest period, the need for additional labour force intensifies and owners employ up to 10 seasonal workers.

Large orchards operate with a more complex employment structure and require broader range of skills and labour. Depending on the orchard's size, these farmers hire between 10 to 30 full time employees. These employees are involved in various aspects of orchard management, including cultivation, agronomical work, and operational roles in financial, marketing, logistics and sales departments.

In medium and large farms, more than 70% of the employees, including seasonal workers, are female. Women are involved especially in tasks related to sorting and packaging.

5.3.5 Sales channels and marketing

Harvest typically occurs from mid-summer to mid-autumn. Usually, after the harvest the fruits are sorted by grades[8].

There are several sales channels for peaches harvested in Armenia:

- ***Exporters*** play a crucial role in the peach value chain in Armenia, predominantly targeting the Russian market. While harvesting is typically organised by the orchard owners, sorting

[8] Information about grades can be found in the main report

and packing in many cases are handled by the exporter's employees. Peaches are packed in plastic or plywood boxes, which are the two main types of packaging used for exporting.

- Mainly middlemen operate in the main ***wholesale markets*** of Armenia. Two main approaches are applied in the wholesale markets: middleman who aggregates peaches from villages and sell them to other middlemen operating in wholesale markets, and wholesalers who collect peaches from villages and sell them in the wholesale market themselves. However, no food safety procedures are observed in the wholesale market.
- ***Retail sales*** through various outlets, including retail shops, fruits and vegetables booths in residential quarters and roadside stands. Typically, middlemen supply fruits to retail shops, although in some cases, purchaser agents from the shops buy fruits directly from wholesale markets. Conversely, booth owners usually purchase fruits from wholesale markets, with fewer being supplied by middlemen.
- ***On-line sales*** have become an integral part of the peach value chain in Armenia, offering an additional channel for small-holder farmers to market and sell their produce. Platforms such as the "Berqarat Shuka"[9] Facebook page provide a popular marketplace where these farmers can directly connect with consumers and businesses. In addition to social media, online shops like www.buy.am, www.list.am, https://koriz.app/ and www.gazar.am, serve as important sales channels for small-holder farmers. These e-commerce platforms offer a user-friendly interface for listing and purchasing fresh produce, including peaches, making it easier for consumers to access high-quality, locally grown fruits.
- ***Processing:*** Processing of the peaches includes making jams, preserves and compotes, drying, and producing fruit vodka as well as oil from kernel. Different grades and qualities of peaches are used for different processes products. Fruits not collected by exporters, wholesalers, or middlemen (typically damaged fruits), are left in orchards by farmers and are later collected by specialized middlemen who sell these fruits to processors.

5.4 CULTIVATION PRACTICES

5.4.1 Current Situation

Often, when farmers establish an apricot orchard, they plant peach trees in the middle of rows of apricot trees. This approach allows using the field maximum efficiently, while trees are small. After 7 years, when peach trees get older and not much productive, farmers remove them, thereby achieving the pre-planned spacing for the apricot trees. Conventional peach orchards require labour-intensive efforts to carry out various agrotechnical tasks in the orchard, including tree pruning, pest management, fruit thinning, harvesting, hail protection, and more.

More details about differences of conventional and intensive peach orchards can be found in the main report.

5.4.2 Input supplies

Saplings: In conventional orchards, only traditional planting materials obtained from seed plants are planted. These trees typically exhibit vigorous growth, reaching a maximum biological height of about 3.5-4 meters. The primary and most important condition for the establishment of modern dense orchards is the availability of planting material based on dwarf clonal rootstocks. The best quality dwarf planting materials are mainly imported from abroad.
Fertilization: Approaches to fertilization of conventional orchards of different fruit species are quite similar. Organic fertilization is mainly used. The organic fertilizers, mainly semi-rotted manure (and occasionally compost), are usually applied in autumn, targeting the near-root space of the trees

[9] Բերքառատ Շուկա | Facebook

towards the end of the vegetation period. In addition to manure and compost, many farmers also use mineral fertilization. Experienced farmers often employ a balanced mix of macronutrients, including nitrogen, potassium, and phosphorus.
Fertilization principles used in intensive peach orchards are significantly different from traditional approaches. Traditionally, half-rotted manure is applied in autumn, with mineral fertilizers (NPK) added in spring and early summer. All necessary activities, including fertilization, pest management, irrigation, etc., are planned by agronomists, often hired from Europe, and heavily rely on advanced technologies.
Plant protection: Plant protection plays an important role in the peach production value chain, as peaches are highly susceptible to several diseases and pests, which can significantly reduce the expected yield and negatively affect the quality of the crop. Only in the case of systematic and widespread treatments, as well as with use of quality pesticides, it is possible to organize effective pest control measures against the mentioned pathogens. Unfortunately, due to a lack of experience among farmers, insufficient number of relevant specialists, and the prevalence of low-quality pesticides in the supply market, pest control measures are often ineffective.
Conventional peach orchards usually don't have any protection systems mitigating the negative impact of hail, freezing, wind, etc. Although the peach tree is smaller compared to other large trees like apricot, hail protection nets are not used in conventional peach orchards. Peach trees bloom later than early blooming trees like almonds and apricots, making their flowers less susceptible to late spring frost damage. Experienced farmers minimize frost risk by delaying tree pruning until the end of the cold season.
Pollination: While the most peach varieties are self-pollinating and don't require separate pollinators, they typically yield abundant and high-quality crops only under cross-pollination conditions. Hence, the presence of flying insects such as honeybees, bumblebees, flies, beetles, wasps, etc. can significantly increase the yield of the orchard
Irrigation: The vast majority of conventional peach orchards are irrigated by surface irrigation methods (furrows). In some cases, drip irrigation systems are implemented in conventional orchards, which are difficult for trees with already developed deep penetrating root systems to adapt to.

5.4.3 Harvesting and post-harvesting/handling (cold storing, etc.)

The harvesting season starts in June and continues until the end of September. In the small conventional orchards, the harvesting is usually organized by the farmers jointly with their family members, sometimes (depending on the size of the orchard) involving seasonal workers. Farmers having large orchards hire seasonal workers that are mainly women.

In general, no specific postharvest handling procedures are observed by farmers. Most of the small and part of medium-sized farmers don't have cold storages and sell the fruit directly to wholesalers and exporters from the farm gate. These farmers use cold storages only in September, if there are such facilities in their villages or nearby.

5.4.4 Services

Extension: As agricultural extension services are underdeveloped in Armenia, small farmers usually lack skills in horticulture practices. The gap in advisory structures is partially filled by the consultancy provided by input suppliers (for instance pesticide sellers). These advices sometimes are approximate and totally incomplete.

Machinery: The use of agricultural machinery in peach production is primarily determined by the size of the orchards. In small gardens the level of mechanization is minimal. Farm machinery is used primarily for inter-row soil cultivation, tree spraying, and transporting fertilizers and crops.
Compared to conventional gardens, intensive orchards employ a wider range of agricultural machinery, which enhances work efficiency. This often includes machinery such as tractors, mobile harvesting platforms, high-efficiency garden sprayers, soil tillers, crop transporters, and more.
Tree training and pruning: Conventional robust trees necessitate the application of suitable tree training and pruning systems. For conventional peach orchards, a low-trunk and open-vase training system is applied. The choice of tree training systems in intensive orchards largely depends on the planting density and the rootstock type utilized for producing planting materials. Training systems used in intensive orchards differ significantly from conventional garden methods. Intensive peach orchards predominantly adopt a canopy structure with a central axis (Tall Spindle). Along with the Tall Spindle, other different training systems with different planting densities can be used in intensive peach orchards.

5.5 HINDERING FACTORS AND RECOMMENDATIONS

5.5.1 Hindering factors

The analysis has revealed several hindering factors affecting peach cultivation in both conventional and intensive orchards:

- ***Quality and health of planting materials:*** One of the major issues highlighted by peach orchard owners is the poor quality and health of planting materials. Many nurseries do not implement necessary measures to protect their planting materials from viruses and diseases, leading to the widespread transmission of these diseases to other orchards. The absence of nurseries producing certified planting material is a big issue.
- ***Irrigation:*** Poor water management by WUAs continues to be one of the biggest hindering factors mentioned by orchard owners, similar to the issues faced by other fruits and vegetables producers. Often, WUAs open the irrigation season in late April or early May, resulting in water shortages during crucial cultivation periods. The inflexibility of WUAs in providing irrigation water outside the designated season, when necessary for frost protection, leads to significant yield losses in orchards.
- ***Selection of pesticides and fertilizers***: While there are big varieties of pesticides available in the local market, the quality of some products is questionable. Often, effective treatments for tree diseases are either unavailable in the local market or are imported in small quantities and quickly consumed. Pesticide retailers' low knowledge level on plant protection methods exacerbates the problem. This further impedes effective pest and disease management, emphasizing the need for increased access to high-quality pesticides and fertilizers, as well as improved training for retailers.
- ***Harvesting and post-harvesting issues***: In Armenia, the post-harvest handling culture is underdeveloped and there is a big gap of knowledge and relevant infrastructure. Fruits often remain in the orchards for extended periods and are frequently harvested in hot weather. They are placed in large boxes where they get pressed together and damaged. The vehicles used for transportation typically lack refrigeration, or the refrigeration mode is not utilized. This improper handling leads to substantial damage.
- ***Climate related issues:*** Peach growers face various climatic challenges, including frost, hail, temperature fluctuations, droughts, heat waves, which significantly affect yields. Frost events can severely damage the blossoms and reduce fruit yield. Hailstorms cause physical

damage to the fruit and trees, leading to lower quality and marketability. Fear of potential hailstorms often prevents farmers from carrying out complete fruit hand thinning. The prevalence and types of diseases can vary depending on the weather events, affecting the costs and agro-technical solutions necessary. This diversity complicates pest and disease control since producers must constantly adjust their techniques to mitigate these changing threats.

- ***Soil analysis and laboratory testing***: Currently, farmers rarely conduct soil tests to determine the nutrient composition and health of their soil. Moreover, many farmers are unaware of where to go for such tests or what specific procedures to follow, indicating a need for better guidance and organization. There is also a general lack of motivation to undertake laboratory testing. Many farmers do not feel the need to go to a laboratory, partly due to the high costs and partly because some labs cannot determine all the necessary factors and provide precise recommendations.

More hindering factors affecting peaches value chain are described in the main report.

5.5.2 Recommendations

Based on the hindering factors identified during interviews with orchard owners, the following recommendations are proposed to address the challenges and improve the productivity and sustainability of the fruit-growing sector in Armenia:

- ***Support in solving groundwater level and water quality issues***: Particularly, the usage of groundwater is not well coordinated especially in Ararat valley, as a result of which the artesian basin is depleting. In this regard it is recommended:
    - Support the GoA in implementation of Integrated Water Resource Management (particularly with monitoring the use of artesian basins).
    - Promote improvement of soil health and quality by encouraging usage of soil amendment techniques such as the addition of organic matter (compost or manure, as well as soil ameliorants- bentonite, zeolite) to improve soil structure and fertility and implementing practices like mulching to reduce soil evaporation and enhance moisture retention.
    - Educate local farmers on the importance of water quality and its impact on crop health and yield.
    - Conduct workshops and training sessions for farmers on:
        - sustainable water and soil management practices
        - crop varieties that are more tolerant to saline soils and variable water conditions.
        - Importance of utilizing conservation tillage practices to reduce soil erosion and improve water infiltration.
- ***Promote soil analysis and laboratory testing***: Increasing access to affordable soil and general laboratory testing services through mobile testing units and local laboratories will make these services more accessible to farmers. This needs to be done in parallel with a) raising awareness about the importance of soil and disease analysis and providing training on how to interpret test results and apply recommendations effectively to further support farmers in making informed decisions; and b) creating demand from the buyers on critical aspects such as quality, food safety, and pesticide residue levels. For this purpose, it is recommended to:
    - Establish mobile testing units,

- Encourage the GoA to include the requirement of having soil and general laboratory testing as a part of all relevant state support programmes,
- Promote buyer demand for tested products.

- ***Support nurseries to improve quality and health of planting materials*:** Provide financial and technical support to nurseries, enabling them to increase their capacity and ensure the production of certified, high-quality seedlings. Implementing certification programs for nurseries will help standardize seedling quality. Hence, it is recommended to provide relevant advice and support to the GoA in effective enforcement of certification efforts.
- ***Harvesting and post-harvesting issues*:** Investing in the development of proper post-harvest infrastructure, including cold storage facilities and refrigerated transport vehicles, is crucial to reduce fruit damage and preserve quality during transportation. Training farmers in best practices in harvesting and post-harvest handling, promoting the use of appropriate containers and cooling systems during transportation will minimize damage and losses.
- ***Lack of professional knowledge and experience*:** Establishing comprehensive training programs for farmers covering various aspects of fruit growing, such as balanced fertilization, pest management, irrigation practices, etc., is essential. Strengthening agricultural extension services will provide continuous support and guidance to farmers, helping them adopt best practices and improve their productivity.

5.6 PRIMARY PRODUCTION FINANCIALS

Total costs and expected income for 1 ha of yielding orchard:

Intensive orchard		**Conventional orchard**	
Main directions	**Amount in AMD**	**Main directions**	**Amount in AMD**
Orchard establishment costs	21,462,000	Orchard establishment costs	2,888,000
Industrial yielding orchard cultivation costs	4,282,300	Industrial yielding orchard cultivation costs	3,281,000
Estimated marketable yield, t/ha	21*	Estimated marketable yield, t/ha	14**
Estimated low-quality yield, t/ha	3	Estimated low-quality yield, t/ha	8
Estimated yield, t/ha	24	Estimated yield, t/ha	22
Average sales price of the crop, AMD/kg	300	Average sales price of the crop, AMD/kg	300
Average sales price of low-quality crops, AMD/kg	100	Average sales price of low-quality crops, AMD/kg	100
Income from marketable crops, AMD	6,300,000	Income from marketable crops, AMD	4,200,000
Income from low-quality crops, AMD	300,000	Income from low-quality crops, AMD	800,000
Total income from 1 ha	**AMD 6,600,000 EUR 15,529**	Total income from 1 ha	**AMD 5,000,000 EUR 11,765**

*Full yield on 3rd year
**Full yield on 5th year

6 VALUE CHAIN ACTORS

Detailed information on the value chain actors is provided in the main report. Main actors can be grouped as:

- Inputs suppliers (nurseries, pesticides, fertilizers and other agrochemical input suppliers)
- Producers (primary producers of apricots, peaches, walnuts, and raspberries: farmers, cooperatives, etc.)
- Middlemen and traders (intermediaries between growers and buyers, including cold storage owners, cold chain operators)
- Processors
- Exporters
- Wholesalers
- Retail markets (supermarkets, small shops and fruits and vegetables booths, etc.)

6.1 WOMEN'S ROLE IN THE VALUE CHAINS

Although Armenia's legislation guarantees gender equality and equal access to employment opportunities, women's participation in the labour market remains significantly lower than that of men. As of January 1, 2023, women made up 53% of the population, compared to 47% for men. However, their labour force participation was substantially lower at 48.2%, compared to 71.2% for men by the end of 2022.

Occupational segregation by gender is prevalent in Armenia, with most women working in three sectors: agriculture (23%), education (19%), and trade (12%) in 2022. In the agriculture sector, approximately 55% of workers were male and 45% were female in 2022[10].

Women play a crucial role in Armenia's agricultural sector, particularly in the value chains for apricots, peaches, walnuts, and raspberries. They are involved in various stages of the value chain, including production, processing, marketing, and sales.

Table 2 - Role of women in different phases of the value chain

Primary production	Women are responsible for labour-intensive tasks. Around 90% of the workforce involved in weeding, picking, sorting, and grading are women. In many small-scale farms, women are responsible for managing household plots where these fruits, nuts and berries are grown.
Processing	Women are engaged in various value-adding activities that enhance the marketability and shelf life of the produce: fruit drying preparatory activities or shelling walnuts. Women's expertise in these areas enhances the market value of the produce and provides additional income streams for their families.
Marketing and sales	Women also play an important role in the marketing and sales stages of the value chain connecting producers with consumers. They are often found selling produce at local markets and retail shops and booths.

Despite their significant contributions, women in Armenia's agricultural value chains face numerous challenges that hinder their productivity and limit their potential. Addressing these challenges is essential for ensuring equitable participation and improving the overall efficiency of the agricultural sector.

[10] Labour market in Armenia 2023, SC of the RA

- ***Access to resources***: Women often have limited access to critical resources such as land, credit, and modern farming equipment. Women living in rural areas have limited experience applying for and receiving agricultural and business loans due to a lack of awareness about available funding or women's certain predispositions[11]. Providing women with tailored financial products and services, as well as building their financial literacy, can help overcome these challenges.
- ***Knowledge and training***: There is a significant gap in access to knowledge and training for women in agriculture. Extension services and training programs are often designed without considering the specific needs and constraints of women. As a result, women may lack the technical skills and information needed to adopt modern farming practices and improve their productivity. Tailored training programs that address the unique challenges faced by women are essential for bridging this gap.
- ***Market access***: Women face challenges in accessing markets and selling their produce at fair prices. They may have limited mobility due to household responsibilities and cultural restrictions, making it difficult to travel to distant markets. Additionally, women often lack the networks and market information needed to negotiate better prices and reach larger buyers. Improving market access for women through support services and infrastructure is crucial for enhancing their economic opportunities.
- ***Social and cultural barriers***: Social and cultural norms can limit women's participation in the agricultural value chain. Traditional gender roles often confine women to specific tasks and limit their decision-making power. Cultural norms and stereotypes greatly affect women's activity outside the household, including entrepreneurship. Overcoming these barriers requires efforts to promote gender equality and empower women through education and community engagement. Changing perceptions and encouraging men to support women's involvement in all stages of the value chain is essential for achieving equitable participation.

7 VALUE CHAIN CONTRIBUTORS / SUPPORTERS

The main report provides detailed information on roles of value chain contributors and supporters. Here the short description of those structures, such as service providers, government, research and academia, etc. are provided.

Table 3 - Short description of key contributors/supporters operating in the target value chains

SERVICE PROVIDERS	
Extension	The extension system, established with support of international partners, was discontinued in 2018 and no alternative solution was suggested instead. There is a significant lack of professional advisors (agronomists and extension agents), who can consult farmers and businesses. Moreover, most farmers and other value chain operators lack specific knowledge and skills for conducting their everyday working routine. As a result, farmers may use wrong inputs, apply wrong technologies, use manpower instead of machinery services, etc., which all cut down? the productivity and efficiency of their work. There is an urgent need to support establishment and institutionalization of the network of (private) agricultural advisors and extension agents. Introduction and localization of international best practices in a short period of time could significantly contribute to development of agriculture in general and selected value chains in particular.

[11] Women Agripreneurship in Armenia, https://red-neo.am/wp-content/uploads/2024/04/Women-Agripreneurship.pdf

Certification	The Armenian National Accreditation Body (ARMNAB) under the MoE is the only Armenian body authorized to accredit laboratories and certification bodies. However, except with the Eurasian Economic Union, ARMNAB does not have any international recognition for accrediting local laboratories and certification bodies to issue internationally or regionally recognized certificates of conformity. To be able to get internationally recognized certification, farmers and other actors of the value chains need to pass pre-certification consultation, invest in improvement of capabilities, pass pre-certification audit, and get certification from internationally recognised certification body.
Laboratory services	ARMNAB has accredited 35 local testing laboratories, five of which conduct testing of products of the value chains. However, according to the MoE, only three laboratories have international recognition, and their testing are accepted abroad. Some exporters, local producers and farmers complained about the quality of local testing given that the results very often are not compliant with the results of testing conducted by foreign (European) laboratories. This creates many problems for Armenian exporters because some import countries require laboratory analysis from their countries or one of the EU member states.
Machinery	Agricultural machinery used in the target value chains can be divided into two main groups: a) mechanization inherited from the Soviet period and b) machinery purchased/obtained in the last 10-15 years with support of different international projects and state support programmes. The meetings and interviews with orchard owners revealed several obstacles for the introduction of new/modern advanced agricultural machinery and equipment in the rural areas: high cost of machinery; lack of knowledge / skills for successful operation of machinery-tractor parks; small, fragmented and scattered lands; absence of spare parts for good machinery; long duration of importing of those spare parts; lack of qualified repair and servicing.
GOVERNMENT	
State support programs (SSPs)	There are number of SSPs implemented in Armenia aiming to help the sector become more competitive, sustainable and export oriented. Overall target of agricultural development interventions in Armenia is the improvement of agricultural production in terms of quantity and quality, promotion of higher value production and introduction of Armenian products in foreign markets. Meantime, each development and support intervention is aimed at specific objectives of improving the productivity and production volume, better technologies, higher value products, value chain development etc. There are several other SSPs in Armenia aimed at modernizing manufacturing industry, involving high-skilled specialists, and supporting businesses in enhancing workers' skills. Although these programs are not directly targeted at farmers, they are designed to improve the productivity and complexity of the manufacturing sector, which indirectly benefits value chain actors as well.

Food safety inspection body (FSIB)	The FSIB carries out state control and legislative regulation in food safety, veterinary and phytosanitary. The institution carries out state supervision as prescribed by the legislation of the RA and takes disciplinary actions if violations are identified. FSIB is responsible for the state registration of fertilizers and pesticides. The institution also ensures that imported and sold pesticides, fertilizers, and agrochemicals undergo quality laboratory testing, are properly labelled, and are within their expiration dates.
Centre for Agricultural Research and Certification	The institution is operating within the system of the MoE and is responsible for certification of seeds, registration of new varieties and hybrids of plants, protection the rights of breeders of new plant varieties according to provisions of the UPOV Convention and introduction and implementation of planting material certification system in Armenia.
Enterprise Armenia	Enterprise Armenia is the national investment promotion agency established by the GoA. The mission of the institution is to foster a supportive environment for both foreign and domestic investors, positioning Armenia as a highly desirable investment destination on the global stage. In general, the institution does not have a specialized function within the agricultural sector. Nevertheless, given that agriculture is a cornerstone of Armenia's economy, the institution promotes investments in the sector.
Export Insurance Agency	Export Insurance Agency of Armenia plays a key role in supporting the export of Armenian origin products. The agency provides insurance to local businesses against any financial losses incurred as a result of non-payment for supplied goods by foreign buyers or their banks, thus helping to minimise export risks for their customers.
ACADEMY AND RESEARCH	
Armenian National Agrarian University	ANAU is the only higher educational institution in the agricultural sector of Armenia, with the Faculty of Agronomy playing a unique and pivotal role. In addition to its main socio-public educational activities, ANAU also provides commercial advisory as well as soil testing laboratory services.
The Center for Ecological-Noosphere Studies National Academy of Sciences of the RA (CENS)	CENS conducts applied and fundamental multidisciplinary investigations in ecology, environmental protection, food safety and agriculture, utilizing innovative remote sensing and information technologies. Additionally, its scientific and methodological expertise is focused on analysing Armenia’s main food consumption patterns, providing evidence-based information for the development of sustainable food security strategies.
Agribusiness Teaching Center (ATC)	ATC offers a U.S.-style agribusiness education tailored to the Armenian context. The curriculum includes a two-year undergraduate program and an 18-month Master of Agribusiness program, both modelled on the Agricultural Economics curricula of Texas A&M University.
INTERNATIONAL AND LOCAL SUPPORTERS	
Donor programs and organizations	There are number of donor-funded programs and projects implemented so far or in the process of implementation, that directly relate to development of the values chains (for example: Sustainable and Inclusive Growth in Mountainous Armenia; USAID Economic Foundations for a Resilient Armenia Activity; Resilience from the Start projects, etc.)
Local supporting organisations	There are numerous local organizations and institutions (NGOs, foundations, business unions, chambers of commerce and industry, etc.)

	involved in the target value chains, offering various types of support to farmers and value chain actors. This support includes the introduction of innovative practices, the provision of training and capacity-building activities, the identification of partners, and assistance in entering foreign markets.
Associations	Currently, there are no dedicated associations for the apricot, peach, raspberry, and walnut value chains in Armenia. The absence of these associations represents a significant gap, as they play a crucial role in supporting farmers and value chain actors through advocacy, collective marketing, training, capacity building, and facilitating access to markets.

8 SUSTAINABLE AGRICULTURAL PRACTICES IN ARMENIA

- ***Climate-smart agriculture*** (CSA) is an approach that helps guide actions to transform agri-food systems towards green and climate resilient practices. It aims to tackle three main objectives: sustainably increasing agricultural productivity and incomes; adapting and building resilience to climate change; and reducing and/or removing greenhouse gas emissions, where possible. Some examples of CSA practices implemented in Armenia include technologies and initiatives financed by the EU Green Agriculture Initiative in Armenia project implemented by Austrian Development Agency (introduction of smaller and light machinery, usage of agri-drones, installation of Grid-tied Photovoltaic solar system for raspberry greenhouse Agriculture machinery and equipment, anti-hail nets, drip irrigation system).
- ***Organic agriculture in Armenia***: the Law "On organic agriculture" was adopted in 2008. It is based on the principles of the Codex Alimentarius and regulates the production, storage, processing, transport and marketing of organic agricultural products and raw materials as well as the cultivation of wild plants. The main organic certification body in Armenia, Ecoglobe LLC, which has certified 38 organic fruit and vegetable producers and processors as of June 2024. Several best organic agriculture practises are applied in Armenia, such as the Eco Farm established by ICARE, the training centre founded by SHEN NGO, organic dried fruit production by Lukashin cooperative, production of organic raspberry, etc.
- ***Other practices***: the value chain analysis has identified several projects and practices that can be considered as best cases or examples of sustainable agriculture practices applied in Armenia (the USAID-funded ICARE AgriCamp project; Integrated Pest Management and green agro-technical practices applied by ArLeAm in apricot orchards; production of organic fertilisers by Eco Plant LLC, Orwaco CJSC, Zulal Agro; sustainable production of walnut by Vanant Nut LLC, etc.)

9 VALUE ADDING OPTIONS

Table 4 - Value adding options available in the target value chains

Post-harvest handling	This process involves grading, sorting, and cleaning to ensure a smooth flow of produce. Cold storage significantly extends the shelf life of apricots, peaches, walnuts, and raspberries by maintaining them at low temperatures. Other innovative storing methods include controlled atmosphere storage and modified atmosphere packaging.
Processing	Processing of fresh apricots, peaches, raspberries, and walnuts is conducted in various ways, each adding significant value to the raw produce: household processing; small-scale processing; industrial processing
Marketing	• Creating strong brands for apricots, peaches, walnuts, and raspberries; developing a unified Armenian brand identity that captures the essence of the country's agricultural heritage. • Adopt sustainable packaging solutions to appeal to eco-conscious consumers and meet international market standards. • Promotional activities, including advertising, social media campaigns, and participation in trade fairs. • Other marketing strategies (certification, collaboration with food influencers, comprehensive market research, etc.)
Logistics, transportation	Improving cold chain logistics, enhancing real-time tracking and visibility through advanced logistics platforms can further streamline the supply chain, ensuring that produce reaches markets in optimal condition and reducing overall transportation costs.
Sales	Identifying and targeting specific market segments is essential for optimizing sales. For apricots, peaches, walnuts, and raspberries, key market segments include local retail markets, regional wholesale markets, and international export markets.
Exports	The main export market for fresh apricot, peach, raspberry and walnut is Russian Federation, with more than 90% share. According to the Export Potential Map of International Trade Centre, the markets with greatest potential for Armenia's exports of fresh apricots are Russia, Germany and United Arab Emirates. Russian Federation, Germany and Netherlands are potential export markets for fresh peaches and nectarines. Potential export markets of walnut are Germany, Netherlands and United Arab Emirates, while berries, including raspberry have a greatest export potential to Russian, German and Dutch markets.

10 DEVELOPMENT BARRIERS

10.1 GAPS AND HINDERING FACTORS IN PRIMARY PRODUCTION

Below are described all the hindering factors and gaps identified in value chains. Specific value-chain related factors are provided separately.

Gaps/hindering factors	Description
Input Supplies	
Limited availability of certified planting material	The current agricultural landscape in Armenia is significantly hindered by the limited availability of certified planting material. This deficiency results from a shortage of certified nurseries capable of producing high-quality, disease-free saplings. Consequently, farmers often resort to purchasing uncertified planting materials, which carry a higher risk of disease and pest infestation. The reliance on uncertified materials undermines the potential for achieving high productivity and consistent quality in fruit production, thereby affecting the sector's overall competitiveness.
High cost of imported saplings	Establishing intensive orchards involves the use of saplings that are often imported. These imported saplings, although of high quality, come at a significant financial cost. For small and medium-sized farmers, the high cost of purchasing these saplings constitutes a significant barrier to entry into intensive cultivation. The high cost limits the expansion of intensive orchards and restricts smaller farmers' ability to compete with larger, more financially robust operations.
Insufficient pesticide and fertilizer quality control	The effectiveness and safety of pest control and fertilization practices in Armenian agriculture is compromised by the inconsistent quality of pesticides and fertilizers available in the market. Due to a lack of proper quality control measures, farmers often encounter substandard pesticides and fertilizers that fail to provide effectiveness. This inconsistency leads to poor soil health and reduced crop yields, as well as a threat to public health and pollution of the environment. Moreover, the absence of reliable quality assurance undermines farmers' confidence in investing in pest control and fertilization, further exacerbating the productivity challenges faced by the sector.
Inadequate knowledge on fertilization	Many farmers in Armenia lack comprehensive knowledge about the appropriate use of fertilizers, which is crucial for maintaining soil fertility and achieving high crop yields. This knowledge gap often results in the overuse of nitrogen fertilizers while neglecting other essential nutrients such as phosphorus and potassium. The over-reliance on nitrogen not only degrades soil health but also leads to imbalanced plant nutrition, affecting the quality and quantity of the produce. The lack of education and training on balanced fertilization practices is a significant barrier to sustainable agricultural development.
Limited access to advanced irrigation systems and inefficient water use	Despite the availability of modern irrigation technologies like drip and sprinkler systems, their adoption among Armenian farmers remains limited. The primary barriers to the widespread use of these systems are their high investment costs and the technical knowledge required for effective implementation. Many farmers continue to rely on traditional, inefficient irrigation methods that lead to water wastage and suboptimal plant hydration. There is also a big knowledge gap on how to use efficient drip irrigation in traditional orchards, that do not lose harvest and save water.
Access to irrigation water	Ineffectiveness of the Water Users Associations that supply irrigation water to farmers and poor irrigation systems create significant challenges to development of agriculture in the most part of Armenia. Inefficient water distribution leads to water shortages, especially during the crucial cultivation seasons. This not only reduces crop yields but also affects the quality of the produce, making it less competitive in both local and international markets. Additionally, outdated and poorly maintained infrastructure results in significant water loss through leakage and evaporation, further exacerbating

Gaps/hindering factors	Description
	the problem. Farmers are often forced to rely on costly and unsustainable alternatives, such as drilling private wells or purchasing water, which increases their operational costs and reduces profitability. Furthermore, the lack of reliable irrigation discourages investment in modern farming techniques and technologies, stunting the sector's growth and innovation potential. Another serious and general problem is delay of irrigation water supply to farms in Armenia or inflexibility to provide water out of planned schedule if it is needed due to some extreme weather events. The WUA starts supplying irrigation water in late April - early May, while farmers/ fruit and berries producers sometimes need the water earlier depending on weather conditions in a particular year.
Scarcity of professional agronomic services	The agricultural sector in Armenia is constrained by a notable scarcity of professional agronomists and plant protection specialists. Collaboration, cooperation, and knowledge sharing activities of specialists of scientific and academic institutions, such as ANAU and Plant Protection Institute with farmers and producers are not organized, unclear and rare. This shortage means that farmers lack access to expert advice and guidance on effective orchard management and disease control. As a result, many farmers rely on outdated or inappropriate practices, leading to suboptimal crop health and yields.
Inadequate extension services	Public and private extension services play a crucial role in disseminating knowledge and best practices among farmers. However, in Armenia, these services are at very low level and are insufficient to meet the growing needs of the agricultural sector. The lack of robust extension services results in a gap in the transfer of modern farming knowledge and techniques, climate-smart practices, and innovations.
Lack of access to laboratory services	Access to laboratory services for soil and plant testing is essential for informed decision-making regarding fertilization, pest control, and overall crop management. In Armenia, many farmers do not have access to these critical services, limiting their ability to accurately diagnose and address issues affecting their crops. This gap in access to diagnostic services leads to guesswork in farming practices, which can result in ineffective treatments and wasted resources, ultimately impacting crop yields and quality.
Insufficient machinery services	The use of specialized machinery and equipment is vital for modern orchard management. However, small and medium-sized farmers in Armenia often have limited access to such equipment due to high costs and availability issues. The lack of access to advanced machinery, such as mobile harvesting platforms or high-efficiency garden sprayers, as well as very low level of use of digital and precision (digital) agriculture services means that many farmers continue to rely on labour-intensive and less efficient methods. This not only reduces productivity but also increases the physical burden on farmers and workers.
Inefficient disaster risk management practices, climate vulnerability	Armenian farmers face significant risks from natural disasters such as hail, frost, flood, drought and strong winds. However, the current disaster risk management practices are inadequate for effectively mitigating these impacts. The lack of comprehensive disaster risk management practices leaves farmers vulnerable to significant losses, affecting their financial stability and long-term viability. The lack of effective climate adaptation measures and the limited research on developing resilient varieties further exacerbate these vulnerabilities, posing a major threat to the sustainability of crop cultivation.

Gaps/hindering factors	Description
Poor orchard planning	Effective orchard planning is critical for optimizing productivity and ease of management. In Armenia, many orchards suffer from poor initial planning, including inadequate land levelling, improper row and tree spacing, and suboptimal irrigation layout. These deficiencies lead to difficulties in managing the orchard, including challenges in irrigation, pest management, soil cultivation, harvesting, and logistics. The lack of proper planning (including financial planning) results in inefficiencies and reduced productivity, making it harder for farmers to achieve sustainable yields.
Lack of knowledge on modern cultivation practices	The adoption of modern cultivation practices is essential for improving productivity and sustainability in agriculture. However, many Armenian farmers lack the knowledge and training required to implement these practices effectively. This includes understanding the benefits and techniques of intensive orchard systems, integrated pest management, and advanced pruning methods. The gap in knowledge prevents farmers from fully exploiting the potential of their orchards and limits their ability to respond to changing environmental conditions and market demands.
Labor shortages	The agricultural sector in Armenia is experiencing a growing shortage of both skilled and unskilled labour. This labour scarcity is driven by migration and the availability of alternative employment opportunities in sectors such as construction and transportation. The shortage of labour affects the timely and effective management of orchards, leading to delays in critical activities such as pruning, pest control, and harvesting. The lack of adequate labour resources also increases the workload and stress on existing workers, reducing overall productivity.
Uncontrolled use of pesticides and chemicals, absence of the proper knowledge on IPM/IDPM	Different studies and expert assessments showed that the quality and safety of fruits produced in Armenia often suffer from improper pesticide and fertilizer use. Sometimes farmers use pesticides with the advice of neighbours or the seller, without consulting the relevant specialists. Most farmers do not understand ecotoxicity and pollution of natural resources associated with pesticide use. They do not understand pesticide hazards to the public health and environment, which include contamination of water resources and soils, and acute or chronic toxicity to non-target organisms that may lead to disruption of ecosystem functions, such as pollination or natural pest suppression. In general, the farmers have poor knowledge on pesticide handling and management, alternative pest control methods like use of IPM/IDPM practices, bio-control agents, mass trapping, agronomic techniques, etc.
Services Post Harvest	
Lack of refrigerated transport	The transportation of perishable agricultural products, such as fruits and berries, is severely impacted by the lack of refrigerated transport options in Armenia. Without adequate refrigeration, products are susceptible to spoilage and quality degradation during transit. The absence of refrigerated transport results in significant post-harvest losses, reducing the overall profitability and competitiveness of the agricultural sector
High transportation costs	Transportation costs in Armenia are exacerbated by poor road infrastructure and the high cost of fuel. These costs significantly increase the overall expenses associated with getting produce to market, particularly from remote rural areas. The high transportation costs reduce the profitability for farmers and make their products less competitive in both domestic and international

Gaps/hindering factors	Description
	markets. Additionally, the increased costs can discourage farmers from expanding their market reach, limiting their potential income opportunities.
Limited access to export markets	Many small and medium-sized farmers in Armenia struggle to access export markets due to a lack of necessary infrastructure, knowledge, business linkages and support. The complexities of international trade, including compliance with export standards, packaging requirements, and logistics management, pose significant barriers. Without adequate support and resources, farmers are unable to tap into higher-value markets, limiting their income potential and growth opportunities. This also affects the overall export capacity and competitiveness of Armenian agricultural products.
Insufficient cold storage infrastructure	The post-harvest phase in Armenia is significantly hindered by the lack of adequate cold storage facilities. Without proper cold storage, farmers are unable to maintain the freshness and quality of their produce, leading to high post-harvest losses. This forces them to sell immediately after harvest, often at lower prices. The construction and maintenance of appropriate cold storage facilities requires significant investments, which are often unaffordable for many small and medium-sized farmers. The high energy costs associated with operating these facilities further add to the financial burden. This financial barrier not only affects the quality and shelf life of the produce but also limits the farmers' ability to access higher-value markets. Many existing storage facilities in Armenia are outdated and not equipped with modern technology. These facilities often lack temperature control systems, proper ventilation, and humidity regulation, which are essential for maintaining the quality of stored produce.
Limited knowledge on post-harvest handling	Effective post-harvest handling practices are crucial for maintaining the quality and extending the shelf life of agricultural products. However, many farmers in Armenia lack the necessary knowledge and skills in this area. This includes proper techniques for sorting, grading, packaging, and storing produce. The lack of awareness and training on post-harvest handling leads to significant quality degradation and losses. Providing education and training on best practices can help improve the overall efficiency and profitability of the agricultural sector.
Fragmented distribution networks	The distribution of agricultural products in Armenia is characterized by highly fragmented networks. This fragmentation results in inefficiencies and increased costs in getting produce to market. The lack of coordination among various stakeholders, including farmers, distributors, and retailers, leads to delays and suboptimal handling of produce. A more integrated and streamlined distribution network is essential for reducing costs, improving efficiency, and ensuring timely delivery of high-quality products to consumers.
Lack of aggregation centers	The lack of sufficient aggregation centers where small farmers can collectively store and distribute their produce is a significant barrier. Aggregation centers play a crucial role in consolidating produce, improving market access, and reducing transaction costs. Without these centers, small farmers are often forced to sell their produce individually, which limits their bargaining power and access to larger markets. Establishing more aggregation centers can help enhance the efficiency and effectiveness of the distribution network.
Inconsistent quality standards	The lack of standardized quality results in inconsistent product quality. This makes it challenging for Armenian produce to compete in higher-value markets that demand consistent quality standards. Implementing uniform quality control measures throughout the distribution network can help ensure

Gaps/hindering factors	Description
	that all products meet the required standards, enhancing market competitiveness and consumer trust.
High intermediary costs	The presence of multiple middlemen in the distribution chain increases the cost of getting produce to market. Each intermediary adds a margin to the price, reducing the final price received by farmers. This affects the overall profitability and sustainability of farmers. A more integrated and streamlined distribution network would reduce the number of intermediaries, and facilitating more direct linkages between farmers and markets can help lower costs and increase the share of profits for farmers.
Value Adding	
High cost of processing equipment	Modern processing equipment, necessary for efficient and high-quality processing (including the shock-freezers in case of raspberry), comes at a significant cost. Many SMEs cannot afford those investments, limiting their ability to engage in value-adding activities. This financial barrier restricts the growth and competitiveness of the processing sector, making it difficult for SMEs to scale up their operations and meet market demands.
Limited innovation in value addition	The agricultural sector in Armenia suffers from a lack of innovation in value-adding processes. This limits the potential for developing new and high-value products that can meet diverse market demands. Encouraging innovation, as well as continuous improvement, is essential in enhancing the value addition in the agricultural value chain.
High cost of packaging	Modern and attractive packaging is crucial for enhancing the market appeal of agricultural products. However, the cost of high-quality packaging materials is restrictive for many producers, limiting their ability to compete in premium markets. Reducing packaging costs through economies of scale, subsidies, or support programs can help improve the marketability of products and increase profitability.
Lack of marketing skills or affordable services	Many producers lack the necessary marketing skills and services to effectively promote and sell their value-added products. This skill gap limits their market reach and profitability. Providing training and support in marketing and branding or facilitating their access to high-quality marketing services provided by professional companies can help producers better position their products in the market and attract more customers.
Sales	
Limited marketing skills and inadequate branding	The agricultural sector suffers from a significant gap in marketing skills among farmers and small producers. This affects their ability to effectively promote and sell their products, both domestically and internationally. Providing training and capacity-building programs focused on marketing techniques, branding, and customer engagement can help producers enhance their marketing capabilities and reach a broader audience. Proper branding is essential for differentiating products in the market and adding value. However, many agricultural products in Armenia lack proper branding, making it difficult to stand out and attract premium prices. Developing branding strategies and supporting producers in creating strong, recognizable brands can enhance market appeal and consumer loyalty.
Limited access to digital marketing	Digital marketing tools offer significant opportunities for reaching a wider audience and enhancing sales. However, the use of these tools is limited among farmers and small producers in Armenia, reducing their market reach. Promoting the adoption of digital marketing strategies and providing training

Gaps/hindering factors	Description
	on their use can help producers leverage these tools to expand their market presence and boost sales.
High compliance costs	Meeting export compliance requirements and standards involves high costs, which limits the ability of producers to access international markets. These costs include certification, testing, and documentation, which can be restrictive for small producers. Reducing compliance costs through subsidies and financial support can help increase export capacity.
Limited market information	Producers often lack information about potential export markets, their requirements, and opportunities. This knowledge gap hinders their ability to penetrate new markets and capitalize on export potential. Providing market research, information services, and training can help producers better understand and access international markets.
Limited support for export promotion	There is limited support for export promotion activities, which are essential for accessing new markets and increasing export volumes. Providing financial support, marketing assistance, and trade promotion programs can help producers expand their international presence and increase exports.
Other	
Lack of financial skills	Many farmers and producers lack the necessary skills and knowledge for simple cost and benefit calculations, simple financial planning, and effective bookkeeping. This leads to inaccurate financial records, making it difficult to manage finances. Providing training and support for bookkeeping can help improve financial management and business operations.

10.2 SHORTCOMINGS OF THE STATE SUPPORT PROGRAMS

There is no specific negative feedback from the beneficiaries towards the objective and relevance of any SSP. However, many complaints were obtained about the procedural complexity of the SSPs. Among others, the following shortcomings were identified:

- SSPs require a lot of paperwork; documents should be ordered/obtained from the State Cadastre, municipalities, real estate measurement and layout design organizations, and elsewhere. Some applicants were not even able to collect all the necessary documents. Others attract experienced friends or “service providers” to pass through the process of documents’ collection.
- The duration of the lease for the equipment and machinery is short, not sufficient to repay the proceeds generated with that equipment.
- Suppliers of the machinery sometimes speculate their involvement in the SSPs; they do not import and supply sufficiently wide range of machinery (beneficiaries are artificially made to procure what is offered), often they inflate prices for the proposed machinery and equipment, etc. Usually, applicants are aware of the machinery and equipment they need, and know who the best supplier is, or even do not want to procure the equipment from other suppliers. However, they are asked to provide price quotations from 3 suppliers to choose the best option.
- The formal and actual location of the orchards differ, and farmers should not be blamed for that. However, data from satellite screening and formal documents should comply and farmers are supposed to pass sophisticated process of harmonization, which takes much time and resources.

- Beneficiaries are dissatisfied with the work of “monitoring”, i.e. verification of expenditures. Some applicants mentioned that they have been waiting for it for already 6 months and even longer. Communities do not have so many professional and technical resources to conduct all the work appropriately and on time. Delays in verification happen and those postpone payments of the compensations, which may result in (partial or full) failures of investment plans. Sometimes, beneficiaries have to find alternative sources of (bridge) financing in order not to lose the agricultural season.
- There is a significant lack of professional advisors (agronomists and extension agents), who can consult beneficiary farmers and businesses on participation in the SSPs and ensuring the compliance with the requirements. National extension service has been ceased and many agents simply changed their specialization.

Understandably, some of the complaints presented are subjective and sourced from the wishes of beneficiaries. Similarly, in-detail formalization of all the processes and requirements of many documents have the primary purpose to avoid violations of the SSPs’ conditions and keeping the overall process transparent (at least formally). However, gradually and consistently tightened conditions do not contribute to the effectiveness of the SSPs’ distribution and intensive use.

10.3 Special Needs of Female Farmers

The role of women in business continuously grows. However, there are still shortcoming that prevent active involvement of women in value chains. These shortcomings include:

- **Limited access to resources**: Female farmers often face significant barriers to accessing crucial resources such as land, credit, and inputs, which impedes their productivity and economic empowerment. These limitations hinder their ability to grow and impact on the overall productivity and competitiveness of the agricultural sector. According to the "Women Agripreneurship in Armenia"[12] survey conducted as part of the Rural Economic Development - New Economic Opportunities program funded by the United States Agency for International Development, over 60% of the interviewed women identified affordable finance as a key motivator for starting a business.
  To enhance access to financial resources and support for women in agriculture, the following measures are recommended:
  - Engage with the MoE to explore the implementation of a differentiated agricultural loan interest rate subsidy scheme. This scheme should offer larger subsidies to qualified women entrepreneurs (farmers) who are adopting or have implemented Climate Smart Agriculture and Sustainable agro-processing practices.
  - Provide targeted support to women farmers to facilitate the adoption and implementation of CSA and sustainable agro-processing practices.
- **Knowledge gaps and gender bias in training programs:** Many women prefer to start businesses in the agriculture sector, particularly in processing fruits and berries, believing that their general or specific knowledge will contribute to their success. However, their expertise is largely experienced based. Analysis from the Rural Economic Development - New Economic Opportunities program revealed that only 13.3% of interviewed women have attended courses in business management, marketing, or related subjects, or have received online training in these areas. Similarly, the FRUITENIA[13] project found low female participation in orchard establishment and maintenance training, with only 29% of participants in short-term intensive agriculture training courses being women.

[12] Women Agripreneurship in Armenia Report | RED-NEO
[13] Fruit Production Sector Development (FRUITENIA) Project in Armenia – ICARE

Often, training and capacity-building programs do not adequately address the specific needs and challenges faced by female farmers. This gender bias limits access to training and negatively impacts the overall productivity and competitiveness of female farmers.

To address these issues, the following recommendations are proposed:

- When developing or planning capacity-building events or training courses, prioritize engaging women and other vulnerable groups to ensure equal access to project benefits.
- Include topics in training courses such as effective horticulture, post-harvest management, growing high-value crops, marketing, negotiation skills, and financial planning.
- Engage experts or successful women farmers and entrepreneurs as mentors. Their guidance and experience can inspire and assist beneficiaries in overcoming the challenges of starting and growing a successful agribusiness. Providing ongoing support is also crucial for business sustainability.
- Support existing extension service providers to offer consistent and ongoing assistance to women farmers and entrepreneurs, particularly in CSA and sustainable agriculture and agro-processing topics.

- **Lack of support networks**: Female farmers frequently lack access to support networks and associations that offer guidance, advocacy, and peer support. This absence of support hinders their access to vital information, resources, and opportunities, which impacts their growth and productivity. Specifically, women entrepreneurs and farmers often need assistance with sales. This is confirmed by the Rural Economic Development - New Economic Opportunities program, as 29% of interviewed women cited support with sales organization as a key motivation for starting a business. To overcome this issue, it is recommended to organize networking and matchmaking events for women farmers and entrepreneurs who are implementing Climate Smart Agriculture and sustainable agriculture and agro-processing practices. These events should connect them with representatives from online fruit and vegetable stores, supermarket chains, and exporters or foreign buyers. Such sessions offer valuable opportunities for women entrepreneurs to network with potential buyers, showcase their products, and build mutually beneficial business relationships.

11 ENVIRONMENTAL SUSTAINABILITY AND GREEN OPPORTUNITIES

11.1 ENVIRONMENTAL SUSTAINABILITY

Fruit, berry and nuts value chains can have various environmental impacts throughout their production, distribution, and consumption phases. Some of the main environmental impacts associated with these value chains include:

- Inefficient usage of water
- Overuse and uncontrolled use of pesticides, herbicides and chemical fertilizers
- Energy consumption
- Packaging waste.

11.2 GREEN OPPORTUNITIES

The following best green and climate smart agro-ecological practices can be applied in fruits, berries and nuts value chains production that can help to mitigate environmental impacts and promote sustainable production of fruits and berries in Armenia.

❖ **Soil preparation for crops planting, orchard establishment**

Important considerations in site preparation include alleviating soil compaction, enhancing fertility, adjusting soil pH, and managing weeds, pests, and diseases. Most fruit trees, including apricot, and peach perform best around pH 6.5, although they tolerate a pH range between 5.5 and 7.2.

❖ **Polyculture system (mix-cropping/intercropping) in fruit, berry and nuts production**

Polyculture involves growing multiple crop species together in the same field or growing area to maximize space utilization, improve soil organic matter, enhance biodiversity, and improve overall productivity. Here are some ***examples of varieties that can be intercropped effectively*** to create mutually beneficial conditions:

Apricot, peach and walnut trees and nitrogen-fixing crops/plants:

- Nitrogen-fixing plants (legumes/grasses) like alfalfa or clover, vetch or beans, peas, can be intercropped with apricot and peach trees.
- Nitrogen-fixing plants improve soil fertility by adding nitrogen to the soil, which benefits the growth of apricot and peach trees. Additionally, they can provide beneficial habitat for insects and improve overall ecosystem resilience.
- Low-growing groundcovers such as strawberries or clover can be planted around apricot and peach trees.

Raspberry bushes and groundcovers/ shallow-rooted plants:

- Low-growing groundcovers such as strawberries or clover can be planted around raspberry bushes. Groundcover grass and crops suppress weeds, improve soil structure, fertility, and water infiltration while reducing erosion, and conserve soil moisture.

❖ **Soil health management**

One of the important aspects of fruits, berries and nuts production is improved soil management. The soil's health and fertility are essential for the growth of healthy fruit, nut trees and berry bushes. Here are some ***steps and examples of best soil management practices***:

- ***Soil testing:*** Regularly conduct soil tests to determine nutrient levels, pH, and organic matter content. Adjust soil pH to optimal levels for crops. Most fruit crops prefer slightly acidic soils (pH 6.0–6.5).
- ***Organic matter management***: Incorporate organic matter into the soil through composting, cover cropping, green manuring, organic mulching or carbon storing. Organic matter improves soil structure, water retention, and nutrient availability.
- ***Intercropping***: Intercrop fruit, berry and nut crops with other groundcover types of crops such as leguminous grass and crops (e.g. alfalfa, clover, vetch etc.) to break pest and disease cycles, manage nutrient components which maintain soil fertility.
- ***Mulching***: Apply organic mulches such as straw, wood chips, or compost to conserve soil moisture, suppress weeds, and regulate soil temperature.
- ***Proper irrigation***: Irrigate crops efficiently to ensure adequate moisture without waterlogging the soil. Drip irrigation or soaker hoses are preferred over overhead sprinklers to minimize water wastage and reduce disease pressure.
- ***Nutrient management***: Use balanced fertilization practices based on soil test results and crop nutrient requirements. Avoid over-application of fertilizers to prevent nutrient leaching and groundwater contamination.

❖ **Water efficient use management in fruits, berries and nuts production.**

Water-efficient management practices or water natural resource saving technologies are crucial in fruit, berry and nuts production to optimize water usage, reduce loss of water, and improve crop yields to ensure sustainability of their farms. Here are some ***examples of water efficient use sustainable techniques and practices:***

- ***Drip irrigation:*** This ensures efficient water use by minimizing evaporation and runoff.
- ***Proper timing of irrigation:*** Timing irrigation to coincide with plant water demand can optimize water usage.
- ***Soil moisture monitoring:*** Utilizing soil moisture sensors helps farmers accurately assess soil moisture levels and avoid overwatering.
- ***Improving soil structure:*** Well-structured soil with good organic matter content has higher water-holding capacity, reducing the frequency of irrigation.
- ***Plant selection and spacing:*** Choosing drought-tolerant fruit, berry and nut varieties and optimizing plant spacing can help maximize water efficiency. Selecting varieties adapted to local climate conditions and soil types reduces water requirements and improves overall crop resilience. They also optimize plant spacing to avoid “overcrowding”, which can lead to competition for water and nutrients among plants.
- ***Rainwater harvesting***: Installing rainwater collection systems like rain barrels or cisterns, or small and medium-water reservoirs that let farmers capture and store rainwater from rooftops or other surfaces for irrigation.
- ***Precision irrigation technologies***: Implementing precision irrigation technologies, such as weather-based irrigation controllers (meteo-bots) and soil moisture monitoring systems, ensures precise water application tailored to specific crop needs and environmental conditions.

❖ **Reduction of food loss and waste through sustainable post-harvest and handling management**

Proper and sustainable post-harvest and handling practices can ensure the delivery of high-quality, safe, and marketable products to consumers while minimizing food losses and maximizing profitability. Here are ***key components of sustainable post-harvest and handling management*** for fruit production:

- ***Harvest timing:*** Harvest apricots and peaches at the optimum stage of ripeness, which varies depending on the variety and intended market.
- ***Gentle handling:*** Handle apricots, peaches, raspberries with care during harvesting, sorting, and packing to minimize bruising and mechanical damage.
- ***Cooling:*** Immediately after harvesting, cool apricots and peaches to the optimal storage temperature to slow down ripening and reduce physiological deterioration.
- ***Temperature and humidity control:*** Store apricots and peaches in refrigerated conditions with controlled temperature and humidity levels to extend their shelf life and maintain quality.
- ***Packaging:*** Pack apricots and peaches in breathable packaging materials such as perforated plastic bags or ventilated crates to allow air circulation and reduce condensation.
- ***Quality sorting and grading:*** Sort apricots and peaches based on size, colour, maturity, and visual defects to ensure uniformity and marketability.
- ***Ethylene management:*** Monitor and manage ethylene levels in storage facilities to prevent premature ripening and senescence of apricots and peaches.
- ***Post-harvest treatments:*** Apply post-harvest treatments such as controlled atmosphere storage, modified atmosphere packaging, or edible coatings to prolong the shelf life and freshness of apricots and peaches.
- ***Handling and transportation:*** Handle fruits and berries carefully during loading, unloading, and transportation to minimize mechanical damage. Choose transportation vehicles equipped with temperature control systems and adequate ventilation for perishable goods.
- ***Quality control and monitoring:*** Implement regular quality control/inspection measures at various stages of post-harvest handling, including sorting, packing, and storage.
- ***Food safety and hygiene:*** Maintain cleanliness and sanitation in handling facilities, storage areas, and transportation vehicles.
- ***Traceability and documentation:*** Implement traceability systems to track the origin, handling practices, and storage conditions of apricots and peaches throughout the post-harvest supply chain.

❖ **Integrated Pest Management**

Implementing IPM practices minimizes pest and disease pressure on plants reducing pesticide application thus minimizing environmental impact. IPM combines various pest control methods, including biological control, cultural practices, and selective pesticide use, to manage pests effectively with minimum impact on natural resources. One of the important components of the IPM is **biological pest control**. Biological pest control of the IPM/IDPM, is focuses on introducing of natural enemies of pests to regulate pest populations reducing the need for pesticide applications. Here are some ***methods of biological pest control*** that can be applied:

- ***Predatory insects:*** Introducing or conserving natural enemies of pests, such as ladybugs, lacewings, predatory mites, and parasitic wasps, which feed on pest insects like aphids, mites, and caterpillars.
- ***Pathogens:*** Biological control agents like certain fungi, bacteria, and viruses can be used to infect and kill pests. For example, the bacterium Bacillus thuringiensis (Bt) is commonly used to control caterpillar pests.
- ***Parasitic wasps:*** These insects lay eggs inside or on the bodies of pest insects. The developing larvae then consume the host, ultimately killing it. They are often used to control pests like aphids, caterpillars, and whiteflies.
- ***Crop rotation and polyculture:*** Varying crops within the orchard or intercropping with plants that repel or deter pests can disrupt pest life cycles and reduce their populations.

- ***Trap crops:*** Planting specific crops that are more attractive to pests can attract them away from the main crop, making it easier to control them.

❖ **Energy Efficiency**

Integration of Renewable Energy sources such as solar panels to generate clean energy for fruit orchard operations, or greenhouses for berry production, reducing reliance on fossil fuels and mitigating greenhouse gas emissions.

❖ **Agrivoltaics strategy**

Agrivoltaics is a strategy that combines the cultivation of crops with the installation of solar panels on the same land, allowing for the simultaneous production of both agricultural produce and solar electricity.

❖ **Precision application of agricultural drones (also considered as a precision agriculture activity)**

By the application of agricultural drones as precision farming practices, farmers can minimize their environmental footprint by reducing chemical usage, optimizing resource efficiency, and promoting sustainable land management practices.

11.3 ORGANIC AGRICULTURE

Organic agriculture is an integrated approach to active and observant management of a farming system. It begins with good soil management for nutrient cycling, productivity, and tillage. It involves an integrated, preventative approach to pest management to protect the health and productivity of the orchard.

Planning and planting an organic orchard: Cultural practices in fruit production begin with selection of an appropriate site, fruit crop, rootstock, and fruit variety, followed by site preparation (tillage and pre-plant soil amendments) and orchard layout (tree and row spacing).

Soil preparation for fruit crops planting: The process of soil preparation for fruit crop planting required for organic certification involves several steps to ensure the soil is conducive to organic farming and meets strict organic standards.

- **Initial soil assessment:** This step involves a thorough assessment of the soil's current condition. This includes testing for soil composition, pH levels, nutrient content, and contamination by prohibited substances such as synthetic fertilizers or pesticides.
- **Soil enrichment and amendment**: Once the initial assessment is completed, the soil needs to be enriched to support healthy fruit crop growth. Certification bodies stipulate the use of organic matter such as compost, manure, or green manure to enhance soil fertility.
- **Soil structure improvement**: Improving soil structure is another critical aspect of preparation. This involves practices that enhance soil aeration, water retention, and root penetration. Techniques such as deep tilling, cover cropping, and the use of mulch are encouraged.
- **Pest and weed management:** Farmers should adopt organic pest control methods such as crop rotation, intercropping, and the use of natural predators. For weed control, mechanical methods like mulching, hand weeding, and the use of biodegradable weed barriers are preferred.

- **Documentation and compliance:** Throughout the soil preparation process, farmers must maintain detailed records of all practices and inputs used. This documentation is crucial for the organic certification process, as it provides evidence of compliance with organic standards.

Orchard floor management: The orchard floor - the tree rows and alleyways - can be managed in many ways, using tillage or mowing with cover crops, grazing, or mulching.

Planting cover crops in alleys is an increasingly popular way to protect the soil and add organic matter and biodiversity to the system. Grass and legume ground cover crops with shallow root system promote water infiltration, hold the soil in place during the rainy season and increase soil organic matter. The legume crops, such as bell beans, vetches, and clovers are best suited for this role.

Mulching can be an especially beneficial orchard floor as weed control practice. Almost any organic material will contribute to soil organic matter, but some are better than others. The best options of organic mulch materials are straw, hay, leaves, saw dust and wood stick.

Fertilization: Most organic fertilization programs focus on supplementing nitrogen as the key element since it is needed in the greatest amount for the crop. Annual foliar analysis generally provides the best guide for adjusting complementary fertilization by using the best combination of organic and mineral fertilizers.

Mycorrhizae and fruit plants: Mycorrhizae (myco=fungal, rhizae=roots) are soil fungi that have a mutualistic or symbiotic relationship with other plants, including fruit plants. Mycorrhizae take the form of threadlike strands (mycelia) that attach to plant roots and spread into the soil environment.

Organic fertilizers[14] - especially un-composed animal manures - should be incorporated into the soil to avoid nitrogen volatilization and to comply with organic standards. Manures should be incorporated into the soil at least three or four months before harvest (depending on the crop type) to comply with Organic Program standards.

Soluble organic fertilizers - such as “Bio Liquid” (Orwaco LLC) or “Green Mix” (Green Farm LLC) are suitable for use in drip irrigation and can provide quick supplemental fertility.

11.4 FARM TO FORK STRATEGY PERSPECTIVE

The Farm to Fork Strategy (F2F) is a key component of the European Green Deal (EGD) 2050. EGD aims at making Europe the first climate-neutral continent by 2050. It aims to address various challenges within the food system, including nutrient loss, with the overarching goal of ensuring food security, reducing the environmental footprint of food production, and promoting healthier diets. The EGD includes several strategies for achieving its objective, with the Farm to Fork (F2F) strategy at its heart.

The F2F strategy includes specific objectives and actions: ensuring sustainable food production; stimulating sustainable food processing, wholesale, retail, hospitality, and food services' practices; promoting sustainable food consumption, facilitating the shift toward healthy, sustainable diets; and reducing food loss and waste.

[14] There are good examples of organic fertilizers production in Armenia, which are presented above in this document.

As part of the F2F Strategy, several indicators have been identified to monitor and evaluate progress towards its objectives. Some of the F2F strategy ***key indicators*** include:

1. *Reduction in pesticide use:* Monitoring the use of pesticides and progress towards reducing their use, with a target to reduce the overall risk and dependency on chemical pesticides by 50% by 2030.
2. *Organic farming area*: Tracking the expansion of organic farming and the proportion of agricultural land under organic management, with a target to increase the share of organic farming to 25% of agricultural land by 2030.
3. *Reduction in use of hazardous chemicals:* Monitoring the use of antimicrobials and veterinary medicines in livestock production, with a goal to reduce the overall use of antimicrobials in animals and humans by 50% by 2030.
4. *Sustainable Agriculture Practices*: Assessing the adoption of sustainable agricultural practices, such as precision farming, agroforestry, and crop diversification, to enhance resource efficiency and biodiversity conservation.
5. *Food loss and waste reduction:* Tracking progress towards reducing food loss and waste along the entire food supply chain, with targets to halve food waste at the retail and consumer levels and reduce food losses along the production and supply chain by 50% by 2030.
6. *Nutritional quality of diets:* Monitoring dietary patterns and nutritional intake to promote healthier and more sustainable diets, with a focus on increasing consumption of fruits, vegetables, and plant-based proteins while reducing consumption of unhealthy foods.
7. *Animal welfare standards:* Assessing compliance with animal welfare standards and the implementation of measures to improve animal welfare in livestock production systems.
8. *Carbon footprint of food production:* Evaluating the carbon footprint of food production and the contribution of agriculture to greenhouse gas emissions, with targets to reduce emissions from agriculture and promote climate-smart farming practices.

Nutrient losses impact

Nutrient losses can occur due to several factors, including inefficient agricultural practices, food waste, and processing methods that degrade nutrient content. Pollution from nutrients (especially nitrogen and phosphorus) has a negative impact on biodiversity in rivers, lakes and wetlands.

Within the F2F Strategy, the EU is implementing various initiatives and policies, including:

- ***Promotion of sustainable agriculture***: Encouraging practices such as organic farming, agro-ecology, and precision agriculture that help to conserve soil fertility and minimize nutrient loss.
- ***Reduction of food waste:*** Implementing measures to reduce food waste throughout the supply chain, including improved storage and transportation practices, better labelling, and consumer education campaigns.
- ***Nutritional labelling:*** Enhancing nutritional labelling requirements to provide consumers with better information about the nutrient content of food products, enabling them to make healthier choices.

12 RECOMMENDATIONS AND INTERVENTIONS

12.1 GENERAL RECOMMENDATIONS

Recommendations	Short description
General recommendations	
Establishment of demonstration certified nurseries	Establishing demonstration-certified nurseries would act as both a capacity-building and knowledge transfer hub. These nurseries would offer consultancy on current trends, new varieties, and technologies in the fruit, berry and nuts sectors. Additionally, they could supply specific agricultural inputs needed for nursery and orchard management. It is recommended, in collaboration with the MoE, support initiatives for setting up fruit, berry and nuts nurseries with the stipulation of mandatory certification. Emphasis should be placed on developing more climate-resilient varieties and sorts. **"Noratunk" LLC** or demo orchards established by **ICARE** foundation within the FRUTENIA project can be considered as nurseries, where this practice can be piloted.
Promotion the application of IPM/IDPM practices	Prepare and disseminate widely educational video-materials or social advertisements on the principles and techniques of IPM, focusing on biological pest control, implement IPM pilot projects that include the use of predators/entomophagy and repellent plants such as honeysuckle, mites, lacewings, ladybugs as well use of pheromone traps, and trap crops. Support the purchase of pheromone traps and other IPM-related tools and supplies.
Support in installing frost protection systems for intensive orchards	In addition to traditional irrigation methods, there are other specialized frost protection systems like overhead sprinklers. Overhead sprinklers are cost-effective frost protection method that works by releasing latent heat during the freezing process of water, thereby warming the surrounding air and plant tissue. They are activated when frost is forecasted, spraying water continuously over trees to prevent frost damage. It is recommended to pilot this approach in one of the intensive orchards with anti-hail nets.
Introduction of mobile applications for farm management, linking with specialists	Introducing mobile apps and relevant tools for farm management can help farmers monitor and manage their operations more effectively. Mobile apps and relevant tools for farm management offer a wide range of functionalities that can significantly improve the efficiency and effectiveness of farming operations. They provide real-time data on various aspects of the farm, including soil moisture, weather conditions, and crop health, fruit ripening level, potential volume of the yield; help farmers optimize their irrigation schedules by providing data on soil moisture levels and weather forecasts; alert farmers regarding potential pest and disease outbreaks, assist farmers in managing their finances by tracking expenses and revenues, by aggregating and analysing data, these apps can provide actionable insights and

Recommendations	Short description
	recommendations to improve farm productivity and sustainability, etc.
Support in introduction of early warning systems (example - RIMpro)	Early warning systems based on meteorological data collection and analysis can be set up in the orchards to foresee a timely and precise implementation of plant protection and monitoring measures. For instance, the Dutch company called “RIMpro” is specialized on provision of plant protection advisory services. The meteo-stations installed in the orchard periodically provide data to the “RIMpro” system. The system is processing the forecasted meteorological data and provides data on exact dates for insects’ mating, hatching, larva stages and flight periods of adults. These help to detect the most sensitive stage of insect and implement pest control at proper and exact periods and avoid additional, non-effective sprayings.
Rainwater harvesting and storage	Rainwater harvesting and storage methods vary widely around the world, tailored to local climate conditions, available technologies, geographical area and cultural practices. Roof harvesting systems collect rainwater from roofs through gutters and downspouts into storage tanks, underground storages or pits or bunds constructed to capture and store rainwater can be considered as potential options for Armenia. Nets designed to capture moisture from fog and convert it into water can be considered for mountainous areas with frequent fog.
Support setting up soil analysis laboratories, particularly mobile laboratories	Increasing access to affordable soil and general laboratory testing services through mobile testing units and local laboratories will make these services more accessible to farmers. This needs to be done in parallel with a) raising awareness about the importance of soil and disease analysis and providing training on how to interpret test results and apply recommendations effectively to further support farmers in making informed decisions; and b) creating demand from the buyers on critical aspects such as quality, food safety, and pesticide residue levels. There is already experience of establishing such laboratories in provinces of Armenia, done by ADA, GIZ and WFP. It is recommended to use this practice, and the lessons learned and establish mobile laboratories at least in Ararat and Armavir provinces of Armenia.
Support in establishing pesticide and fertilizer comprehensive registration system	• Support in establishing pesticide and fertilizer comprehensive registration system with centralized database, mandatory registration and approval process. There should be regular market surveillance to ensure compliance with quality standards and removal of expired products from the market. A comprehensive digital traceability mechanism shall be developed and applied which will allow tracking of the chemicals import, sales and usage.

Recommendations	Short description
	• Ensure proper advisory services that will advise farmers on pest and disease management and the safe use of pesticides and fertilizers. • Launch trainings and public awareness campaigns on the risks associated with the improper use of chemical pesticides and fertilizers and the benefits of sustainable farming practices, develop and distribute educational materials, such as brochures, videos, and posters, to farmers, retailers, and the general public, develop and implement education programs for farmers on integrated pest management and sustainable farming practices. Implementing these recommendations requires a coordinated effort from governmental bodies, stakeholders in the agricultural sector, and the community. The proposed measures will ensure the effective regulation of chemical pesticides and fertilizers, promote sustainable agricultural practices, and protect the environment and public health.
Support in improving capacities of the FSIB	The FSIBis an institution that implements awareness raising and provides consultancy in terms of proper usage of pesticides and fertilizers. It is recommended to provide a support to the FSIB in following directions: • Capacity development of FSIB inspectors on organic inspection and control • Enhance monitoring system for the pesticides residue levels in food samples and reporting implemented by State laboratory (“Republican Veterinary-Sanitary and Phytosanitary Centre of Laboratory Services” SNCO) • Development of clear guidelines for organic monitoring by FSIB inspectors. • Enlarge awareness raising activities on proper use of pesticides, fertilizers and agrochemicals. Also, it is recommended to conduct capacity building activities for farmers, retailers and exporters to enhance their knowledge on food safety, safe use of agri-chemical and compliance with food safety standards.
Support in implementation of sustainable practices	It is recommended to develop and conduct training programs for farmers on the benefits and techniques of sustainable orchard floor management, nitrogen management, and integrated pest management. Providing technical assistance for the implementation of cover cropping systems and pest management strategies, mulching (as an alternative to conventional polyethene mulch films) by using biodegradable plastic, is essential, along with ensuring the availability of necessary resources, such as seeds for cover crops, organic fertilizers, and pest management tools.

Recommendations	Short description
Promotion of agroforestry systems in Armenia	Agroforestry is a land use management system that integrates trees and shrubs with crops to create environmental, economic, and social benefits. It combines elements of forestry and agriculture to enhance productivity, sustainability, and resilience. Alley cropping (mix cropping) and windbreaks are systems that can be used and promoted in Armenia, particularly for new establishing orchards. Moreover, there was windbreak establishment experience in Armenia in Soviet period, that can be identified and promoted in cooperation with the GoA and regional and local authorities.
Promote better harvesting practices	To improve harvesting efficiency, it is essential to provide better training for seasonal workers. Training programs should focus on teaching farmers and workers who are usually involved in harvesting how to pick and handle the fruit gently and efficiently to minimize damage and waste.
Support in improvement of post-harvest infrastructure	Improving access to cold storage or freezing facilities can extend the marketability period for fresh fruits, berries and nuts, allowing farmers to sell their produce at better prices. Training farmers and logistic service providers on proper storing practices for each crop can further protect the fruit from spoilage, maintaining its quality and market value.
Support in establishing aggregation and distribution centers	Establishment of aggregation and distribution centers (logistic hubs), as well as support to all the consolidation ideas (consolidated supplies, transportation, distribution, raw materials procurements, cultivation) will notably contribute to the development of agricultural sector of Armenia. These centers could also become institutions promoting climate smart agriculture practices in the country. Support establishment of small-capacity local logistic hubs, that together with aggregating and marketing of fresh fruits, berries or nuts, will provide consultancy to farmers on sustainable agriculture practices, will ensure grading, sorting, washing, packaging of aggregated fruits, small processing or adding value to not marketable fresh fruits, berries and nuts (drying, freezing, getting fruit/berry or nut oils, etc.) It is recommended to discuss with the MoE on possibility of using public-private partnership principles for establishing and operating of such centers. Measures could be taken to increase the interest of cooperatives in these activities. Contract farming principles can be used for the operation of these centers as a model that can be replicated to other relationships between farmers and buyers.
Support in finding markets for green, organic and sustainable agricultural products	The farmers or companies that produce green, organic and environmentally friendly products will need support in finding relevant markets or increasing demand for their products. Such support will need also aggregation and distributions centers.

Recommendations	Short description
	There are several models of support, where the role of the Government is important. It is recommended to discuss with the MoE and the GoA introduction of following methods: • Green and humanitarian procurement of primary and processed agricultural products for state-controlled bodies: schools, the army, kindergarten, state reserve, etc. • Support in identification of foreign markets, including assessment of potential markets, identification of promising niches, publication of market reports, distribution of regular information on standard and certification requirements of target markets, publication of lists of potential buyers or institutions able to provide support to Armenian exporters, organisation of networking and matchmaking events and provision of marketing and branding assistance, etc. • Support in marketing of Armenian products in foreign markets by implementing direct marketing, organising promotional events at export markets, supporting in participation of international fairs, festivals, and other events. • Promote CSA practices, by developing specific state support programs or making supplements in existing ones, by providing more technical support to those farmers who want and apply CSA practices.
Support in introduction of sustainable (green) packaging	Green packaging for fruits, berries and nuts refers to using environmentally friendly materials and methods to pack these products. The goal is to reduce the environmental impact of packaging by using sustainable materials, minimizing waste, promoting recycling or composting and reducing footprint. Many foreign companies already have committed to using recyclable, compostable, biodegradable materials for packaging fresh and processed fruits, berries and nuts (for example Driscoll's, Nuts.com, Sun-maid, etc.) It is recommended to promote usage of such packaging in target value chains, discussing involvement of relevant assistance in state support programmes as well.
Support in introduction of agriculture information system	The Agriculture Information System is a comprehensive framework designed to manage, process, and analyse agricultural data to improve decision-making, efficiency, and productivity in the agricultural sector. It is considered an integral part of modern agriculture. It gives an opportunity not only to collect manage the situation in the field, but also to guide the farmers, provide agricultural advice, evaluate the development trends of farmers, the volume of agricultural products produced by them during the given year, and develop appropriate policies. It is recommended to discuss with the MoE the potential of introducing such system, for promoting CSA agriculture in Armenia.

Recommendations	Short description
Support in introduction of Agricultural Market Information System in Armenia	Market information can play an extremely important role in promoting agricultural development, especially among small-scale producers. Agricultural market information systems collect, analyse, package, store and disseminate prices and other information relevant to farmers, traders, processors and others interested in agricultural commodities. Originally, these systems delivered mostly price information, and not necessarily in a timely manner, e.g. once/week or once/month. Later, to meet the needs of private sector actors, MIS started to deliver additional services: more frequent price information at different markets, information on different produce from input to final produce, selling – buying offers, sellers / buyers contacts, weather forecast, stock availability, market analysis, etc. It is recommended to discuss with the MoE the possibility of establishing similar system for Armenia, for promotion of CSA practices and making evidence-based decisions.
Specific recommendations	
Promoting new technologies in raspberry freezing	There are different raspberry freezing methods, which can be used to prolong the shelf-life of harvested products. Considering cost-effectiveness and quality of final product, **blast freezing** is considered as a good option. This option is efficient in terms of energy use, requires a small amount of initial investment (purchase of equipment) and preserves the texture, colour, shape, and nutritional content of raspberries. **Shock freezing** is like blast freezing in terms of quality, but often more expensive due to higher energy consumption.
Equipment for walnut processing (washing, cracking, packaging, oil production etc.)	To enhance walnut processing, invest in automated washing and peeling machines for efficient and consistent removal of dirt and green pericarp. Use precision cracking machines to extract kernels with minimal damage and adopt advanced optical sorting and grading technology to ensure high quality. Additionally, implement climate-controlled storage facilities and modern packaging solutions to maintain freshness and extend shelf life. These improvements will reduce costs, improve quality, and increase market competitiveness.
Sky Agro Fabrika	The Armenian agricultural sector faces significant challenges that impede its growth and sustainability, including limited adoption of modern and precision agricultural technologies and data-driven farming practices. By the application of agricultural drones as precision farming practices, farmers can minimize their environmental footprint by reducing chemical usage, optimizing resource efficiency, and promoting sustainable land management practices. **SkyAgro** has an initiative to create a network of 100-200 high-tech farming hubs to integrate modern agricultural solutions, establish iFarm database and cloud-based farm

Recommendations	Short description
	management as well as blockchain/smart-contract-based systems for providing farmers modern agricultural intelligence and data-driven decision-making tools and connecting them with food processors, warehouses, transportation, and other value chain actors. It is suggested to support this initiative and scale it up by involving other similar service providers.
Advanced AI and robotic solutions in agriculture	Traditional farming practices face numerous challenges, including inefficient resource management, labour-intensive processes, and limited ability to monitor and optimize crop health and growth. **Andranik Ugujyan IE** is pioneering the transformation of conventional farming into a high-tech industry through the development and implementation of advanced AI and robotic solutions. His initiative focuses on providing state-of-the-art tools designed to enable precise monitoring and management of crop growth and plant health. It is recommended to support this initiative for accelerating the development and refinement of AI algorithms and robotic technologies, ensuring manufacture and deployment of innovative agricultural machinery and for training programs to educate farmers on the use of AI and robotic technologies
Organic agro-centre and store	The agricultural sector faces challenges in transitioning to organic farming due to the limited availability of certified organic inputs and a lack of centralized resources for farmers. **Agro911** company plans to address these challenges by establishing a dedicated organic center and store, named “Organic Agro.” This center aims to be a one-stop shop for certified organic agricultural inputs and expert advice, thereby promoting and supporting the expansion of organic farming. It is suggested to support this initiative by helping obtain organic certification for the store, developing training programs to educate farmers on organic farming practices and raising awareness about the benefits of organic farming.
Organic-origin fertilizer production	The agricultural sector in Armenia heavily relies on imported mineral fertilizers, particularly nitrogen-based ones, which creates several challenges. Although there are some practices of using organic fertilizers, they have not significantly influenced the behaviour of farmers and orchard owners. Promoting the production of organic origin fertilizers in Armenia can be a cost-effective and environmentally sustainable alternative. Several organizations in Armenia produce organic and environmentally friendly products that can be supported and promoted to boost their production volumes and promote wide usage in Armenia, with the potential for future export to foreign markets. Some of them (**Eco Plant LLC, Zulal Agro, MAquaponics LLC**) apply bacterial processing of manure and fish visceral waste, while

Recommendations	Short description
	others use biotechnology (such as **GreenFarm LLC**) or Californian worms (**Orwaco CJSC**) for producing fertilizers and bio-humus. It is recommended to provide the necessary support to these companies to expand their production and enlarge their markets.
Recycling of plastic boxes	Plastic boxes are widely used by Armenian farmers, aggregators and exporters for collecting, storing and distributing fresh fruits (particularly apricot and peach). Very often broken boxes are thrown into nature of landfills, thus polluting the environment. To address this issue as well as to reduce costs for plastic boxes, **Apricot Group LLC** started to recycle broken plastic boxes for producing new ones. The initiative involves collecting and purchasing raw materials (broken plastic boxes, plastic bottle caps) from neighbouring villages, shops, and other sources, which supports local economies and promotes sustainable business practices. It is suggested to support this initiative aiming to enhance their plastic box production capabilities and promote collection and recycling of broken plastic boxes, plastic bottle caps and all other materials necessary for production.
Establish a pilot biochar production	Biochar is a form of charcoal produced by heating organic material (usually biomass) without oxygen (pyrolysis). It is used for soil enhancement, carbon sequestration, and waste management. Raw materials for biochar production can be wood, agricultural residues, or municipal waste. The initial investment in biochar production equipment can vary widely based on the scale of the operation and the technology used. The initial investment in pyrolysis equipment and infrastructure can be substantial. The cost varies depending on the scale of production and the type of technology used. There are also ongoing costs that include energy for heating, labour, maintenance, and feedstock procurement. Nevertheless, while biochar production can be energy-intensive and costly, advances in technology and the potential environmental and agricultural benefits can make it a worthwhile investment in certain contexts.
Testing drought resistant varieties of apricot and peach in Armenian conditions	There are drought-resistant varieties of apricot and peach that are well-suited for areas with limited water availability. **'Moongold'** and **'Harglow'** varieties of apricot, **'Elberta'** and **'Redhaven'** varieties of peach are well known for their ability to thrive in dry conditions. These varieties are not well known and piloted in Armenian conditions. It is recommended to work with nurseries or research-educational centers for importing and piloting growth of these varieties in Armenia. While walnuts generally require more water compared to apricots and peaches, some varieties are more drought tolerant. **Black walnut** and **English walnut** trees can adapt to a range of soil types and once established, can tolerate dry conditions to some

Recommendations	Short description
	extent. However, ensuring deep watering during the establishment phase is crucial for better drought resilience. These drought-tolerant varieties can be beneficial for farmers operating in arid regions, contributing to sustainable agricultural practices by reducing water usage.
Pilot freeze-drying / lyophilisation practice in Armenia	Lyophilization preserves fruits and berries by retaining their flavour, colour, and nutritional content better than other drying methods. To boost preservation and marketability, it is recommended to implement a pilot project by establishing freeze-drying facilities with advanced technology and setting up mobile units or local centers for farmers. This activity could include provision of training and raising awareness on freeze-drying practices and benefits, offer subsidies or grants for equipment to assist small-scale producers, facilitate collaboration between facilities and local markets to streamline distribution.
Online consultancy through aygi.am	Aygi.am platform was established in the framework of FRUTENIA project implemented by ICARE. The platform is currently maintained by the ICARE and provides important information and guiding documents on orchard establishment and maintenance. The analysis has shown that there are some features that could improve the work of platform and direct communication between farmers and agricultural specialists and consultants. Thus, it is recommended to provide support for enhancing the aygi.am platform by expanding its content to include detailed information on various tree varieties, modern grafting techniques, and pruning practices implemented worldwide. Furthermore, integrating an online consulting tool would enable farmers to seek advice from agricultural professionals and facilitate communication and knowledge sharing among farmers. Development of professional networks among farmers and consultants will contribute to strengthening agricultural capacity-building activities.
Integration of scientific knowledge into agriculture.	To enhance the integration of scientific knowledge into agriculture, implement a pilot project at CENS that leverages remote sensing and in-situ data collection to identify hazardous chemicals in fruit plants. Focus on mapping 1-2 regions to generate detailed data on chemical contaminants. This data can be used by exporters and traders to identify high-quality, safe fruit from specific farmers, potentially allowing for premium pricing and expanded export opportunities. Such a project will not only improve market access for farmers but also promote sustainable and green agriculture practices by providing actionable insights into chemical safety. Additionally, this initiative will demonstrate the practical application of **CENS's** research capabilities, bridging the gap between scientific research and agricultural practice.