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Federal Ministry
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based on a decision of
the German Bundestag

IKI INTERNATIONAL CLIMATE INITIATIVE

PROGRESS
Promoting Green Deal Readiness in
the Eastern Partnership Countries

ANALYSIS OF ALMOND, BLUEBERRY, STRAWBERRY AND TANGERINE VALUE CHAINS IN GEORGIA

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DEPA CONSULTING

Analysis of Almond, Blueberry, Strawberry and Tangerine Value Chains in Georgia

(short version)

Promoting Green Deal Readiness in the Eastern Partnership Countries
(PROGRESS)

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ABBREVIATIONS

AWPA	Georgian Almonds and Walnuts Producers Association
BMUV	German Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection
CA-ULO	Controlled Atmosphere and Ultra Low Oxygen
CIS	The Commonwealth of Independent States
CSA	Climate Smart Agriculture
DCFTA	Deep and Comprehensive Free Trade Area
EaP	The Eastern Partnership
EBITDA	Earnings Before Interest, Taxes, Depreciation and Amortization
EBRD	The European Bank for Reconstruction and Development
EEA	European Economic Area
ENPARD	EU-supported European Neighbourhood Programme for Agriculture and Rural Development
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
GBGA	Georgian Blueberry Growers Association
GEL	Georgian Lari
Geostat	National Statistics Office of Georgia
GIZ	The Deutsche Gesellschaft für Internationale Zusammenarbeit
HACCP	Hazard Analysis and Critical Control Point
ICCs	Information and Consultation Centers
IFS	The International Featured Standard
INC	International Nut and Dried Fruit Council
IPM	Integrated Pest Management
IQF	Individually Quick Frozen
ISO	International organization for Standardization
LLC	Limited Liability Company
MEPA	The Ministry of Environmental Protection and Agriculture
PROGRESS	Promoting Green Deal Readiness in the Eastern Partnership Countries
RDA	NNLE Rural Development Agency
SDC	The Swiss Agency for Development and Cooperation
SRCA	Scientific Research Center of Agriculture

SWOT	Strengths, Weaknesses, Opportunities, and Threats
TVET	Technical Vocational Education and Training
UNDP	United Nations Development Program
USAID	United State Agency for International Development
VCs	Value Chains

CHAPTER 1.
INTRODUCTION

DEPA Consulting conducted value chain (VC) analysis of almonds, blueberries, strawberriesand tangerines in Georgia within the framework of the PROGRESS project, to identify promising value chains (VCs) for sustainable growth through innovative practices and support the transition to climate-friendly, sustainable economic models.

Georgia's agriculture benefits from diverse agro-climatic zones but faces challenges such as land fragmentation and small-scale farming. Agriculture employs 17.8% of the workforce, with most engaged in primary farming[1]. Although agriculture's GDP contribution has declined to 6.9% in 2023, its output rose to GEL 7 billion (approx. USD 2.4 billion), distributed among plant cultivation (47.2%), animal husbandry (46.5%), and services (6.3%)[2]. Agricultural development remains vital for Georgia's economic growth, employment, poverty reduction, and food security, with broad consensus on its importance for sustainable progress.

A significant challenge in Georgia's agriculture sector is the dominance of small-scale family farms and agricultural holdings, leading to inefficient farm structures and significant land fragmentation. According to the 2014 agricultural census, 97% of farms are smaller than 3 hectares, with over three-quarters (77.1%) operating on less than 1 hectare. The average agricultural landholding size is 1.4 hectares, with households averaging 1.2 hectares and legal entities averaging 49.2 hectares. Agricultural development presents substantial investment opportunities and is essential for the country's overall development, particularly in terms of employment, economic growth, poverty reduction, and food security.

1.1 Background

The PROGRESS project is funded by the BMUV and is implemented by a consortium led by GIZ. It aims to promote sustainable agriculture and climate resilience in Eastern Partnership (EaP) countries, focusing on transforming selected VCs to mitigate the greenhouse gas (GHG) emissions and improve economic conditions.

DEPA Consulting conducted a value chain analysis of these crops in Georgia, identifying promising chains for green, climate-smart development, and recommended interventions to enhance sustainability and productivity. Key tasks included data collection, stakeholder mapping, market assessment, and preparation of a comprehensive report with prioritized VCs using the ValueLinks 2.0 tool. Findings were validated by the representatives of the Ministry of Environmental Protection and Agriculture of Georgia (MEPA), sectoral experts and the GIZ PROGRESS team. The scope covered the entire value chain—production, processing, and marketing—identifying

[1] National Statistical Office of Georgia, employment and unemployment - https://www.geostat.ge/ka/modules/categories/683/dasakmeba-umushevroba
[2] Annual Report of Ministry of Environmental and Agriculture - https://mepa.gov.ge/Ge/Reports

gaps and opportunities, and ensuring alignment with the project's sustainability goals through stakeholder collaboration and site visits.

1.2. Methodology

The value chain analysis methodology for almonds, blueberries, strawberries and tangerines in Georgia integrates qualitative and quantitative research, i.e., mixed methods approach, to provide a comprehensive understanding of these sectors. It examines economic, social, and environmental factors influencing their performance and sustainability.

The approach included mapping the VCs, identifying stakeholders, and analyzing their roles and interactions. Data collection combined key informant interviews, surveys, and desk research, drawing on sources like the National Statistics Office of Georgia (GeoStat) and market reports. Analysis employed statistical methods, thematic analysis, and tools like ValueLinks 2.0 to identify strengths, weaknesses, and intervention points.

This systematic methodology supported practical recommendations for climate-smart, resilient, and sustainable practices, aligning with goals to enhance Georgia's agricultural productivity and sustainability.

1.3. Most promising value chains for climate-oriented, resilient and green economic development

The team used the ValueLinks 2.0 framework, a recognized methodology for VC development, to ensure a data-driven and transparent selection process. This approach prioritized economic, environmental, and social criteria, aligning with Georgia's strategies for green and climate-resilient agriculture.

The selection matrix included six key parameters, ten criteria, and 49 guiding questions per VC, rated on a 1 to 6 scale (1 = least desirable, 6 = most desirable). Final VC selection was based on the highest cumulative scores, with expert opinions weighted to emphasize climate-resilient and green criteria while maintaining balance across other parameters. This approach identified two VCs with strong potential for sustainable development. A comparison of rankings across the four VCs, using unweighted average scores for each criterion, highlights their respective strengths and weaknesses, providing a clear rationale for the selection.

The final scoring highlights almonds and blueberries as the top VCs for climate-oriented, resilient, and green economic development within the PROGRESS project. While tangerines and strawberries excelled in areas like employment creation and production, focusing too heavily on these criteria could have led to biased and less sustainable outcomes:

The weighted analysis confirmed almonds and blueberries as the most promising for climate-oriented, resilient, and green economic development. The team conducted an in-depth analysis and provided detailed recommendations for these crops. This approach ensured a systematic understanding of the value chains, offering actionable insights to promote sustainable agricultural development in Georgia.

Final Scoring	Almond	Blueberry	Strawberry	Tangerine
Weighted Average	4.09	4.2	3.64	3.47

CHAPTER 2.
VALUE CHAIN ANALYSIS OF ALMOND PRODUCTION

2.1. Almond value chain introduction

Georgia, traditionally a leading hazelnut producer, is now gaining recognition for its emerging almond industry, driven by rising global demand for healthy foods. Almonds, cultivated in Eastern Georgia for centuries, were not a cash crop until late-blooming varieties were introduced in the 21st century by Institute of Horticulture, Viticulture and Oenology (IHVO) researchers, overcoming the issue of early flowering and frost damage. Today, commercial almond orchards are concentrated in Kakheti, Kvemo Kartli, and Shida Kartli, covering over 6,000 hectares, including super-intensive plantations.

2.2. Almond value chain visualization

The visualization of Georgia's almond value chain provides a comprehensive overview of the interconnected processes, stakeholders, and product flows involved in almond production, processing, and distribution. This sub-section presents a clear and detailed graphical representation of the almond value chain, highlighting key components and their interconnections within the industry.

By mapping out the value chain, stakeholders can better understand the roles and interactions of input suppliers, almond producers, processors, distributors, and retailers. Such visualization serves as a valuable tool for identifying opportunities, challenges, and potential areas for improvement within the almond sector, ultimately enhancing the overall efficiency and sustainability of almond production in Georgia:

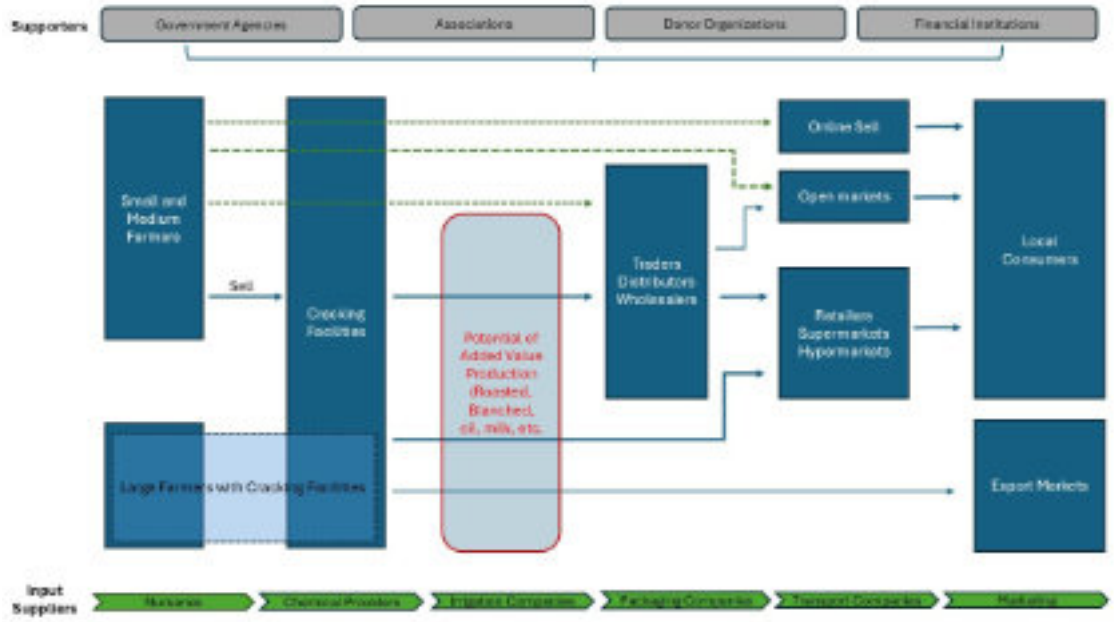

Figure 1: Almond value chain visualization

2.3. Almond value chain information

2.3.1. Geographical coverage, Production Statistics

Almond production in Georgia has grown significantly, with over 6,000 hectares of orchards, 4,100 hectares of which were established under the "Plant the Future" program. Private investments, including the Adjara Group's 2,300 hectares in Kakheti, have further stimulated the sector growth, which now produces 3,000 tons annually. Almond production is projected to reach 4,000 tons by 2025 and up to 10,000 tons in the coming years, driven by improved farming practices and increased private investment.

Georgia imports almond kernels primarily from the U.S., with 42% of imports re-exported to Armenia and Kazakhstan. In 2023, U.S. almond kernel imports averaged USD 3.56/kg, while Georgia's export price reached USD 5.32/kg, reflecting higher quality and value addition through processing. Globally, the almond market is dominated by the U.S., Australia, and Spain, with California controlling 75% of global production. In 2023–2024, international almond prices fluctuated due to surplus stockpiles and shifting yield forecasts; however, reduced supply and stronger demand in 2024 have led to a price recovery. This dynamic market highlights opportunities for Georgia's almond industry to expand exports, though global price volatility requires careful monitoring to ensure competitiveness.

2.3.2. Employment in the almond production sector

The almond production sector in Georgia is rapidly growing, driven by domestic investment and international demand. It significantly contributes to rural employment in farming, agro-processing, and supporting industries:

- Farm Labor: Almond orchards require substantial labor for planting, maintenance, and harvesting. On average, around 4,300 seasonal workers are employed annually during the harvest season (August–October), along with year-round staff for orchard management. Mechanization complements, rather than replaces, seasonal labor (Almond and Walnut Producers Association (AWPA), 2024).
- Processing Potential: Investments in processing facilities (e.g., shelling, grading, packaging) and value-added products such as almond oil and flour can create additional skilled jobs, particularly in quality control and management.
- Support Services: The sector generates employment in irrigation, logistics, advisory services, and input supplies, driving growth in related industries.

- Challenges: The sector faces global price volatility, limited infrastructure, and the need for skilled labor, requiring further investment and training to ensure sustainable growth.

With expanded orchards, modernized facilities, and continued support, Georgia's almond sector holds significant potential for creating stable rural employment and boosting the agricultural economy.

2.3.3. Processing - Value addition and sales channels in almond production

The almond value chain involves several key players, each adding value and influencing the product's final price:

- Farmers: Farmers sell in-shell almonds for 3.5 GEL/kg, earning a profit of GEL 6 per 3 kg after production costs (33% of total profit share). However, for farmers using manual harvesting, higher costs reduce profits to 20%. Farmers contribute 26% of total value added in the chain.
- Cracking Facilities: Facilities purchase 3 kg of in-shell almonds for GEL 10.5, incurring 2.5 GEL/kg in processing costs. They sell almond kernels for GEL 16, generating a profit of GEL 3 (17% of profit share) and adding 23% to total value.
- Intermediaries: Intermediaries buy kernels for GEL 16 and sell them for GEL 21, earning GEL 4 profit (22% profit share) and adding 21% to total value.
- Retailers: Retailers purchase almonds for GEL 21 and sell them to consumers for GEL 28. They earn a profit of GEL 5 (28% profit share) and add 30% to total value.

Farmers currently face the lowest profitability due to high production costs and limited market diversification. Some farmers invest in their own cracking facilities to improve margins and reduce reliance on intermediaries. Expanding processing capacities and competition in the sector could help distribute profits more evenly across the chain.

2.4. Value chain actors of almond production

2.4.1. Producers (farmers, businesses, cooperatives)

The almond sector in Georgia is experiencing significant growth, supported by government initiatives and favorable conditions. While the industry is still developing

post-harvest infrastructure, it plays a vital role in diversifying agriculture and enhancing export potential. Major almond producers include:

- Udabno Ltd (Kakheti Region): The largest producer, with 2,300 hectares of orchards, focusing on late-flowering varieties such as Guara and Soleta. The company is transitioning to organic farming and investing in digital agriculture and modern irrigation systems.
- Nuts Incorporated Ltd (Shida Kartli Region): Managing 800 hectares of almonds and 2,200 hectares of hazelnuts, the company focuses on export-quality almonds using modern farming and irrigation techniques.
- Nuts Cultivation Company Ltd (Kakheti Region): Operating 160 hectares with varieties like Laurann and Ferragnes, the company is pursuing organic certification for EU markets.
- Mkisa Ltd (Kvemo Kartli Region): Cultivating 40 hectares with super-intensive technology, with plans to expand to 100 hectares. Mkisa focuses on mechanization and green energy solutions, with the first harvest expected in 2024.

The almond processing industry is steadily expanding, with seven cracking facilities operational by 2024 and two more under construction. Facilities handle 250-1,500 kg of in-shell almonds per hour. However, storage remains a challenge, as many farmers process almonds but lack proper storage for kernels, leading to quality issues. Some processing facilities include:

i. **Udabno Ltd**: Operates a high-capacity processing plant (10 tons/hour) for cleaning, sorting, and packaging;
ii. **Nuts Incorporated Ltd**: Manages all post-harvest processes, including cracking, drying, and packaging, ensuring high-quality standards (AWPA, 2024). This sector's ongoing development, combined with investments in infrastructure and sustainable practices, positions Georgia’s almond production for strong growth and increased competitiveness in global market.

2.4.2. Input suppliers (functions, needs, challenges, development opportunities)

Nurseries and Seedling Production in Georgia: During the Soviet era, large-scale farms produced 15–20 million saplings annually. After a significant decline post-Soviet period, the nursery sector began recovering in the 2010s, driven by new orchards and the "Plant the Future" subsidy program. Almond seedlings are now in high demand, surpassing walnut orchards due to their commercial potential.

As of 2023, Georgia has around 30 registered nurseries and 60–80 small-scale producers, with 15–25 considered major players. Annual production ranges from 10,000 to 400,000 saplings, with almond-focused nurseries producing 100,000–200,000 grafted trees annually, mainly in Kakheti and Shida Kartli regions. Local saplings cost GEL 4–6 (EUR 1.30–1.50), complemented by imports from Spain, Italy, and Turkey (8–20% of supply).

Challenges include ensuring phytosanitary standards, true-to-type propagation, and a lack of certified mother blocks. Efforts led by MEPA, supported by FAO, ENPARD, USAID, and GIZ, aim to implement certification systems to enhance nursery production quality and meet global market standards.
Key Suppliers of Agrochemicals and Pesticides: Agrochemicals play a vital role in almond production by protecting crops and enhancing yields. In 2021, Georgia's agrochemical market was valued at USD 50.59 million, with future growth expected. Proper pathogen forecasting, Integrated Pest Management (IPM), and increasing use of bio-based agrochemicals drive this sector's development.

Fertilizer efficiency has improved globally, with Georgian almond farmers adopting water-soluble and micro-fertilizers, though their use remains lower than global averages. Five major companies—Agrosphere-Noblex, Bornagro-Syngenta, Cartlis, Agrokartli, and Agronom—control 75–80% Georgia’s market, distributing globally recognized products from firms like Bayer, DuPont, and Syngenta. Medium and small suppliers also import from the EU, Ukraine, Turkey, and India. Growing interest in organic production has boosted the demand for bio-products (fungicides, insecticides, and agrochemicals) and suppliers now offer farmers a range of organic solutions alongside conventional products and equipment.

Irrigation System Providers in the Almond Value Chain in Georgia: Irrigation system providers are critical to almond VC in Georgia, supporting efficient water management and advanced technology adoption. Nearly all new orchards now use drip irrigation systems, with over 20 companies offering services. Among these, at least five are well-regarded for providing advanced solutions from brands like Netafim, Metzerplas, and Naan.

These providers supply essential drip and automated irrigation systems, improving water efficiency, reducing waste, and enhancing orchard resilience to climate variability and drought. However, some orchards use outdated or poorly designed systems due to affordability, limited technical expertise, and low-quality installations. Addressing these challenges is key to ensuring the adoption of modern drip-irrigation technologies, maximizing productivity and adapting to climate variability and drought.

2.4.3. Market Iintermediaries and distribution channels

Until 2024, nearly all Georgian almonds were sold domestically, with only small export volumes in 2023 to the EU and Uzbekistan. Sales channels for almonds remain underdeveloped, with farmers typically selling through direct sales to processing facilities, using cracking services, or selling in-shell almonds at markets.

Some small-scale farmers rely on low-cost Turkish-origin machines for processing. Most processors sell almond kernels in bulk to distributors, who supply open markets and supermarkets, with a few also serving snack companies such as "Kalakuri." Farmers using cracking facilities typically sell at local markets or through distributors, while others sell directly online.

Despite limited exports, the almond sector shows growth potential. Future success will depend on developing export sales channels, particularly in the Gulf and Asian markets, where certification requirements are less stringent. Georgia's almonds could mirror the hazelnut industry model, focusing on bulk exports. Domestically, almonds can substitute imported snacks, lowering prices and boosting consumption. However, exporting in-shell almonds is unlikely due to the low kernel-to-shell ratio, which makes it economically unfeasible.

2.5. Assessment of common agricultural practices in almond cultivation

The following subsections provide an assessment of current agricultural practices in almond cultivation, based on in-depth interviews with industry representatives and semi-structured interviews with farmers conducted during the research.

2.5.1. Assessment of current agricultural practices in almond cultivation

Orchard Systems and Layout: Almond orchards in Georgia average 20 hectares, with 90% following conventional farming and 5–10% practicing organic methods. The Udabno project, representing over a third of the industry, is transitioning to organic production, a process expected to take two years. Yield averages 0.4 tons per hectare, but this is lower due to many new orchards still being in their early growth stages. Common orchard layouts include standard (7x4 meters), semi-intensive (6x4 meters), and super high-density (3.5x1.2 meters), with a planting density of 333-415 trees per hectare. Windbreaks are used in 46% of orchards, though layout designs often lack site-specific optimization.

Site Selection and Climatic Considerations: Almond orchards are concentrated in Georgia's eastern regions, with favorable soil and climate conditions. However, site selection is crucial due to climatic variability, such as frost risk and wind exposure, which can affect tree health and productivity. Areas lacking weather data or with higher wind exposure may face additional challenges.

Rootstock and Cultivar Selection: Varieties like Supernova, Avijor, Guara, and Soleta are commonly planted, with some growers experimenting with Californian varieties. Rootstocks such as Bitter Almonds and GF 677 are commonly used, but inconsistencies in rootstock and cultivar selection contribute to unstable orchard performance. High-quality plant materials are therefore essential for ensuring success.

Pruning and Training Practices: The open vase pruning system is most common, but practices vary. Some farmers employ methods unsuitable for local conditions, indicating a need for tailored research and training.
Irrigation Management: Drip irrigation is standard in Georgian almond orchards, but inefficient system design and misconceptions about water requirements for almonds have led to suboptimal productivity. High winds increase water demand, further complicating irrigation management.

Soil Management and Fertilization: Most orchards follow conservative soil management practices, including using mulchers and herbicides. A growing trend of conducting soil and leaf analyses is improving fertilization decisions.

Pest and Disease Management: While pest and disease issues have been limited, 42% of growers report challenges. Pest management decisions are mostly made by agronomists, with input from growers and suppliers.

Technology Adoption and Sustainability Practices: The use of smart technologies, such as sensors and meteorological stations, remains low, with only 30% of growers adopting such technologies. Adoption of renewable energy solutions, such as solar panels, is also limited.

2.5.2. Harvesting, post-Harvesting, processing, and value-Adding practices

Harvesting and Post-Harvest Practices in Georgia’s Almond Industry: Almond harvesting in Georgia takes place from late August to September, with time varying by regions. Manual and semi-mechanized methods are common due to the young age of many orchards, low yields, and limited access to mechanized equipment. Introducing mechanized harvesting is essential for reducing production costs and increasing

competitiveness, though some farmers are already adopting mechanized solutions. Common harvesting methods include:

- Californian method: Shakers, sweepers, and harvesters (less common in Georgia due to smaller plots and higher rainfall risks).
- Super High-Density Harvesting: Uses combine machines (tested in Sagarejo, but costs remain high).
- Shakers and Nets: Suitable for standard and intensive layouts.
- Umbrella and Shaker: Best for standard setups.

Hulling, which separates the almond from the hull, occurs after harvesting. The process involves additional winnowing in Georgia to remove leaves, while stone sorting is not required. Drying is crucial due to higher humidity at harvest, with almonds needing to reach 6% humidity to prevent spoilage. However, many farmers do not consistently adhere proper storage guidelines, which can lead to quality issues.

Table 1: Cost of Establishing an Almond Orchard per Hectare

Orchard planting budget, GEL				
Cultivable area	1 Ha			
Orchard Layout 6.0 *4.0, 420 plants/ha	* Local sapling 6.0 Gel, foreign sapling 5.2 EUR= 15,6 GEL			
Operations	unit	QTY	unit price	Total
Soil analysis	Ha	1	300,00	300,00
Land cleaning	Ha	1	400,00	400,00
Plowing the soil plantage or chisel	Ha	1	800,00	800,00
Plowing with a 4-wing plough	Ha	1	450,00	450,00
Soil cultivation with heavy discs	Ha	1	250,00	250,00
Rotary tilling	Ha	1	300,00	300,00
Plot planning GPS	Ha	1	200,00	200,00
Planning with poles in the plot	Ha	1	180,00	180,00
Holes	piece	420	0,60	252,00
Planting, pruning	piece	420	0,50	210,00
Preparation of supporting poles and tying of seedling	piece	420	0,20	84,00
Watering after planting	Ha	1	200,00	200,00
Application of mineral fertilizer	kg	400	0,15	60,00
Application of herbicide (4 times)	Ha	1	240,00	240,00
spraying (50 GEL,8 times)	Ha	1	400,00	400,00
Weeding around plants (3 times)	piece	420	0,80	336,00
inter-row cultivation or mowing (4 times)	Ha	1	350,00	350,00
Drip irrigation 60 times	Ha	60	8,00	480,00
Total works				5 492,00

Required materials	Unit	QTY	Unit price	Total
almond Plants*	piece	420,0	15,6	6552,0
Support poles	piece	420,0	0,3	105,0
Mineral fertilizer MAP	kg	100,0	3,5	350,0
trunk protectors	piece	420,0	0,5	210,0
mineral fertilizer	kg	300,0	2,5	750,0
Fungicide (anthracol, cupper, signum)	kg	10,0	50,0	500,0
Insecticide (Karate, Confidor, movento, vertimec)	liter	5,0	90,0	450,0
herbicides	liter	5,0	23,0	115,0
Nitrogen fertilizer #30	kg	150,0	1,2	180,0
micro fertilizers	kg	2,0	15,0	30,0
Total = materials needed				9 242,0
Transportation costs				
plant transportation	piece	420	0,40	168
Transportation of supporting materials	piece	420	0,30	126
Transportation of mineral fertilizer	kg	400	0,20	80
drip irrigation				
trunk lines	meter	120	10,00	1 200
lateral lines	meter	1700	0,80	1 360
Pumps,taps, fertigator	set	1	3 300,00	3 300
Cutting channels,arrangement of drip, installation, maintenance	service	1	2 700,00	2 700
Total				8,560,0
other expenses				
land tax	Ha	1	50,00	50
Water consumption	Ha	1	80,00	80
An unexpected expense	5%			1,189,90
Total				1319,90
Total on 1 hectare				24,988

**Assuming the farmer is using foreign sapling*

2.6. Calculation of prime cost and farmers' profitability estimates

2.6.1. Orchard establishment investments

The decision to establish an almond orchard requires careful consideration, as it involves a long-term investment and demands comprehensive management strategies for successful nut production. A well-planned and organized orchard can lead to higher efficiency by reducing input needs and maximizing potential returns. The cost breakdown for establishing an almond orchard in Georgia is presented in Table 2:

Table 2: Key Operating Expenses for Almond Orchard (2023)

Agronomic Operation costs of almond orchards, GEL				
Cultivated area		1	Ha	
Operations	**Unit**	**QTY**	**Unit price**	**Total**
Pruning, shaping	piece	420,00	2,00	840,00
Irrigation (60 times with drip)	Ha	1,00	500,00	500,00
Application of mineral fertilizer	Ha	1,00	80,00	80,00
Application of herbicide in the row - 4 times (80 GEL)	Ha	1,00	320,00	320,00
Poisoning (80 GEL, 8 times)	Ha	1,00	640,00	640,00
Inter-row cultivation or mowing with a mulcher (4 times)	Ha	1,00	300,00	300,00
Name of required materials				
Water soluble fertilizer, SOP	kg	200,00	6,00	1 200,00
Mineral fertilizer, Nitrogen	kg	300,00	1,20	360,00
Microelements, Mn, Zn, B, Fe, aminoacids	L	5,00	30,00	150,00
Mineral fertilizer, MAP	kg	100,00	5,00	500,00
Green pruning	piece	420,00	1,00	420,00
Fungicide (Anthracol, Polyram, Bravo)	kg	6,00	45,00	270,00
Fungicide (Signum, Switch, Teldor)	kg	1,50	280,00	420,00
Insecticide (Ampligo, Koragen)	liter	2,00	320,00	640,00
Insecticide (Karate, Decis)	liter	2,00	100,00	200,00
Insecticide (Confidor, Movento)	kg	0,20	600,00	120,00
Acaricide (Masai, Vertimek)	L	2,00	170,00	340,00
Herbicide (Reglon, Basta)	liter	8,00	45,00	360,00
Herbicide (Gliposate)	liter	8,00	25,00	200,00
Other expenses				
land tax	Ha	1,00	50,00	50,00
Water consumption	Ha	1,00	80,00	80,00
Unplanned additional cost	0,05			399,50
Total per hectare				**8,389.50**

2.6.2. Profitability estimates

The following data reflects the profitability of almond orchards. On average, almond growers generate a gross income of GEL 8,389 per hectare. The break-even point, when economic profit equals GEL 0, is typically reached five to six years after planting, depending on orchard management and environmental factors.

Table 3: Profitability Estimates of Almond Orchards

Year	Harvest per tree kg	Per ha	Price 1 kg	Gross income	Expenses	Harvest cost	Investment profile (GEL)
1	0,0	0,0	4,00	-	24 987,90	-	- 24987,9
2	0,0	0,0	4,00	-	4 194,50	-	- 4 194,50
3	1,3	546,0	4,00	2 184,00	6 711,20	546,00	- 5 073,20
4	3,8	1596,0	4,00	6 384,00	8 389,00	1 596,00	- 3 601,00
5	7,0	2940,0	4,00	11 760,00	8 389,00	2 940,00	431,00
6	12,0	5040,0	4,00	20 160,00	8 389,00	5 040,00	6 731,00
7	12,0	5040,0	4,00	20 160,00	8 389,00	5 040,00	6 731,00
8	12,0	5040,0	4,00	20 160,00	8 389,00	5 040,00	6 731,00
9	12,0	5040,0	4,00	20 160,00	8 389,00	5 040,00	6 731,00
10	12,0	5040,0	4,00	20 160,00	8 389,00	5 040,00	6 731,00

2.7. Value adding options

Value-added almond products present a major opportunity for revenue diversification beyond raw kernel sales. Globally, almonds are processed into products like oil, butter, flour, milk, roasted almonds, paste, and even almond-based cheeses, serving industries such as food, beverages, and cosmetics. Though Georgia's value-added almond sector is still emerging, there are promising signs of growth:

Current State in Value Adding Options	In Georgia, the almond industry is in its early stages of value-added processing, with a few notable examples. Udabno, a leading company, operates a 2,300-hectare almond orchard and the largest almond cracking facility in Georgia. Their value-added products, including almond oil, meal, paste, and milk, are produced separately in Tbilisi and sold domestically through their HoReCa chain and a specialty shop. Mkisa, another company with 40 hectares of almond orchards, has started producing roasted and salted almonds and is exploring EU export opportunities. Some Georgian snack producers have also begun using locally grown almonds in their products, replacing imported almonds.
Perspectives in Value-Adding Options	Most processed almond products in Georgian supermarkets, such as almond milk and roasted almonds, are imported and expensive. However, as local almond production has increased, almond kernels have become more affordable, and a similar trend is expected for processed almond products.

	Udabno's competitively priced value-added products in Tbilisi indicate potential for growth. While domestic availability will likely expand, exports of processed almond products will remain limited, as EU buyers primarily use almonds in industrial applications, preferring raw kernels. Similarly, in Asian markets, roasted and flavored almonds are typically processed locally. Therefore, the growth of Georgian value-added almond products will be gradual, with challenges in the international market.

2.8. Development Barriers, gaps and hindering Factors

Strengths, Weaknesses, Opportunities and Threats (SWOT) in Almond Production Value Chain in Georgia:

Key Strengths	Key Weaknesses
Favorable Natural Conditions: Ideal climate and soil in Kakheti, Kvemo Kartli, and Shida Kartli for almond cultivation. **Expanding Cultivation Area**: Over 6,000 hectares of almond orchards with ongoing government and private sector investment. **Government Support:** Programs such as "Plant the Future" significantly boost orchard establishment and sector growth. **Employment Opportunities**: Significant rural job creation in cultivation, harvesting, and processing.	**Knowledge Gaps**: Limited agronomical and operational knowledge among farmers, leading to suboptimal practices. **Infrastructure Deficiencies**: Insufficient access to modern harvesting equipment, storage facilities, and irrigation systems. **Lack of Certification in Processing Sector**: Many processing facilities lack certifications such as ISO 22000, HACCP, BRC, and IFS, restricting export potential. **High Initial Costs**: Establishing almond orchards is capital-intensive, with a long period before reaching profitability. **Low Technology Adoption**: Minimal use of smart farming technologies and renewable energy. **Varietal Issues**: Presence of uncertified seedlings and mixed varieties in some orchards reduces productivity. **Local Market Competition**: Imported Californian almonds dominate due to established market presence and perceived quality.
Key Opportunities	**Key Threats**

Export Market Growth: Potential to access high-demand markets such as the EU, Gulf countries, and Asia with targeted strategies. **Market Potential**: Growing global demand for almonds as a health-conscious food product. **High-Quality Varieties**: Adoption of late-blooming, drought-resistant almond varieties reduces risk from late frosts. **Value-Added Products**: Development of almond-based products such as almond milk, butter, oil, and snacks for domestic and export markets. **Sustainability Practices**: Opportunities to incorporate climate-smart agriculture, organic farming, and circular economy practices. **Improved Branding**: Establishing a positive reputation for Georgian almonds through quality improvements and strategic marketing. **Private Investment**: Increasing interest from private investors in both production and processing sectors. **Export Potential**: Potential to leverage hazelnut export channels for almonds, particularly in the EU, Gulf, and Asian markets.	**Global Price Volatility**: Dependence on international market trends heavily influenced by Californian production and pricing. **Climate Risks:** Vulnerability to frost, drought, and other climate change impacts. **Competition**: Strong competition from established producers like the USA, Australia, and Spain. **Certification Barriers**: Lack of certifications may delay access to premium international markets such as the EU. **Logistical Challenges**: High costs and complexities of transporting almonds to global markets. **Perception Issues**: Historical quality concerns related to Georgian hazelnuts might affect almond market trust. **Economic Viability**: High production costs may limit export competitiveness if global prices remain low.

Gaps and Hindering Factors

Primary Production

Limited Agronomical and Operational Knowledge: Georgian almond producers lack practical experience in adapting modern agro-technology to local conditions, leading to suboptimal tree development and reduced yields. Many farmers are investors from non-agricultural sectors with limited agricultural knowledge, which affects essential practices like pruning, irrigation, and pest management.

Inadequate Irrigation Management and Water Resource Planning: Irrigation in Georgian almond orchards often suffers from poor planning, improper system design, and inadequate water management, especially during critical growth stages. There is also a lack of water storage infrastructure and regulated water use, posing a threat to long-term sustainability.

Low Adoption of Technology and Sustainable Practices: The almond industry in Georgia is slow to adopt modern technologies and sustainable practices, with limited use of smart technology, solar energy, and organic certification. This restricts growers' ability to optimize resources, reduce environmental impact, and meet market demand for sustainably produced products.

Inconsistent Seedling Quality and Varietal Issues: Early stages of almond production in Georgia faced challenges with the use of low-quality, uncertified seedlings, resulting in poor orchard development and high mortality rates. Additionally, mixed or unidentified

varieties, including bitter almonds, threaten productivity and market reputation.

Challenges from the Lack of Windbreaks: The lack of windbreaks in almond orchards, which protect crops and improve yields, is a major challenge. Financial constraints, limited awareness, and lack of support hinder their implementation, affecting agricultural productivity and sustainability.

Agro-Insurance Gaps - Addressing Qualitative Damage Assessments for Almonds and Hard-Shelled Crops: Current agro-insurance evaluations in Georgia focus solely on quantitative yield loss but fail to account for qualitative damage, such as internal harm from hail. Incorporating qualitative assessments would ensure fairer evaluations and more comprehensive risk coverage for producers.

Post-Harvesting Phase

Harvesters: The Georgian almond industry faces challenges in adopting modern harvesting equipment, with many farmers still relying on manual labor. Limited access to machinery, especially for smaller farms, results in longer harvesting periods, increased risks of crop damage, and higher production costs.

Limited Knowledge of Proper Harvest Model Selection: Georgian almond producers lack expertise in selecting the most suitable harvest model for their orchards, such as Californian or French models, which leads to inefficient harvesting practices that increase operational costs and decrease profitability.

Almond Post-Harvest Handling Technologies: The industry is also grappling with post-harvest handling issues, especially hulling. Nevertheless, few farmers have access to specialized equipment, and centralized hulling systems, common in Spain, offer a more efficient alternative but require significant investment.

Organizing a Demonstration Plot for Harvesting: Setting up a demonstration plot for modern harvesting techniques can help assess and improve the efficiency, cost-effectiveness, and benefits of advanced technologies, such as centralized hulling systems, in local conditions.

Limited Access to Adequate Storage Facilities: Many almond farmers in Georgia struggle with inadequate storage options, leading to potential quality issues such as mold and contamination. Developing climate-controlled, dedicated storage solutions is crucial to preserve almond quality as production volumes increase.

Value Adding Phases

Almond Cracking: The number of almond cracking facilities in Georgia has increased from four to seven, with more expected soon, but existing facilities face challenges with cleaning procedures. Upgrading equipment, such as proper cleaning machinery, is needed to meet international standards and improve product quality, especially to address issues like dust accumulation in almonds.

Almond Processing: The development of value-added almond products, such as almond milk and almond butter, is essential for expanding Georgia's almond industry. Supporting local processing initiatives through government and donor-backed programs can help reduce reliance on imported products and enhance the market presence of Georgian almonds.

Sales

Local Market Competition: Georgian almond producers face strong competition from the Californian Nonpareil variety, with exclusive contracts limiting their access to larger hypermarkets. However, as these contracts expire, Georgian almonds can become more attractive due to their competitive pricing.

Export Challenges and Vulnerability to Price Fluctuations: Georgian almond producers face challenges from international price competition, especially from California. The fluctuations in prices linked to California's harvest outcomes makes it difficult for

Georgian producers to secure stable export markets.

Certification Barriers: Georgia's almonds struggle to meet EU food safety standards, which restricts their access to this high-demand market. Efforts to upgrade processing facilities and obtain necessary certifications are critical for future EU export success.

Perception and Reputation: The Georgian almond industry is still overcoming past quality concerns related to aflatoxin contamination in hazelnuts, which has led to skepticism among European buyers. Ensuring top-quality production is key to restoring trust in Georgian almonds.

Participation in Trade Fairs: Georgian almond companies are supported by government agencies in attending international trade fairs, but it is recommended that sectoral associations have their own booth to strengthen industry promotion and visibility.

Lack of Experience and Logistical Challenges: The Georgian almond industry lacks experience in exporting to markets such as the Gulf and Asia, facing challenges related to logistics, particularly land transportation through countries such as Iran. Sea freight is the most viable option for reaching these markets.

Increase Country's Visibility as an Almond Producer: Despite being a member of the International Nuts and Dried Fruits Council (INC), Georgia's recognition as a significant almond producer is limited. Hosting an INC Congress could boost the country's visibility and enhance its position in the global nut market.

Shortcomings of the State Support Programs Sales

Limited Support for Technical Assistance and Training: While capital investment subsidies exist, there is insufficient funding for technical assistance and training. Providing subsidies for hiring agronomists can help farmers implement modern practices and improve orchard productivity.

Insufficient Focus on Water Resource Management: Efficient irrigation and water management are crucial for agricultural success, but many farms lack proper water reservoirs. Grant programs should address this need to ensure sustainability, especially in water-scarce regions.

Insufficient Coverage for Long-Term Sustainability: Almond farming requires ongoing investment in soil management, water resources, and pest control, but there is limited focus on supporting the long-term care of orchards. This gap could impact the future productivity and sustainability of almond farming.

The Lack of Accessible Export Financing Programs: High costs and the impact of trade finance tools, such as letters of credit, on a company's debt-to-income ratio create barriers for SMEs, limiting their ability to scale exports and compete internationally.

2.9. Recommendations and interventions

2.9.1. General recommendations

Primary Production

Increasing Agronomic Knowledge: Strengthen collaboration between associations and educational institutions to enhance young agronomists' qualifications, offering practical experience in orchards. Noteworthily, the Almond and Walnut Producers Association has successfully trained agronomists, with some now working in industry orchards.

Testing New Varieties and Technologies: Conduct research trials on scientific platforms and private farms to evaluate new varieties and technologies. Research stations should assess field performance, supported by a regulatory framework for phytosanitary measures.

Introducing International Expertise and Digital Extension Opportunities: Engage international experts to provide targeted consultations and support sector associations in accessing digital extension services such as TELAGRI, which connects Georgian farmers to global expertise.

Conducting Applied Research: Identify suitable regions and micro zones for almond cultivation and develop guidelines to prevent common mistakes observed in early almond projects caused by insufficient.

Enhancing Agronomical and Operational Knowledge: Implement training programs, strengthen extension services, and foster farmer networks to share best practices in pruning, irrigation, fertilization, and pest management, tailored to local conditions.

Assisting the High-Quality and Advanced Variety Sapling Production: Improve local sapling quality control standards, develop an almond-focused subsidy scheme for nurseries, and encourage the use of certified, traceable, high-performing plants for better orchard productivity.

Enhancing Orchard Sustainability Through Windbreak Integration: Introduce financial incentives to establish windbreaks alongside orchards, supported by guidelines, training, monitoring to improve crop protection and yields.

Improving Irrigation Management and Water Resource Planning: Develop region-specific water needs assessments, involve irrigation professionals for system design, establish Water Users' Organizations, and invest in water storage infrastructure to enhance water availability and long-term sustainability.

Encouraging Adoption of Technology and Sustainability Practices: Subsidize precision agriculture tools, promote renewable energy, support sustainability certification, and improve waste management practices to reduce environmental impact and enhance productivity.

Enhancing Agro-insurance in Georgia through Integrating Quantitative and Qualitative Damage Assessments: Introduce policies that combine quantitative and qualitative damage assessments to ensure that hidden quality damages, such as internal crop defects, are evaluated alongside yield losses. This can be modeled after successful international insurance systems.

Setting up Demonstration Plot for Irrigation Management: Establishment of a demonstration plot could help illustrate the benefits of advanced irrigation technologies such as moisture sensors and automated systems, which optimize water use. While investment is a barrier, trials could show potential returns and improve irrigation practices.

Harvesting and Post-Harvest Technologies

Strengthening Harvest Mechanization Service Providers: Develop subsidy and grant systems to support businesses in providing harvest mechanization services, enabling small and medium farmers to adopt mechanized harvesting with lower upfront costs.

Developing Methodologies for Harvesting and Post-Harvest Practices: Create practical guides for almond harvesting and post-harvest technologies based on international best practices, disseminated through associations and government programs.

Supporting Leasing Instruments: Improve government-backed leasing programs for farmers to lease machinery during harvest seasons, alleviating high upfront costs associated with mechanization.

Organizing Demonstration Days for New Harvesting Technologies: Showcase harvesting equipment in orchards of various terrains and planting configurations, helping farmers make informed decisions with demonstrations from multiple machinery providers.

Supporting Essential Post-Harvest Equipment: Develop programs to enhance access to post-harvest processing equipment such as dehullers and elevators, and support farmers in establishing on-site storage facilities.

Introducing Advanced Drying Technologies: Assess the feasibility of progressive drying technologies, such as stockpile almond drying, to provide viable alternatives to sun drying, especially during rainy harvest seasons.

Adoption of Modern Harvesting Technologies

Investment in Machinery: Encourage investment in modern harvesting equipment through financial incentives or subsidies and collaborate with manufacturers to introduce affordable solutions.

Demonstration Projects: Establish demonstration farms to showcase advanced machinery, allowing farmers to experience the benefits firsthand.

Collaborative Harvesting Initiatives: Promote shared machinery models among farmers to reduce individual costs and provide access to modern harvesting tools.

Sales and Marketing

Supporting Food Safety Standards: Promote the implementation of rigorous food safety certifications (e.g., GFSI) to meet EU market requirements, with involvement of government, associations, and certification bodies.

Promoting Sector Representation: Facilitate the participation of associations in international exhibitions and trade missions to raise awareness and amplify the voice of Georgia's almond industry.

Knowledge Dissemination and Training

Targeted Training Programs: Develop workshops focusing on various almond harvest models, delivered through agricultural universities or extension services.

Field Days and Demonstrations: Organize field days where experts demonstrate different harvesting methods, enabling farmers to observe their efficiency in real time.

Resource Materials: Create and distribute materials such as brochures and videos outlining the benefits and limitations of harvesting methods tailored to Georgian context.

Improving Market Access

Negotiating Partnerships: Facilitate negotiations between Georgian almond producers and hypermarkets to establish direct supply agreements, supported by associations or government trade bodies.

Strengthening Distribution Channels: Develop alternative distribution channels to bypass exclusive importer contracts, such as aggregators collecting supplies from multiple farmers.

Processing and Value-adding Products

Enhancing Sorting and Cracking Facilities: Support the adoption of advanced sorting technologies to maintain almond kernel quality, financed through state or donor programs.

Developing Storage Protocols: Establish guidelines for optimal storage conditions for cracked almonds, focusing on humidity and moisture control.

Expanding Product Range: Strengthen processing enterprises focused on value-added almond products such as blanched and roasted almonds.

Introducing Technologies for Specialized Products: Facilitate access to technologies for producing almond-based products such as almond oil and almond milk with international expertise.

Enhancement of Storage Facilities

Investment in Storage Infrastructure: Advocate for dedicated, climate-controlled storage facilities, potentially through public-private partnerships or government grants.

Warehouse Standards and Certifications: Develop guidelines and certification programs for proper storage conditions, ensuring almond quality is maintained.

Utilization of Existing Facilities: Assess and retrofit existing warehouses to accommodate almond storage with necessary technology to control conditions.

Enhancing Export Competitiveness

Cost Reduction Initiatives: Implement strategies to reduce costs in almond production, including efficient farming practices, modern machinery, and resource optimization.

Market Research and Development: Conduct research to identify market niches and opportunities in international markets, analyzing competitor pricing and products.

Raising Awareness on Georgian Almonds

Developing Umbrella Branding: Support the creation of a unified Georgian almond brand to enhance marketing efforts for all stakeholders.

Organizing High-Profile International Congresses in Georgia: Promote events such as the International Nut and Dried Fruit Council Congress to prioritize the almond sector, with collaborative support.

Promoting Through International Media and Social Platforms: Engage international bloggers and journalists to create targeted articles/programs on Georgian almonds.

Enhancing Export Competitiveness

Cost Reduction Initiatives: Implement strategies to reduce costs in almond production, including efficient farming practices, modern machinery, and resource optimization.

Invest in Technology

Automate Cleaning Processes: Explore automation options to improve the efficiency and effectiveness of almond cleaning procedures.

Boosting Domestic Market Awareness: Increase local almond consumption by educating the public about the nutritional benefits through media and social platforms.

2.9.2. Specific interventions

Recommended Interventions	Possible Responsible Stakeholders
Conduct research trials at scientific research center platforms and private farms to evaluate and recommend new varieties, rootstocks, and technologies	MEPA, SRCA, AWPA
Create a Technical Assistance Program for sectoral associations to finance international expert field visits or provide online extension services through the associations' platforms.	MEPA, RDA, SRCA, Donor Programs
Provide accessible and practical research reports on consumer trends and regulatory requirements in key export markets such as the EU, EEA, Gulf and other export countries, enabling producers to plan and align their production and practices with evolving demands.	MEPA, Donor Organizations
Conduct research to identify optimal regions and micro zones for almond cultivation and to develop comprehensive guidelines and recommendations based on the accumulated successes and failures in the industry.	MEPA, SRCA, Donor Programs
Design standalone financial support program for Business Service Providers (BSPs) offering harvest mechanization services for almonds and other sectors.	MEPA, RDA
Create practical guides for almond harvesting and post-harvest technologies tailored to the characteristics of the Georgian industry	MEPA, SRCA, Donor Programs
Develop a hands-on comprehensive certification program on almond cultivation and post-harvest handling in collaboration with agrarian universities, and colleges. This program should be mandatory for grant applicants and voluntary for other farmers interested in entering almond production.	MEPA, SRCA Environmental Information and Education Centre (EIEC), Profile Association, higher education institutions, vocational colleges
Support the installation of windbreaks alongside orchard establishment in the grant program Plant the Future to protect crops and improve yields.	MEPA, RDA, SRCA
Include provisions for establishing appropriate water reservoirs in future grant programs to support effective irrigation management and water resource planning.	MEPA, RDA, SRCA
Enhance existing government-backed leasing programs, enabling farmers to lease expensive harvesting machinery.	MEPA, RDA, Leasing Partner Companies

Prioritize processing facilities that focus on quality improvement and production of value-added almond products within existing State and Donors' Grant Program.	MEPA, RDA, Donor Programs
Finance the participation of almond exporter companies at product-specific trade fairs under the association-branded pavilion.	MEPA, RDA, Enterprise Georgia, Donor Programs
Organize industry-specific congresses and conferences in Georgia to raise awareness of Georgia's almond industry.	MEPA, RDA, Almond and Walnut Producers Association
Prioritize the development of an umbrella branding and strategic marketing plan for Georgian Almond, focusing on creating a strong, unified brand identity.	MEPA, RDA, Enterprise Georgia (EG), Profile Association (AWPA), Export Development Association (EDA), other relevant Stakeholders
Integrate both quantitative and qualitative damage assessment methods, ensuring that insurance adjusters are trained to evaluate internal crop damage, such as hidden quality losses in almonds, to more accurately reflect the market value of the produce.	MEPA, RDA, SRCA, Donors, Insurance Companies, The Insurance Association of Georgia, the State Insurance Supervision Service
Add Agricultural Meteorological Stations financing to the grant programs to support climate-smart agricultural practices.	MEPA, RDA
Government to implement or expand support mechanisms, such as guarantee schemes and interest subsidies, to help SMEs better manage their Debt-to-Income (DTI) ratios and utilize trade finance products without jeopardizing their financial stability.	MEPA, RDA, EG
Pilot the "Contract Farming" project within the Almond value chain, emphasizing the enhancement of export quality compliance through collaborative certification initiatives	MEPA, RDA, Donors
Strengthen the institutional capacity of the AWPA to establish and expand network of farmers for "Contract Farming" Practices with the implementation of appropriate policy and financial incentives. This will improve overall process and promote sustainable development within the sector.	MEPA, RDA, Donors
Organize a demonstration plot focused on modern harvesting techniques, such as centralized hulling systems, to evaluate their efficiency and cost-effectiveness.	MEPA, Donors, SRCA

Georgia to pursue hosting an International Nuts and Dried Fruits Council (INC) Congress to enhance its visibility in the global nut market, providing an invaluable platform to showcase Georgia's growing almond, walnut, and hazelnut industries.	MEPA, MFA, Profile Association AWPA

2.10. Environmental sustainability and green opportunities

2.10.1. Environmental sustainability - Climate change in the almond production sector

Climate Change and Its Implications for the Almond Sector in Georgia

Georgia's diverse climate, with 22 distinct microclimates and 49 soil types, offers favorable conditions for almond cultivation. However, global climate change, including rising temperatures and fewer frost days, is increasingly affecting almond orchards, which are sensitive to temperature fluctuations. While longer growing seasons and warmer temperatures may improve yields if managed properly, climate-related risks could harm farmers. The Climate Change National Adaptation Plan for Georgia's Agriculture Sector, focusing on resilient agricultural practices, aims to address these effects.

Climate Smart Agriculture (CSA) practices, such as efficient water management and soil conservation, are key to enhancing productivity and adapting to climate change. Almond-growing regions, especially in drier areas, require tailored strategies to optimize irrigation and reduce vulnerability to climate extremes. Developing climate-resilient practices is crucial for ensuring the sector's long-term sustainability.

2.10.2. Proposal of green solutions in almond production sector

Interventions	Activities
Utilization of Almond Hulls - Focusing on Compost Production	**Almond Hulls for Composting**: Almond hulls, a by-product of almond production, can be used for composting, promoting waste reduction and environmental sustainability in Georgia. **Integration with Other Agricultural By-Products:** In Kakheti, almond hulls can be combined with grape pomace and chicken manure to produce high-quality compost, benefiting both the environment and the economy. **Soil Health and Nutrient Supply**: The compost improves soil structure, water retention, and nutrient availability, while suppressing soil-borne diseases and reducing chemical pesticide use.

	Benefits for Perennial Crops: Compost from almond hulls represents a slow-release nutrient source, supporting healthier growth and higher yields for perennial crops such as almonds and grapes. **Cost Reduction and Income Generation**: Composting reduces reliance on commercial fertilizers, lowers production costs for farmers, and allows surplus compost to be sold for extra income. **Environmental and Economic Benefits**: Composting in Georgia's almond sector addresses waste management, soil health, and input costs, while contributing to circular economy and sustainability.
Shell Processing in Almond Production - A Green Practice for Fuel Production	**Almond Shells as Renewable Energy**: Using almond shells as biofuel is a clean, sustainable practice that reduces waste and contributes to a zero-waste production cycle. **Environmental Benefits**: This practice supports global efforts to reduce GHG emissions and fossil fuel dependence, aligning with cleaner energy goals and promoting environmental conservation. **Economic and Energy Benefits**: Selling almond shells for biofuel provides growers with extra income and reduces energy costs for processing facilities, fostering local energy security. **Dual Advantage**: Almond shell processing offers both economic gains and environmental sustainability, making it a valuable practice for almond growers.
Irrigation Scheduling Based on Soil Moisture Sensors - A Tool for Efficient Irrigation Management in Almond Orchards	**Advanced Soil Moisture Sensors**: These sensors allow precise monitoring of soil moisture, helping farmers optimize irrigation and ensure sustainable yields. **Water Stress Prevention**: Maintaining optimal soil moisture supports healthy root development, flowering, and almond production, preventing water stress. **Cost Reduction**: Efficient water use lowers water costs, reduces expenses related to pumping, and decreases labor costs with automated systems. **Environmental Benefits**: Proper irrigation minimizes erosion, protects ecosystems, and lowers energy consumption for water pumping and distribution. **Improved Crop Health**: Adequate irrigation enhances nutrient uptake, promoting healthier trees and better yields.
Solar Panels for Irrigation Systems - Harnessing Renewable Energy in Almond Orchards	**Renewable Energy in Farming**: Integrating solar panels in almond farming supports sustainable practices by powering irrigation systems and processes such as unshelling and drying almonds.

	Environmental Impact Reduction: Solar-powered irrigation reduces environmental impact, lowers energy costs, and supports global sustainability goals by decreasing GHG emissions. **Financial and Operational Benefits**: Solar panels lower electricity costs, reduce dependence on external providers, and ensure a consistent power supply, offering protection against rising energy prices. **Long-Term Savings**: While installation costs can be high, solar panels provide long-term savings and a strong return on investment with minimal maintenance needs compared to diesel generators.
Shell Processing in Almond Production - A Green Practice for Fuel Production	**Weather Data Collection**: Modern agricultural meteorological stations gather essential weather information to support decisions on frost alarms, irrigation, fertilization, pest management, and harvesting. **Climate Forecasting**: Accurate climate forecasts help identify optimal times for agricultural activities, improving planning and efficiency. **Smart Pest Management**: Phenology models predict harmful pathogens, allowing for targeted pesticide use during critical growth periods, minimizing chemical applications. **Precision Farming**: Satellite imagery and multispectral analysis identify problem areas of orchards, enabling precise fertigation and irrigation interventions. **Sustainable Agriculture**: Adopting these technologies helps optimize operations, reduce environmental impact, and enhance productivity, promoting sustainable farming practices and long-term resilience.
Irrigation Scheduling Based on Soil Moisture Sensors - A Tool for Efficient Irrigation Management in Almond Orchards	**Environmental Sustainability**: Organic almond farming reduces reliance on synthetic pesticides, supports biodiversity, and contributes to long-term environmental stewardship. **Economic Feasibility**: Transitioning to organic farming requires evaluating production costs, price premiums, and market dynamics, with research suggesting price premiums above 30% make it viable. **Market Opportunities**: Consumers are willing to pay more for organic products, creating new opportunities for Georgian almond growers in premium markets. **Challenges of Transitioning:** Transitioning to organic farming involves higher costs, labor requirements, and the need to meet stringent standards in specific markets such as the EU.

	Best Practices: Successful organic almond farming focuses on soil health, integrated pest management, and efficient irrigation systems. **Support for Farmers**: Government and donor support through research, education, and financial incentives is essential for helping farmers navigate the transition to organic almond farming.

CHAPTER 3.
VALUE CHAIN ANALYSIS OF BLUEBERRY PRODUCTION

3.1. Introduction to the value chain

Blueberries have become a profitable cash crop in Georgia, with production rapidly growing over the past decade. While most blueberries are exported, domestic demand is rising as well, attracting interest from entrepreneurs. The first experimental orchards were planted in 2005, and significant progress started in 2015 with the "Plant the Future" program by MEPA. This initiative, implemented by the NNLE Rural Development Agency (RDA), supported the establishment and modernization of perennial orchards.

3.2. Value chain visualization of blueberry production

The blueberry value chain visualization provides an overview of production, processing, and distribution processes, highlighting key stakeholders and their interactions, and helps to identify opportunities, challenges, and areas for improvement:

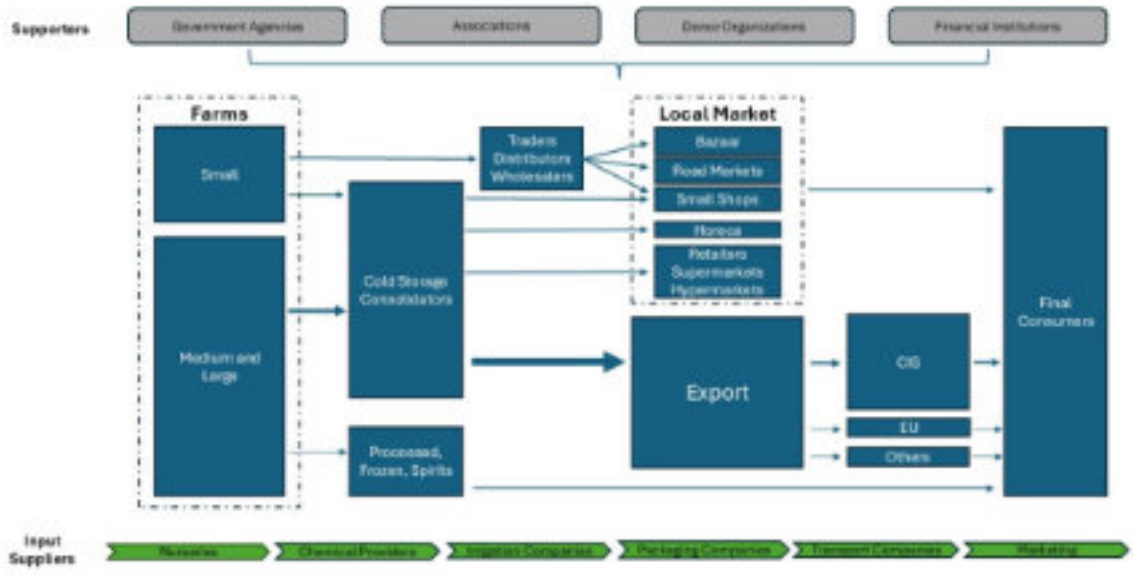

Figure 2: Blueberry Value Chain Visualization

3.3. Value chain information

3.3.1. Geographical coverage, production Statistics

The primary blueberry production regions in Western Georgia - Guria, Samegrelo, Adjara, and Imereti - are characterized by predominantly acidic soils and adequate water supply. Currently, blueberry plantations cover more than 3,000 hectares. In addition to numerous small farmers with orchard sizes ranging from 0.5 to 1.0 hectares, more than 50 producers have orchards of 10 hectares or more, with several large investment initiatives planned. For business-oriented investors, the high investment levels are not a

limiting factor, given the potential for export markets, including Russia, Europe, and the Gulf region.

According to GeoStat statistics, Georgia exported 4,564 tons of blueberries during the harvest period (May, June, July) in 2024. Based on the Blueberry Growers Association's estimate, 15-20% of the harvest was consumed locally, projecting the total 2024 harvest at around 6,000 tons. Looking ahead, with the orchards established under the RDA program and considering the average yield potential of various-aged orchards, the industry is expected to produce up to 15,000 tons in the next three years.

Based on the information provided by blueberry primary producers, investments for one hectare of blueberry cultivation range from a minimum of USD 35,000 to USD 40,000. When a protected production system, such as high tunnels, is included, the investment may rise to USD 120,000-140,000.

Since 2019, blueberry exports have grown rapidly, reaching nearly USD 18.2 million in 2023. From 2019 to 2023, Georgia exported blueberries valued at USD 40 million, with volumes increasing from 199 tons in 2019 to 3,462 tons in 2023. Russia accounted for 94% of 2023 exports, with smaller shares going to the Gulf countries, Germany, the Netherlands, Poland, and the UK. Strong export prospects - particularly to Russia and Europe - combined with yield improvements and investments, position Georgia to become a significant player in the global market despite competition from Peru and Chile.

3.3.2. Employment in the blueberry production sector

Georgia's blueberry production sector has seen employment opportunities grow, offering a variety of roles, from fieldwork to technical and managerial positions. Key areas of employment include:

- **Field Workers**: These workers are involved in planting, maintaining, and harvesting blueberries. Their responsibilities include tasks like soil preparation, irrigation, pest control, and berry picking. Seasonal labor is needed during the peak harvest period.
- **Technical Staff:** This group consists of agronomists, horticulturists, and pest management specialists who improve crop management and yield through their expertise and best practices.
- **Processing and Packaging Workers**: These employees work in facilities where blueberries are sorted, cleaned, and packaged to meet quality standards before reaching the market.

- **Management and Administrative Roles**: These positions oversee operations, manage supply chains, and coordinate the production process. Key roles include farm managers, sales coordinators, and financial analysts.

Manual harvesting makes the sector highly reliant on labor. Each worker can harvest no more than 50-60 kg of blueberries per day, and there is currently a slight shortage of workers. Teams are mostly recruited from nearby villages. Notably, 90% of harvest workers are women, while men typically handle loading and unloading. The average daily wage ranges from GEL 40 to GEL 70, depending on the harvest size. Labor shortages, particularly for tasks like pruning, are a concern for farmers. These challenges, combined with the sector's reliance on manual labor, may hinder future growth. Addressing workforce supply issues is critical for sustaining and expanding Georgia's blueberry industry to meet both domestic and international demands.

3.3.3. Processing - Value addition and sales channels

The Georgian blueberry market includes small, medium, and large-scale farmers with diverse practices and sales strategies:

- **Small-Scale Farmers:** Sell mainly at the farm gate, relying on verbal agreements with aggregators/traders who collect, sort, and store the harvest. Some sell at local farmers' markets in cities like Tbilisi, Batumi, and Kutaisi.
- **Medium and Large-Scale Farmers:** Operate or partner with cold storage facilities for efficient post-harvest management. Most of their produce is exported, with minimal sales locally.
- **Retail and Processing:** Supermarkets like Spar and Carrefour source from local producers, while some farmers supply processing facilities for jams, juices, and frozen products.
- **Export Markets:** Georgian blueberries are gaining traction internationally, with exports to neighboring countries, the Gulf region, and the EU. Exporting requires adherence to strict quality and packaging standards. In 2022, local consumption amounted to 0.2 kg per capita, expected to rise to 0.5 kg by 2027.
- **Pricing:** During the 2024 harvest, farm gate prices ranged from USD 3.8 – USD 4.2/kg, middlemen sold at USD 5.5 – USD 6/kg, and export prices started at USD 6.25/kg. These differences reflect added costs and margins across the value chain.

Georgia’s blueberry industry continues to grow with increasing domestic consumption, rising export opportunities, and diverse sales channels.

3.4. Value chain actors of blueberry production

Understanding the key actors in Georgia's blueberry value chain - farmers, agribusinesses, cooperatives, suppliers, processors, exporters, associations, financial institutions, and policymakers, is essential for boosting growth and sustainability, addressing challenges, and unlocking opportunities for innovation, capacity building, and market expansion.

3.4.1. Producers (farmers, businesses, cooperatives)

Blueberry producers in Georgia primarily include smallholder farmers, agribusinesses, and cooperatives, each playing a critical role in the blueberry VC. Producers are responsible for planting, nurturing, and maintaining blueberry bushes, which involves soil preparation, planting, watering, pruning, and applying fertilizers and pesticides. Blueberry harvesting is typically done manually to ensure high quality fruit, with the harvest period generally occurring from late spring to early summer, depending on the region and variety. After harvesting, producers handle the initial sorting, grading, and packaging of blueberries. Some larger farms may also engage in basic processing, including freezing or drying the berries.

When analyzing the ownership of blueberry plantations by area, approximately 400 hectares are owned by small-scale farmers, representing between 700 and 800 individuals. It is important to note that nearly 50% of these small farmers are actively engaged in commercial production, primarily targeting markets outside their production regions. The remaining farmers, with smaller plots, sell most of their produce in local regional Agro-Markets. Most of the sector consists of medium-scale farmers with plantations ranging between 5 and 20 hectares. Additionally, there are up to 8 large-scale companies in the country, each managing plantations exceeding 40 hectares. Expert estimates suggest that between 230 and 280 blueberry producers currently export their products.

Although blueberry production in Georgia is currently limited to open fields, there is a growing trend toward protected cultivation methods, particularly soilless technology in pots. Presently, blueberry production in high tunnels covers only about 15 to 18 hectares; however, farmers plan to expand this area to around 100 hectares in the coming years.

The majority of commercial blueberry production is managed by investors without prior farming experience, often referred to as "non-farmer investors." The key factors attracting these investors include the high profitability potential of blueberries, the crop's relatively early maturity compared to other crops, and the availability of state subsidies and grant programs that support both new and existing blueberry producers.

3.4.2. Input suppliers (functions, needs, problems related, development opportunities)

Blueberry cultivation in Georgia requires standard agricultural inputs such as planting materials, fertilizers, pesticides, irrigation systems, and specialized equipment (e.g., bed makers, mulch, and peat or sawdust applicators).
Modern tools like drip irrigation systems and drainage channel cutters are also essential. Improving access to these inputs is key to strengthening the blueberry value chain.

Nurseries and Seedling Production Providers: Georgia's blueberry industry relies heavily on imported seedlings, with 95–98% sourced from international suppliers such as Fall Creek and Multibaies. Local production is minimal, with only 2–3 nurseries supplying just 2–3% of the market. Seedling prices range from EUR 2.0 to EUR 5.5, depending on variety and age, with additional transportation costs. Expanding local nursery capacity is crucial to reduce reliance on imports and support the industry's growth.

Key Suppliers of Agrochemicals and Pesticides: The supply of agrochemicals and pesticides is well-established within Georgia's agricultural value chains. Major global companies, including Bayer, Syngenta, BASF, and FMC, as well as distributors offering generic pesticide products, have a strong presence. The supply chain features numerous distribution and sales points, ensuring easy access for farmers to the necessary products. Compared to other agricultural sectors, blueberry farmers report fewer concerns regarding the quality or pricing of these products (detailed information on the key suppliers of agrochemicals and pesticides is provided in the main report of this analysis).

Suppliers of Specific Materials for Growing Blueberry Plantations: Establishing a blueberry plantation requires woven polyethylene film (5,300-5,800 m^2/ha), sourced directly by farmers (40-50%), pesticide companies (15-20%), or mulch importers (30-40%). Sawdust is supplied by intermediaries from sawmills at 70-80 GEL/m^3, while peat, mostly imported from the Baltics, costs 40-55 euros/m^3 plus shipping (2,000-2,300 euros/container). A local supplier offers raw peat at 60-80 GEL/m^3.

Irrigation System Providers in Georgia's Blueberry Value Chain: In Western Georgia's humid subtropical zone, where all blueberry plantations are located, water sources include drainage channels, small rivers, and lakes. During dry summers, over 50% of plantations use underground water from wells (80-120 m deep, yielding 20-30 m^3/hour). As the groundwater is readily accessible in the Kolkheti plain, securing irrigation water is not a major challenge. Blueberries require substantial water, and surface drip irrigation is commonly used, ensuring efficient water and fertigation management. Reliable irrigation infrastructure is critical for optimizing yields and maintaining plant health.

3.4.3. Market intermediaries and distribution channels

Blueberry VC development in Georgia relies on intermediaries like traders, distributors, exporters, and retailers. Traders connect producers with markets, while distributors ensure efficient transportation and storage to maintain quality. Retailers provide direct access to consumers, boosting market reach. Georgia's preferential trade agreements (e.g., A Deep and Comprehensive Free Trade Area (DCFTA) with the European Union (EU)) and World Trade Organization (WTO) membership create strong export opportunities, but competitiveness relies on meeting quality standards, stable ensuring stable supply, and maintaining competitive pricing.

Exporters are categorized into two groups:

- **Organized Exporters:** Operate with contracts, meeting international packaging standards. Examples include Georgian Blueberry Growers Association (GBGA) (exporting ~500 tons to Europe in 2024), LLC Agrolane (exporting to Gulf countries) and others.
- **Fragmented Exporters**: Smaller, less structured exporters focusing on opportunistic markets such as Russia.

In terms of logistics, most blueberry exports are shipped by refrigerated trucks with an average capacity of 18-20 tons. The majority of these shipments use trailers. For exports to the Gulf countries, blueberries are often shipped via Tbilisi Airport on regular passenger flights, using reduced-load pallets to minimize handling stress on the berries.

3.5. Assessment of common agricultural practices in blueberry cultivation

Analyzing the blueberry production VC requires focusing on cultivation techniques such as soil preparation, planting densities, irrigation, and pruning to optimize plant health and yields. Evaluating pest management, fertilization, and irrigation practices, alongside sustainability and compliance with food safety and environmental standards, is essential for improving efficiency and competitiveness. Additionally, Georgia's blueberry sector needs improvements in market-oriented varieties, cultivation practices, and orchard establishment methods to enhance quality, yield, and long-term sustainability.

3.5.1. Assessment of current agricultural practices in blueberry cultivation

Georgia's blueberry production practices align with those in advanced countries like the USA and Poland. The typical planting density is 3,333 plants per hectare, with planting in fall or spring. Raised beds are formed with sawdust, peat, and plastic mulch. Varieties

include Legacy, Bluegold, Bluecrop, and newer genetics like New Hannover and Suzie Blue. The average yields areis 7-8 tons per hectare, with advanced growers reaching 10-12 tons. Pesticide treatments (8-10 per season) target pests and diseases, while fertilizers like nitrogen, phosphorus, and potassium are increasingly used. Despite rising interest, organic production remains limited due to challenges.

3.5.2. Harvesting and cold storing

Blueberry cultivation in Georgia has grown significantly, but post-harvest handling and cold storage are crucial for maintaining fruit quality. Berries are hand-harvested to avoid bruising, sorted, cleaned, and quickly cooled to 0°C (32°F) to preserve freshness. Cold storage at -1°C to 0°C (30°F to 32°F) with 90-95% humidity extends shelf life for 3-4 weeks. While some farms have modern cold storage, others use less efficient methods. Improving storage infrastructure and practices is essential for enhancing competitiveness in both domestic and international markets.

3.6. Calculation of prime cost and farmers' profitability estimates

Prime costs in Georgian blueberry production include seedlings, fertilizers, pesticides, labor, irrigation, and post-harvest handling. Profitability depends on yield, market prices, subsidies, and efficient resource management, with government support boosting productivity and reducing risks.

3.6.1. Orchard establishment investments

Investing in blueberry orchards requires careful planning, including soil testing, land preparation, and amendments for well-drained, acidic soils. Key costs include purchasing disease-resistant plants and installing efficient irrigation systems to ensure healthy growth and consistent yields. A detailed cost breakdown is essential for calculating orchard establishment investments. A comprehensive outline is presented below:

Table 4: Blueberry Orchard Estimated Budget

Blueberry orchard estabslihment Budget , GEL
Planting Layout 3.0 * 1.0 m
1 EURO=2,98 GEL

N	Activity	UNIT	QTY	Cost per Unit, GEL	Total (GEL)
A	Land Preperation				
1	Soil analizis	Sample	2	350.00	700.00
2	Cleaningof the land from plant remains	Ha	1	4,500.0	4,500.00
3	Land leveling	Ha	1	1,000.0	1,000.00
4	Deep Ploughing/Chiselling	Ha	1	700.0	700.00
5	Secondaryploughing	Ha	1	350.0	350.00
6	Rotarytiling/disking	Ha	2	300.0	600.00
7	Orchard Layout Planning by GPS	Ha	1	300.0	300.00
TOTAL for Land Preparation					8,150.00

B	Planting of plants				
1	NPKfertilizer application	Man/Day	1	50.00	50.00
2	Bedmaking	Ha	1	900.00	900.00
3	Peat/Sawdust Application In beds	Ha	1	1,100.00	1,100.00
4	Rotarytiling/disking interrows	Ha	1	300.00	300.00
5	Mulching with woven mulch of beds	Ha	1	1,000.00	1,000.00
6	preparation of holes for planting	Piece	3333	0.10	333.30
7	Planting of plants	Piece	3333	0.21	699.93
8	Covering of Bed ends	Man/Day	10	50.00	500.00
9	Transportation of plants to planting place	piece	3333	0.10	333.30
11	Fertilizers - complex NPK	kg	400	2.50	1,000.00
12	Peat	m3	140	150.00	21,000.00
13	Sawdust	m3	60	80.00	4,800.00
14	Mulch woven	m2	1.2	5,300.00	6,360.00
15	Plants, (approximately 4.2-4.8 euro with delivery)	piece	3333.0	13.41	44,695.53
TOTALfor PLANTING					83,022.06
C	1 Year cultural practicies				
1	Fertilizersfor drip irrigation	Kg/L	250.00	5.00	1,250.00
2	Foliarfertilizers	Kg/L	5.00	30.00	150.00
3	Herbicides	L	4.00	30.00	120.00
4	Insecticides (Mixed)	Kg/L	6.00	80.00	480.00
5	Fungicides (mixed	Kg/L	2.50	180.00	450.00
6	Cupper Fungicides	Kg	5.00	25.00	125.00
7	Weedcontrol near plants	Man/Day	6.00	50.00	300.00
8	Interrow Moving/mulching	Ha	5.00	85.00	425.00
9	Spraying	Ha	8.00	90.00	720.00
10	Pruning	Man/Day	8.00	50.00	400.00
11	Irrigation	Ha	1.00	320.00	320.00
TOTAL for 1 Year Practicies					4,740.00
D	Drip irrigation Installation				
1	Magistral	Ha	1	1,200.00	1,200.00
2	Literal	Ha	1	4,350.00	4,350.00
3	Valves, Units, Accesorries	Ha	1	750.00	750.00
4	instalation	Ha	1	1,500.00	1,500.00
TOTALfor Drip Irrigation					7,800.00
TOTALfor Establishment Blueberry plantation on 1 Ha. GEL					
A	LandPreperation				8,150.00
B	Planting				83,022.06
C	1 year Practicies				4,740.00
D	Drip - irrigation installation				7,800.00
TOTAL					103,712.06

3.6.2. Orchard treatment operational expenses

Operational expenses of blueberry orchard treatment typically include costs for pest and disease management, soil amendments, and fertilization. These expenses cover the application of pesticides, fungicides, and herbicides, as well as routine soil testing and adjustments. Additionally, they include irrigation costs, labor for maintenance activities, and equipment operation. Effective management of these costs is essential for maintaining orchard health and maximizing fruit yield. To provide a detailed breakdown of operational expenses for blueberry orchard treatment, the following aspects should be considered:

Table 5: Blueberry Orchard Treatment Operational Expenses

	Blueberry Orchard Treatment Operational Expenses per Ha				
	Planting Layout	3.0 * 1.0	m		
	1 EURO = 2,98 GEL				
	Cultural practicies				GEL
1	Fertilizers for drip irrigation	Kg/L	450.00	6.00	2,700
2	Foliar fertilizers	Kg/L	8.00	30.00	240
3	Herbicides	L	6.00	30.00	180
4	Insecticides (Mixed)	Kg/L	7.00	80.00	560
5	Fungicides (mixed products)	Kg/L	4.00	180.00	720
6	Cupper Fungicides	Kg	8.00	25.00	200
7	Polination hive renting	Ha	1.00	120.00	120
8	Weed control near plants	Man/Day	12.00	50.00	600
9	Interrow Moving/mulching	Ha	5.00	85.00	425
10	Spraying	Ha	12.00	90.00	1,080
11	Pruning	Man/Day	16.00	50.00	800
12	Irrigation	Ha	1.00	320.00	320
	TOTAL for 1 Year Practicies				**7,945 ₾**

3.6.3. Profitability estimates

Blueberry profitability estimates using Earnings before Interest, Taxes, Depreciation and Amortization (EBITDA) assess earnings from blueberry sales by focusing on core operational performance before accounting for interest, taxes, depreciation, and amortization. By analyzing EBITDA, growers can better understand the financial health of their blueberry operations and make informed decisions to improve profitability.

Table 6: Blueberry profitability estimates using EBITDA

Years	Harvest / KG / Pl	Number of Plants	Harvest / KG / per Ha	Price per KG (GEL)	Sales (GEL)	Expencies (GEL)	Harvesting Cost (GEL)	Total Expencies, Gel	Income per ha EBITDA (GEL)
Year 1	0	3,333	0	-	0	4,740		4,740	
Year 2	0.4	3,333	1,333	10	13,332	7,945	2,000	9,945	3,387
Year 3	1.5	3,333	5,000	10	49,995	7,945	7,499	15,444	34,551
Year 4	2.5	3,333	8,333	10	83,325	7,945	12,499	20,444	62,881
Year 5	3.2	3,333	10,666	10	106,656	7,945	15,998	23,943	82,713
Year 6	3.2	3,333	10,666	10	106,656	7,945	15,998	23,943	82,713
Year 7	3.2	3,333	10,666	10	106,656	7,945	15,998	23,943	82,713

Overall, the data suggests a strong potential for profitable blueberry farming, particularly with effective management and cost controls. This highlights the importance of early investment and operational efficiency in achieving long-term success.

3.7. Value adding options

Adding value to blueberry production is a key strategy for increasing profitability, enhancing market appeal, and expanding the sector's economic impact of the sector in Georgia. By exploring and implementing various value-adding options, producers can differentiate their products, meet consumer demands for premium and processed goods, and access new markets both locally and internationally:

Post-harvest Practices	**Harvesting, Timing, and Technique**: Blueberries are hand-harvested at full ripeness to ensure quality, using specialized tools to avoid damage. **Sorting and Grading**: After harvest, blueberries are sorted by size, color, and quality to remove damaged or overripe fruit, often using optical sorters for greater accuracy. **Cleaning**: Blueberries are washed with cold water to remove contaminants and may be sanitized to ensure cleanliness. **Drying**: The fruit is carefully dried to prevent mold and decay during storage. **Packaging**: Blueberries are packed in protective containers such as clamshells or bulk cartons, depending on the market. **Labeling**: Packages are labeled with origin, grade, and packaging date for traceability and compliance. **Storage**: Blueberries are stored at refrigerated temperatures (0°C to 2°C) to extend shelf life, with controlled atmosphere storage used for longer periods. **Quality Control**: Quality checks include visual inspections and tests for firmness and pesticide residues to meet market standards. **Distribution**: Packaged blueberries are transported under proper temperature conditions to wholesalers, retailers, or consumers.
Processing	**Blueberry Juice**: Extracted from fresh blueberries, this juice is popular for its refreshing taste and nutritional value, suitable for both domestic and export markets. **Blueberry Syrup**: Made by blending blueberry juice with sugar, blueberry syrup is a versatile product used as a topping or in culinary applications. **Dried Blueberries**: These serve as a healthy snack or ingredient, with advanced drying methods preserving nutrients and extending shelf life for domestic and export use. **Blueberry Spirits**: High-alcohol spirits made from downgraded (i.e., surplus or lower-grade blueberries) blueberries cater to niche markets seeking unique, artisanal flavors. **Blueberry Wine**: Produced by fermenting blueberries with sugar or honey, this wine offers a unique product with the fruit's natural flavors and health benefits.

By expanding the range of blueberry-based products and investing in processing infrastructure, Georgia can better utilize its production, minimize waste, and create additional revenue streams for farmers and processors.

3.8. Development barriers, gaps and Hhindering factors

The blueberry sector in Georgia has a strong potential for growth but faces challenges in production, market access, regulations, and infrastructure. Overcoming these barriers is critical for strengthening the value chain and driving sustainable growth.

SWOT in Georgia's Blueberry Production Value Chain:

Key Strengths	Key Weaknesses
Favorable Climate and Soil: Georgia's climate and soil conditions are suitable for blueberry cultivation, contributing to high yields and good fruit quality. **Shorter time to harvest**: Blueberries yield returns in a shorter period compared to other perennial crops, making them attractive for farmers seeking quicker profitability. **Early Harvest Advantage**: Producing and exporting blueberries earlier in the season creates opportunities to capture higher market prices before major European competitors, such as Poland, enter the market. **Supportive Government Policies**: The Georgian government provides support through agricultural programs and incentives aimed at boosting blueberry production. **Growing Market Demand**: Global demand for blueberries is increasing, driven by their recognized health benefits.	**High Initial Investment**: Blueberry farming requires significant initial investment in terms of planting material and farm setup, which can be a barrier for small farmers. **Limited Infrastructure**: Inadequate storage and post-harvest facilities can lead to losses and reduced profitability. **Labor Shortages**: A lack of skilled workers, particularly during the peak harvest seasons, affects operations. **Dependence on Commonwealth of Independent States (CIS) Markets**: Heavy reliance on exports to Russia and CIS countries exposes the sector to geopolitical risks and economic risks. **Lack of Trade Protocols with Potential Export Markets**: The absence of established trade agreements or protocols with potential high-value export destinations limits access to new market.
Key Opportunities	**Key Threats**
Export Potential: With rising global demand, there is a significant opportunity for Georgia to expand its blueberry exports, particularly to European and Asian markets. **Value-Added Products**: Developing value-added products such as blueberry jams, juices, and dried blueberries can enhance market reach, diversity and profitability.	**Inadequate Soil Preparation**: poor drainage, low organic matter, and incorrect pH levels limit plant growth and yields. **Market Intelligence Gaps**: insufficient market data hampers producers' ability to align with EU, EEA, and Gulf market requirements resulting in reduced competitiveness.

Technological Advancements: Adopting advanced agricultural technologies such as precision farming and mechanization can improve productivity and reduce labor dependence. **Soilless Production Systems**: Soilless production systems in pots offer an alternative to traditional soil-based cultivation. These systems optimize nutrient delivery and water usage, which is particularly beneficial for blueberries. **Extending the Harvesting Period**: By selecting suitable varieties and geographical locations, the harvesting period can be extended, particularly during the early and late fall.	**Climate Change**: Increasing temperatures and changing weather patterns may reduce blueberry yields and affect quality. **Market Competition**: Increasing competition from other Eastern European countries poses a challenge to Georgia's ability to maintain and grow its share in international markets. **Pest and Disease Pressure**: The sector is vulnerable to pest infestations and diseases, which can significantly affect crop health and yields.

Gaps and Hindering Factors

Primary Production

High Initial Investment: Blueberry production requires significant initial investment in planting material and farm setup, creating barriers for small farmers.

Inadequate Soil Preparation: Insufficient soil testing, poor drainage, low organic matter, and incorrect pH levels hamper plant growth and reduce yields.

Factors Limiting Soil Fertility: High clay content and nutritional deficiencies adversely affect soil fertility.

Lack of Market Intelligence: Insufficient access to data on consumer preferences, regulatory requirements, and market trends in export destinations limits producers' ability to align with target market needs.

Limited Variety Selection: Current varieties may not meet the taste, size, or shelf-life demands of target markets, such as the EU or Gulf countries.

Inadequate Climate Adaptation: Blueberry varieties lack resilience to Western Georgia's climatic variability (e.g., humidity, rainfall, and heat).

Short Harvesting Seasons: Limited variety selection reduces the ability to maintain a consistent market supply over extended periods.

Limited Use of High Tunnels and Container Systems: Restricts access to "off-season" niche markets.

Need for Precision Agriculture: Lack of adoption of advanced tools like drones and multispectral analysis limits production optimization.

Pest and Disease Management: Vulnerability to pests and diseases due to limited knowledge and access to sustainable management solutions.

Limited Certification: Few producers hold GLOBALG.A.P.[3], Organic, or Fair-Trade certifications, restricting access to EU market opportunities.

[3] Annual Report of Ministry of Environmental Protection and Agriculture of Georgia - https://mepa.gov.ge/Ge/Reports

Lack of Traceability Systems: Inadequate tracking from farm to consumer fails to meet export market requirements.

Knowledge and Training Deficiencies: Farmers lack training in modern irrigation, pest management, and optimal use of agrochemicals, reducing yields and quality.

Water and Wind Management: Underutilization of soil moisture sensors, combined with financial and policy barriers limit windbreak installation, crucial for protecting the crops.

Post-Harvesting Phase

Challenge in Cold Storage Infrastructure for Blueberries: Insufficient cold storage facilities, especially for small-scale farmers, cause post-harvest losses and reduced competitiveness.

Lack of Expertise in Post-Harvest Handling and Long-Distance Transportation Practices: Inadequate knowledge in post-harvest handling and transportation, affecting blueberry quality and export marketability.

Pesticide Testing and Certification Challenges: Limited local laboratory capabilities hinder the ability to conduct the required pesticide testing for export, leading to costly and time-consuming analysis procedures, with samples sent abroad for certification.

Need for Contract Farming: The absence of formal value chain frameworks for small-scale producers limits their access to markets, storage, and processing facilities, underscoring the need for Contract Farming arrangements to integrate small producers into the export value chain.

Value Adding Phases

High Costs of Value-Adding Technologies: Prohibitively high costs for farmers and processors, compounded by limited domestic market demand and insufficient sales, negatively impact Return on Investment (ROI) and export potential.

Limited Processing Infrastructure: Inadequate infrastructure for processing and storage leads to post-harvest losses and reduced profitability in value-added products.

Disparity in Demand: High demand for fresh blueberries, but limited demand for value-added products (e.g., dried or frozen berries), makes processing less attractive alternative.

Need for Improved Knowledge and Skills: Lack of scientific expertise and modern techniques in blueberry processing limits effective surplus management and profitability.

Regulatory Framework

Food Safety and Export Standards: Georgia's food safety regulations are aligning with EU standards under the DCFTA, but traceability systems and compliance remain a challenge for small farmers.

Laboratory Testing and Quality Assurance: Local laboratory testing capabilities are growing but remain insufficient for meeting international market demands, with many exporters relying on foreign laboratories.

Trade Protocols with Other Export Countries and Phytosanitary Standards: The absence of trade protocols and phytosanitary standards with countries like China, Singapore, and Japan limits Georgia's export potential.

The Need for Specialized Academic Programs in Georgia's Blueberry Industry: There is a shortage of specialized academic programs for agronomists and blueberry experts in Georgia, resulting in a reliance on international consultants.

Sales

Heavy Reliance on the Russian Market: 85% of Georgian blueberries are currently exported to Russia, posing risks due to potential market disruptions, such as trade embargoes.

Logistical Challenges: Exporting to markets like the EU, Gulf, and Asia is hindered by insufficient transportation infrastructure, limited airport capacity, and untested sea transport options, impacting timely market access.

Extended Payment Terms: Buyers in the Middle East often demand extended credit terms (up to 90 days), which pose financial challenges for new exporters and limit access to financing.

Certification Requirements: The EU requires stringent quality certifications (e.g., Global Food Safety Initiative (GFSI), GLOBALG.A.P. Risk Assessment on Social Practice (GRASP)), necessitating compliance with Good Agricultural Practices (GAP), which adds complexity and costs for exporters.

Market Competition: Established blueberry suppliers dominate markets like the Middle East, making it challenging for Georgian blueberries to enter and gain trust with local buyers.

Branding and Marketing Deficiencies: Lack of effective umbrella branding and marketing strategies for Georgian blueberries limits their visibility and competitiveness in global markets.

Pesticide Testing and Certification Challenges: Limited local laboratory capabilities hinder the ability to conduct the required pesticide testing for export, leading to costly and time-consuming analysis procedures, with samples sent abroad for certification.

Need for Contract Farming: The absence of formal value chain frameworks for small-scale producers limits their access to markets, storage, and processing facilities, underscoring the need for Contract Farming arrangements to integrate small producers into the export value chain.

Shortcomings of the State Support Programs

Insufficient Coverage of High Initial Investments: State subsidies and grants do not sufficiently cover the high initial costs of blueberry farming, such as specialized infrastructure like high tunnels and soil-less systems.

Limited Financial Support for Small-scale Farmers - Cold Storage and Post-Harvest Handling: Small-scale farmers lack adequate financial support for establishing cold storage facilities or purchasing necessary cooling equipment.

Insufficient Support for Advisory Services and Capacity Building: While capital expenditure grants are available, funding for advisory services and training remains limited, leaving farmers without the expertise needed to implement advanced farming practices.

Limited Emphasis on Water Resource Management: Current grant schemes do not address the need for irrigation systems or appropriately sized water storage and reservoir facilities on farms, which are vital for sustainable farming.

Need for Specialized Packaging and Logistics: There is no clear support for specialized packaging or refrigerated vehicles, both essential for meeting international export standards.

The Lack of Accessible Export Financing Programs: The underutilization of trade finance products, such as letters of credit, restricts access to export financing due to high costs and their impact on a company's debt-to-income ratio.

3.9. Recommendations and interventions

Addressing the gaps and challenges identified in the Georgian blueberry production VC is essential for unlocking the full potential of the industry. This section outlines targeted recommendations and interventions designed to overcome the barriers to growth and strengthen the sector.

3.9.1. General recommendations

Primary Production

Evolving Market Demands: Continuously monitor market trends and collaborate with trade associations to stay informed.

Importance of Selecting Market-Responsive Varieties: Choose varieties that match market preferences and local growing conditions.

Climate Adaptability: Select varieties suited to Georgia's climate to ensure consistent production.

Extend Harvesting Seasons Through Staggered Varieties: Use staggered planting to extend the harvesting season and optimize market timing.

Government Role in Seedling Availability: Ensure availability of certified virus-free seedlings through government support.

Addressing Challenges in the Blueberry Nursery Sector: Develop a public-private venture for high-quality in-vitro plants.

Leveraging Advanced Technologies and Expertise: Invest in advanced propagation to improve plant quality and competitiveness.

Incorporating Windbreak Establishment into Agricultural Grant Programs: Include windbreaks in grant programs to protect crops and improve yields.

Adopting Innovative Technologies: Promote technologies like high tunnels and soilless systems to boost productivity.

Soil and Water Management: Implement efficient soil and water management for better growth and sustainability.

Post-Harvest Treatments: Use 1-MCP to extend shelf life and improve product quality for export.

Overcome High Initial Investment Barriers: Provide grants and low-interest loans to ease initial investment costs.

Build Capacity for Adaptive and Strategic Farming: Offer training on sustainable and market-oriented farming practices.

Post-Harvesting Phase

Adopt Mechanical Harvesters: Use mechanical harvesters to increase efficiency and manage larger areas with fewer workers.

Enhance Harvest Management with Digital Tools: Implement digital tools for better harvest tracking, sorting, and quality control.

Extend Harvesting Period with Varietal Diversity: Use varieties with different ripening times to spread out labor demands.

Attract Young Workers with Incentives: Offer competitive wages and bonuses to attract younger workers for harvesting.

Invest in Harvesting Equipment: Upgrade harvesting machinery to improve efficiency and reduce reliance on manual labor.

Implement Post-harvest Technologies: Use methods like pre-cooling and Controlled/ Ultra-low Oxygen Storage (CA-ULO) to preserve quality and extend shelf life.

Enhance Post-Harvest Handling and Transportation: Adopt advanced techniques to improve quality and reduce damage during transportation.

Extend the Harvesting Period: Select suitable varieties and locations to extend the harvesting season into early and late fall.

Targeted Financial Support and Technical Assistance Program: Provide support for small-scale farmers to build cold storage, preserving quality and reducing losses.

Processing and Value-added Products

Value-Added Products: Develop blueberry jams, juices, and dried blueberries to expand market reach and increase profits.

Individually Quick Frozen (IQF) Blueberries: IQF technology allows blueberries to tolerate quality variation, reducing waste and increasing yield. Frozen berries cater to the growing demand for smoothies and baked goods and offer longer shelf life and flexibility in market timing.

Dried Blueberries: Use traditional drying for chewy snacks or freeze-drying for premium products. Both methods extend shelf life and reduce spoilage, creating a more resilient value chain and improving profitability.

Jams, Juices, and Spirits: Produce jams, juices, and spirits to utilize berries not suitable for fresh markets. These products help reduce waste, tap into new markets, and address labor shortages and harvesting challenges.

Sales and Marketing

Improve Logistics: Enhance air services, explore sea transport options, and ensure cold chain logistics. Negotiate better payment terms and improve export finance access.

Meet Market Demands: Focus on certification, GAP compliance, and invest in branding. Build distributor relationships for better market visibility.

Export Financing Support: Implement guarantee schemes and interest subsidies to reduce financial risks for Small and Medium Enterprises (SMEs) and banks.

Traceability Systems: Track blueberries from farm to consumer using digital tools. Obtain EU/EEA certifications like GLOBALG.A.P. to improve marketability.

Contract Farming Framework: Promote partnerships through formal Contract Farming. Support pilot projects for scalability and adoption.

Support Small Farmers: Provide technical training, financial assistance, and access to certifications like GLOBALG.A.P.

Build Infrastructure: Establish shared collection centers and cold storage for small farmers to reduce investment costs and improve quality.

Raise Awareness: Educate farmers and buyers on Contract Farming and provide training and negotiation support.

Policy Support: Advocate for incentives such as tax benefits and subsidies. Create institutions to monitor and mediate Contract Farming agreements.

Other Supportive Mechanisms

Establish Specialized Training Programs: Develop short-term courses on blueberry cultivation with local and international experts to reduce reliance on consultants and empower farmers with global best practices.

Upgrade Laboratory Capabilities for Export Compliance: Enhance local labs to meet European pesticide standards, partner with accredited labs, and streamline export procedures for better market access.

Invest in Modern Laboratory Equipment and Training: Modernize equipment, train lab personnel, and provide funding to improve testing capabilities and strengthen the industry.

3.9.2. Specific interventions

Recommended Interventions	Possible Responsible Stakeholders
Provide accessible and practical regular Research Reports on consumer trends and regulatory requirements in key export markets such as the EU, EEA, Gulf and other export countries, enabling producers to plan and align their production and practices with evolving demands.	MEPA, Donor Organizations
Establish demonstration plots on farms and research centers in Georgia to showcase advanced post-harvest technologies such as quick pre-cooling, sulfur/bio fungicide treatments, sulfur pads, breathable films, and Controlled Atmosphere (CA)/ CA-Ultra Low Oxygen (ULO) methods for provision of practical examples for farmers on improving post-harvest quality and extending shelf life for long-distance exports.	MEPA, SCRA, Donor Organizations
Support profile associations and proactive farmers in bringing and testing various post-harvest mechanization solutions to identify which technologies are adaptable and appropriate for Georgian context.	MEPA, Donor Organizations, Input Suppliers, SCRA, RDA, Commercial Banks, Leasing Companies
Establish demonstration plots for high tunnel and soilless production systems to highlight their benefits and practical applications in blueberry farming including sites in Eastern Georgia, integrated with sustainable agricultural practices and green technologies.	MEPA, SCRA, Donor Organizations, Input Suppliers, RDA
Support local labs (e.g., LLEP State Laboratory of Agriculture, Levan Samkharauli National Forensics Bureau) to expand services for the blueberry sector by partnering with accredited European or Turkish labs for pesticide residue testing, upgrading equipment, providing training, and obtaining necessary certifications to meet international standards.	MEPA, Donor Organizations, Partner accredited Labs
Provide subsidies or grants for the implementation of software systems tailored to post-harvest handling, such as Enterprise Resource Planning (ERP) systems that meet the sector's specific needs.	MEPA, Donor Organizations
Develop a hands-on comprehensive certification program on blueberry cultivation and post-harvest handling in collaboration with agrarian universities, and colleges. Make this program mandatory for grant applicants and voluntary for other farmers interested in entering blueberry production.	MEPA, SRCA, Environmental Information and Education Centre (EIEC), Profile Association, higher education institutions, vocational colleges

Fund and implement a program to test and promote climate-resilient varieties, including a mix of early, mid, and late-ripening blueberry varieties specifically suited to Western and Eastern Georgia.	MEPA, SRCA, RDA
Include provisions for establishing water reservoirs of sufficient size in future grant programs to support effective irrigation management and water resource planning.	MEPA, RDA, SRCA
Expand RDA's technical assistance program to provide comprehensive GAP analysis and tailored action plans for farmers, including neighboring ones, with increased grant support.	MEPA, RDA
Support windbreak installation alongside orchard establishment under the “Plant the Future” grant program to protect crops and improve yields.	MEPA, RDA, SRCA
Include funding provisions for high tunnel and soilless production systems within the "Plant the Future" grant program, considering the capital-intensive nature of such investments, and setting an appropriate grant ceiling per hectare.	MEPA, RDA, SRCA
Add financing for high tunnels under the "Subsidized Agro Credit" program, based on successful models like the "Georgian Vegetables from Greenhouses" program, to encourage Controlled Environment Agriculture (CEA) and overcome high capital investment challenges.	MEPA, RDA
Implement or expand support mechanisms, such as guarantee schemes and interest subsidies, to help SMEs better manage their Debt-to-Income (DTI) ratios and utilize trade finance products without jeopardizing financial stability.	MEPA, RDA, Enterprise Georgia (EG)
Prioritize the development of an umbrella branding and strategic marketing plan for Georgia’s blueberries, focusing on creating a strong, unified brand identity, increasing visibility in international markets, and implementing targeted campaigns to boost recognition and competitiveness, especially in key export markets.	MEPA, RDA, MoESD, Enterprise Georgia (EG), MFA, Profile Association (GBGA), Export Development Association (EDA), other relevant Stakeholders
Prioritize the negotiation and establishment of trade protocols with key export markets, including China, Singapore, Japan, and other potential countries, to diversify and expand Georgia's agricultural export opportunities.	MEPA, MoESD, Ministry of Foreign Affairs, Profile Association (GBGA)
Add Agricultural Meteorological Stations financing to the grant programs to support climate-smart agricultural practices.	MEPA, RDA

Establish a targeted financial support and technical assistance program for individual small-scale blueberry farmers (not just cooperatives) to build and operate cold storage facilities with capacities ranging from 20 to 30 tons.	MEPA, RDA
Increase or add co-financing for the purchase of cooling grader lines for cold storage farms/enterprises under the grant program to enhance post-harvest handling capacity.	MEPA, RDA
Include financing component for associations in the grant program, facilitating the engagement of international experts for comprehensive agricultural calendar development.	MEPA, RDA, Donors
Provide state subsidies to support the production of specialized packaging materials (e.g., white boxes) for improving packaging standards and boost blueberry marketability.	MEPA, RDA, EG
Add financing for refrigerated vehicle purchases for aggregators, cold storage farms, manufacturers, and exporters under the Subsidy "Agro Credit" program to improve logistics and supply chain efficiency.	MEPA, RDA
Establish a "Blueberry Day" for promoting the blueberry culture, similar to the "Hazelnut's Day –Tkhiloba". This event should include the organization of a blueberry festival and international forum to attract local and international guests, raising awareness and promoting the culture of blueberries both locally and globally.	MEPA, RDA, MFA
Pilot the "Contract Farming" project within the blueberry value chain, emphasizing the enhancement of export quality compliance through collaborative certification initiatives.	MEPA, RDA, Donors
Strengthen the institutional capacity of the GBGA to establish and expanded network of farmers for Contract Farming Practices, supported by appropriate policy and financial incentives crucial to enhance the overall process and support sustainable development within the sector.	MEPA, RDA, Donors
Establish a public-private joint venture in collaboration with experienced foreign companies and specialists. This initiative would focus on producing in-vitro propagated plants for blueberries and other berry crops, enabling the introduction of highly competitive new genetics under plant variety protection (PVP) regulations and a royalty payment framework.	MEPA, SRCA, RDA, Farmers, Donors

3.10. Environmental sustainability and green opportunities

As global demand for sustainable agriculture grows, this report assesses the environmental impact of blueberry production in Georgia, focusing on key challenges such as soil management, water use, and pesticide application. It highlights green opportunities, innovative practices, and strategies to enhance sustainability, reduce ecological footprints, and promote economic growth, offering actionable measures for producers, policymakers, and stakeholders to ensure the industry's long-term viability and competitiveness.

3.10.1. Environmental sustainability - Climate change in the blueberry production sector

Primary blueberry production regions in Western Georgia - Guria, Samegrelo, Adjara, and Imereti - face climate challenges such as rising temperatures, erratic winters, and intense storms, threatening blueberry production. Targeted adaptive research and proactive strategies are crucial to protect the industry.

To address these challenges, the following important steps should be taken:

> **Introduce and Promote Adaptive Blueberry Cultivars:** Research and introduce climate-resilient blueberry varieties to stabilize production in Western Georgia.
>
> **Utilize Eco-Friendly Sun Protection Materials:** Use kaolin sprays and heat-protectant waxes to shield blueberry plants and improve yields sustainably.
>
> **Implement Efficient Water Use Practices:** Optimize irrigation with soil humidity sensors to conserve water and boost productivity.

3.10.2. Proposal of Green Solutions in Blueberry Production Sector

Interventions	Activities
Adopt Organic Farming Practices	**Introduction of the successful bio (organic) blueberry production models into agronomical production practices**: To enhance competitiveness of Georgian Blueberry sector implementation of organic farming approaches based on bio alternatives for pest control, fertilization, and weed management.
Enhance Water Management	**Install Soil Moisture Sensors**: Accurately monitor soil conditions to enable efficient irrigation. **Utilize Smart Drip Irrigation**: Deliver water and nutrients directly to plant roots, minimizing waste and improving water-use efficiency.

Implement Integrated Pest Management (IPM)	**Use Advanced IPM Agrometeorological Models:** Employ tools such as meteorological stations, satellite imagery, and pheromone traps to monitor pests and optimize pesticide application. **Promote Organic Alternatives:** Use bio-fertilizers and biopesticides to replace synthetic methods to support sustainability and ecosystem health.
Incorporate Renewable Energy Sources into sustainable blueberry production	**Use the Agrivoltaics Approach**: Install solar panels above blueberry plants to generate energy while providing beneficial shading. **Invest in Renewable Energy**: Adopt solar panels and wind turbines to cut costs and environmental impact. **Improve Energy Efficiency**: Introduce electric tractors, drones, and equipment to boost efficiency and lower long-term costs.
Adopt Conservation Agriculture Practices	**Plant Cover Grasses Between Rows**: Protect soil from erosion, improve structure, and enhance nutrient cycling with cover grasses. **Practice Moving-Mulching Between Rows Instead of soil disturbing Cultivation**: Reduce soil disturbance, retain moisture, and boost organic matter for healthier crops.
Promote Sustainable Blueberry Packaging Solutions	**Use Biodegradable Packaging Materials**: Adopt eco-friendly packaging such as bioplastic or bamboo to reduce waste and environmental impact. **Source Local Inputs**: Purchase packaging materials made locally to reduce transportation-related emissions and supports local businesses. This approach also strengthens the local economy by creating demand for locally produced goods. **Provide Training and Education:** Educate farmers on sustainable practices to promote adoption of green solutions.
Enhance Waste Management Through Sustainable Plastic Crate Practices	**Reduce Plastic Waste with Recycled Materials**: Use recycled PP and PE granules for durable, reusable crates to lower the industry's plastic footprint. **Optimize Crate Design**: Create modular, stackable crates to enhance storage and transport efficiency while reducing resource use and emissions.

By integrating these green solutions, blueberry producers in Georgia can significantly reduce their environmental impact, improve productivity, and align with the growing consumer demand for sustainably produced goods.

CHAPTER 4.
VALUE CHAIN ANALYSIS OF STRAWBERRY PRODUCTION

4.1. General introduction to the strawberry value chain

The strawberry value chain in Georgia is an essential component of the agricultural sector, contributing to both the economy and the livelihoods of many rural communities. With its diverse climate and fertile soils, Georgia is well-suited for strawberry cultivation, but there are still challenges and gaps that prevent its full development.

4.2. Strawberry value chain visualization

VC visualization for open field and greenhouse farming: The agricultural value chain highlights the flow of products from farmers to end consumers, with various stakeholders involved. Small farmers typically sell through traders, distributors, or wholesalers, while medium and large farmers supply cold storage facilities or traders for better distribution. Traders and distributors connect farmers to markets and retail channels, while cold storage and warehouses manage storage before distribution. Market outlets include open markets, retail venues like hypermarkets and supermarkets, and the hospitality sector, which sources products directly or via distributors. E-commerce has also emerged as a key channel for direct consumer access. Additionally, products may be processed for export, with importers bringing foreign products into the local market, demonstrating the interconnected nature of the supply chain:

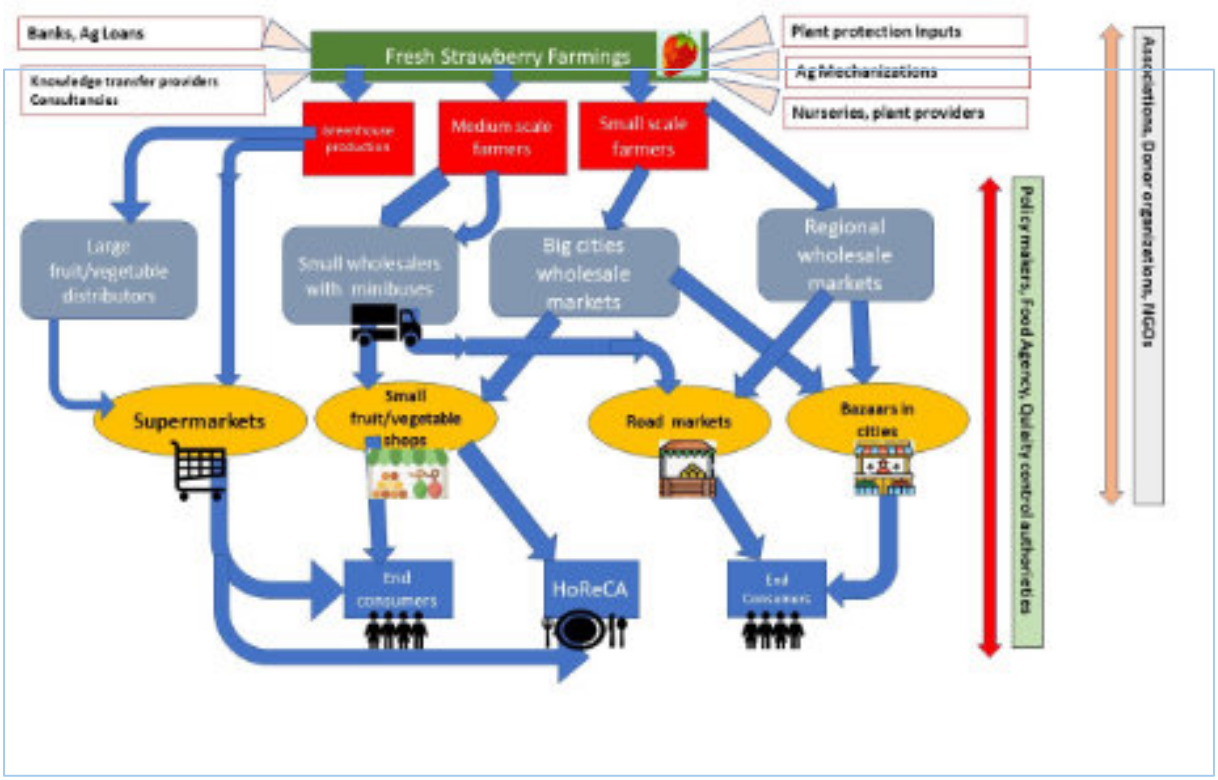

Figure 3: Strawberry VC visualizationBottom of Form

4.3. Strawberry value chain information

Strawberry farming in Georgia is fragmented, with major production regions in Eastern Georgia (Kakheti, Shida Kartli, Mtskheta-Mtianeti, Kvemo Kartli) and smaller-scale farms in Western Georgia (Imereti, Samegrelo, Guria, Adjara). Annual production fluctuates between 1,200 and 2,700 tons, cultivated across 500 to 700 hectares, with increasing farm sizes and yields. Small producers typically farm 0.2 to 0.4 hectares, while modern farms with advanced techniques yield 10 to 15 tons per hectare. Protected agriculture is growing, with greenhouses and hydroponics used in response to increased imports.

Georgia produces a variety of strawberries, including local and international types, with peak production from April to June and August to September. In 2023, 1.2 thousand tons were produced, with the highest yield recorded in 2017 at 2.7 thousand tons. The niche raspberry-strawberry variety is also gaining interest. Domestic sales account for 95% of production, with some exports, primarily to Armenia and Russia. In 2023, Georgia imported 3,690 tons from Turkey, while exporting 207.3 tons. Globally, Mexico and Spain are the largest exporters of strawberries, and Europe's demand exceeds 1.2 million tons, with Germany, the UK, and France being the largest importers. There is a rising demand for organic strawberries, mainly from local sources.

4.3.1. Employment in the strawberry production sector

The strawberry sector in Georgia is an important source of employment in many rural areas, involving small-scale farmers, seasonal laborers, and specialized agricultural workers. Many families depend on strawberry farming, which supports both the local economy and food security. Seasonal labor demand increases during peak harvests, benefiting local communities.

The sector is evolving with modern agricultural practices and technologies, creating new job opportunities in areas such as agricultural management, marketing, and technical support. Training programs from research institutions and international organizations help workers adopt these innovations, contributing to the development of rural communities and improving working conditions.

4.3.2. Processing - Value addition and sales channels in strawberry production

Strawberry processing in Georgia is still developing, with some producers making jams and jellies from locally sourced strawberries. However, the lack of cold chain facilities and processing plants limits large-scale processing, with many producers focusing on fresh sales. Strawberries are harvested during the day, stored in the shade, and transported at night to wholesale markets in Tbilisi, such as Navtlughi and Desertirebi. The supply chain

currently lacks cold chain infrastructure, including pre-cooling equipment and temperature control during transportation, which affects product quality and limits processing opportunities.

4.4. Strawberry value chain actors

The strawberry VC in Georgia consists of several key actors, each playing a vital role in production and distribution. Input suppliers provide necessary resources such as seeds, fertilizers, and pesticides, while smallholder farmers and larger producers manage cultivation and harvest. Middlemen and traders facilitate the collection and transportation of strawberries to wholesale markets and retail outlets, including supermarkets and local markets. Processing facilities for value-added products, such as jams and juices, remain underdeveloped but present an opportunity for diversification. Lastly, exporters and agribusiness associations help connect producers with international markets and support industry development through knowledge-sharing and advocacy.

4.4.1. Producers (farmers, businesses, cooperatives)

Strawberry farms in Georgia typically range from 500 to 1,500 square meters, with farmers managing essential tasks such as land preparation, crop maintenance, and harvesting, often with family or paid labor. Farmers coordinate with buyers during the growing season, and post-harvest, they sort and pack strawberries in plastic containers (3-10 kg). Around 300 to 600 farmers are involved, using methods such as conventional practices, organic cultivation, GAP, and hydroponics. Key production areas include Kakheti, Shida Kartli, Imereti, and Samegrelo.

Notable Strawberry Producers:

- Plant Weli LLC (Natakhtari, Mtskheta-Mtianeti): 1 ha, focusing on sustainable farming and soil health.
- Cooperative Madlieri (Kaspi, Shida Kartli): 1 ha, modern greenhouse with hydroponics and climate control.
- Strawberry Farm (Gurjaani, Kakheti): Traditional farming in a favorable climate with high-quality fruit.
- Company “MaGemme” (Arashenda, Mtskheta-Mtianeti): Organic farming and pest management with a focus on diverse strawberry varieties.

4.4.2. Input suppliers (functions, needs, problems related, development opportunities)

Nurseries: In Georgia, strawberry plants are easily propagated, allowing many small farmers to produce plants for sale and generate additional income. However, this often results in low-quality, non-true-to-type plants, negatively affecting production. Advanced farmers tend to import certified virus-free plants from Italy, Spain, and Poland, while a reputable local nursery, 'Adina' in Imereti, is functional and produces high-quality plants. Global trends favor frigo and potted plants for better productivity.

Input suppliers: The supply of agricultural inputs for strawberries is well-developed, but there is a shortage of specific agricultural machinery (e.g., bedmakers, fumigation equipment) due to the relatively small scale of production in Georgia. Addressing such equipment gap is crucial for improving the productivity.

Irrigation system providers: Strawberries require precise irrigation for optimal growth, but in Georgia, most are grown in open fields, with some in soilless systems. There is a shortage of fertigation equipment tailored to both soilless and conventional strawberry production methods, limiting irrigation precision and efficiency.

4.4.3. Market intermediaries and distribution channels

Market intermediaries: Wholesalers bridge the gap between producers and retailers by buying strawberries in bulk and selling to supermarkets, grocery stores, and food distributors. Major wholesale markets in Tbilisi, such as Navtlughi and Desertirebi, are key hubs for distribution. Retailers often source strawberries from wholesalers, and some emphasize local produce to build direct relationships with farmers. Exporters are growing in importance as international demand rises. Processors are emerging, focusing on value-added products such as jams and frozen strawberries, with potential for further expansion.

Distribution channels: Small-scale farmers often sell strawberries directly at local markets, capturing more profit and building community ties. Wholesale distribution enables access to larger, especially urban, markets. Online sales are expanding, offering convenience for consumers and wider reach for farmers. Agri-tourism, including pick-your-own experiences, provides additional revenue. The food service sector also contributes, with restaurants and cafes sourcing fresh strawberries from farmers or wholesalers. Therefore, strengthening these channels can improve both market access and profitability.

4.5. Assessment of common agricultural practices in Strawberry Cultivation

The assessment of current agricultural practices in strawberry cultivation reveals a mix of traditional and modern techniques. Most growers utilize conventional methods,

including row planting and plastic mulch, to optimize space and control weeds. Integrated pest management practices are gradually being adopted to minimize chemical use while effectively managing pests and diseases. However, many farmers still face challenges with irrigation efficiency and nutrient management, which can impact yield and quality. Additionally, the lack of advanced post-harvest handling practices limits the shelf life and marketability of strawberries. Overall, effective practices exist, there is a significant potential for improvement through education and investment in technology.

4.5.1. Assessment of current agricultural practices in strawberry cultivation

Soil and cultivation: Strawberries grow well in a variety of soils, with the best results in well-drained sandy loam (pH 5.5-6.5). Soils with poor drainage or high alkalinity are less suitable. In Georgia, strawberry-growing regions have diverse soils: Shida Kartli and Kvemo Kartli are more alkaline, while Kakheti is less sol. Kvemo Kartli has comparatively higher humus content.

Cultivation methods: Strawberries in Georgia are cultivated using three main methods: the row system (most common), the spaced-row system with plastic mulch and drip irrigation, and soil-less culture in high tunnels. Conventional cultivation occurs mainly from April to June, with an additional harvest in August-September for day-neutral varieties. Local and international varieties are grown, including Kakheti 1, San Andreas, and Albion.

Challenges and technology: Weed control and disease management during high precipitation are major production challenges. Despite the availability of organic and conventional methods such as solarization, they are underutilized. This leads to labor-intensive weed management, reducing profitability. Advanced technology adoption is promoted by companies and research institutions, but many farmers still face barriers.
Farmer categories: Farmers are categorized into two groups: small-scale farmers with 500-2,000 square meter plots, and larger farmers with up to 1.5 hectares, who hire seasonal labor. Some farmers are experimenting with imported remontant varieties, though these varieties perform poorly in Georgia's open fields due to temperature sensitivity and improper cultivation practices.

Remontant varieties and challenges: Imported remontant varieties (e.g., from Italy and Spain) thrive in greenhouses but struggle outdoors in Georgia’s open fields due to high temperatures. Local farmers favor indigenous varieties for their cost-effectiveness and ease of propagation. The imported varieties require substantial investment but yield suboptimal results in Georgia's climate. High-tech greenhouse projects offer a solution

but they are currently not financially inaccessible for most producers. High tunnels could be a more affordable alternative.

4.5.2. Harvesting, post-harvesting, processing, and value-adding practices

Harvesting and post-harvesting: Strawberries are harvested throughout the day and stored in the shade until evening. Larger farmers hire up to 10-15 workers during harvest. 90% of the varieties in Georgia are local, known for their sweetness but with a short shelf life of just two days due to high perishability. The lack of cold chain infrastructure, pre-cooling, and temperature control during transportation significantly reduces the quality and shelf life of strawberries. Effective post-harvest practices, such as rapid cooling to 0-2°C, are essential but not widely implemented. Only a few larger producers use cold storage, and pre-cooling is often neglected.

Processing and value-adding practices: Processed strawberries typically earn lower prices than fresh ones, but value can be added through Individual Quick Freezing (IQF), syrups, purees, and other products like yogurt and strawberry-based items for niche markets. However, strawberry processing in Georgia is limited, with few products available, such as IQF strawberries and compotes. There is a significant potential to expand processing. Investment in high-tech greenhouse projects or high tunnels could improve production and value-added opportunities, though the industry is currently not ready for such investment.

4.6. Prime cost calculation and farmers' profitability estimates of strawberry production

An important aspect of the strawberry sector is analyzing cost efficiency of production. The following sample budget is based on experiences from Georgia. Conducting a cost analysis for strawberries often involves making certain assumptions to extrapolate data that reflects real-world conditions in strawberry production. As a result, the values presented here can vary significantly depending on the type of operation, the cultivar used, the growing system, and the specific costs of materials and utilities.

4.6.1. Orchard establishment investments

The provided costs for establishing a strawberry field serve as a general guide for estimating potential expenses related to commercial plantation establishment and evaluating production loans. The practices outlined are based on typical production procedures for this crop and region, though they may not apply to every farm. Sample costs for labor, materials, equipment, and custom services reflect current market figures.

Table 7. Strawberry orchard establishing cost per hectare

Strawberry Field Establiisment Budget					
Plantimg Layout : 1.5 m * 0.20 cm (in 2 rows), distance 0.30 m; 68 rows/ha, 600 plants per 100 m row					
Varieties: San Andreas, Camarosa, Ventana, Haney					
The number of seedlings per hectare 40,800 plants					
N	Works	Unit	Price	QTY	Total
Soil preparation					
1	Cleaning of the plot - cleaning	Ha	400	1	400
2	Surface Smoothing	Ha	500	1	500
4	Ploughing	Ha	450	1	450
5	Tilling 1 time	Ha	240	1	240
6	Rotary tilling	Ha	300	1	300
7	Fertilizer NPK	kg	2	300	600
8	Application of fertilizer	Ha	100	1	100
9	Application of pre-emergence herbicide	L	40	4	160
10	Planning	Ha	80	1	80
11	1 beds creating (primary)	ha	500	1	500
Total soil preparation					3,330
Planting plants					
1	Strawberry plants	plant	40,800	1	30,600
2	Transportation of plants	unit	40,800	0	2,448
3	Purchase of plastic mulch	M	10,000	1	7,000
4	Covering mulch over the beds	Ha	600	1	600
5	Planting	Unit	40,800	0	2,040
6	Watering when planting	Ha	200	1	200
	Total planting of seedlings				42,888
	drip irrigation				
1	Magistral lines	m	130	8	1,040
2	lateral drip-lines	m	14,000	0	5,600
3	Installation	ha	2,000	1	2,000
4	Fertigation unit	Unit	2,500	1	2,500
Total drip irrigation					11,140
Total Orchard Establishment Investments					57,358

4.6.2. Orchard operational expenses

Strawberry orchard operational expenses encompass a range of costs essential for maintaining a productive farm. These expenses typically include labor costs for planting, weeding, and harvesting, as well as ongoing maintenance activities such as irrigation and pest management. Additionally, costs for fertilizers, pesticides, and other inputs are significant, along with expenses for equipment maintenance and fuel. Land rental or ownership costs can also factor into the overall budget. Effective management of these operational expenses is crucial for maximizing profitability and ensuring sustainable production in strawberry cultivation.

Table 8. Strawberry orchard operating expenses

Annual Agricultural Maintanance					
1	Drip fertilizer	kg	4	500	1,900
2	Microelements	L	30	10	300
3	Insecticide - Karate	L	60	5	300
4	insecticid - imidori	Kg	160	3	480
5	insecticidi - vertimec	L	30	8	240
6	Fungicide - Signum, Switch	kg	250	4	1,000
7	Fungicide- iroko, cuproxate	kg	20	10	200
8	Herbicide - Basta	L	40	4	160
9	Herbicide - glyphosate	L	20	10	200
10	Herbicide - Stomp	L	45	4	180
11	Herbicide - fusilade	L	50	5	250
12	application of pesticides	ha	50	10	500
13	weeding, three times	men/day	50	25	1,250
14	flowers femoval 1 hand,	men/day	50	25	1,250
15	Cleaning leaves and stems 3 times	men/day	50	25	1,250
16	Inter-row herbicide treatment	ha	20	20	400
Total Annual Maintenance					9,860

4.6.3. Profitability estimates

Profitability estimates for strawberry production can vary widely based on factors such as cultivation methods, market prices, and operational efficiencies. Generally, strawberries are considered a high-value crop with the potential for substantial returns. Profit margins can be influenced by the choice of cultivar, with some varieties yielding better market prices due to quality or flavor.

To assess profitability, farmers must consider both fixed and variable costs, including labor, inputs, and overhead. Analyzing revenue from sales against these costs provides a clearer picture of potential profits. However, external factors such as the market demand fluctuations and climatic conditions can impact overall profitability, making careful financial planning and market analysis essential for success:

Table 9. Profitability estimates of strawberry orchards

Years	Yield kg/ Plant	QTY of plant	Yield kg/ ha	1 kg price/ GEL	Sales, GEL	expenses, GEL	Expense picking, sorting	Revenue EBITDA
1 year	0	42,000	10,500	5	52,500	9,860	10,846	31,794
2 years	0	42,000	16,800	5	84,000	9,860	10,846	63,294
3 years	0	42,000	12,600	3	37,800	9,860	10,846	17,094

4.7. Development barriers, gaps and hindering factors

SWOT analysis provides a clear framework for recognizing the current state of the sector, understanding the challenges it faces, and uncovering opportunities for growth and improvement. Through this structured approach, stakeholders can develop targeted interventions to enhance the competitiveness and sustainability of the strawberry production VC:

Key Strengths	Key Weaknesses
Increasing market demand: There is growing local demand for strawberries, indicating a promising market for cultivation. **Availability of agricultural land**: Suitable land is available for strawberry cultivation in Georgia. **Quick harvest yield**: Strawberries provide quick returns, as they yield fruit shortly after planting and do not require years to mature. **Feasibility for small acreages**: Strawberries can be successfully cultivated on small-acreage plots. **Government support**: The Georgian government offers subsidies and programs to enhance the competitiveness of the strawberry sector.	**Perishable nature**: The highly perishable nature of strawberries requires careful and timely management to maintain quality and reduce losses. **Pest sensitivity**: Strawberries are highly susceptible to pests, requiring vigilant pest control practices. **High production costs**: The cost of producing strawberries is relatively high, impacting overall profitability. **Lack of local expertise**: There is a shortage of local expertise in advanced strawberry cultivation techniques, limiting the sector's growth potential.
Key Opportunities	**Key Threats**
Opportunity for local production: The rising imports of strawberries in Georgia offer an opportunity to replace them with locally grown alternatives. **Increasing consumption**: Strawberry consumption is on the rise, providing a growing market for local producers. **Potential for value-added products**: Developing strawberry-based products such as jams, juices, and dried strawberries can boost profitability. **Export market potential**: Exploring export opportunities, especially to neighboring countries, can generate new revenue streams.	**Competition from neighboring countries**: Increasing competition from neighboring countries, particularly Turkey, may affect local strawberry market share. **Weather pattern changes**: Changes in weather patterns may negatively impact strawberry production, potentially leading to lower yields. **Pests and diseases:** New or evolving pests and diseases can significantly reduce yields and increase pest control costs for strawberry growers. **Labor force challenges**: The agricultural sector may struggle to secure a reliable and skilled labor force, especially during peak harvesting periods.

Integration with tourism: Combining strawberry farms with tourism activities such as pick-your-own operations and farm tours can attract visitors and generate supplementary income. **Advanced cultivation techniques**: Adopting methods such as greenhouse production and hydroponics can improve yields and extend the growing season. **Shift to organic production**: Transitioning to organic strawberry farming can meet the rising demand for organic products both locally and internationally.	

The development of Georgia's strawberry sector faces several challenges, including a lack of cold chain infrastructure, outdated cultivation practices, limited access to modern technologies, and inadequate financing options. These barriers negatively impact strawberry quality, yield, and overall sustainability. Additionally, the slow adoption of new technologies such as plastic mulch, fumigation, and fertigation, along with labor shortages, hinders production efficiency. Addressing these issues is crucial for improving competitiveness and meeting market demands, requiring innovative agricultural practices and technology adoption.

Gaps and Hindering Factors

Primary Production

Highly perishable nature of strawberries: Strawberries are sensitive to environmental conditions, and delays in harvesting or mishandling can lead to high post-harvest losses, making efficient and timely cultivation essential.

Sensitivity to pests: A wide variety of pests, such as spider mites and aphids, easily attack strawberries, leading to increased use of pesticides and management efforts.

Production and harvest costs are quite high: Due to labor-intensive harvesting practices, pest management, and input requirements, strawberry production requires significant financial investments.

Lack of local expertise in advanced strawberry cultivation: There is limited knowledge of modern and innovative cultivation methods (e.g., greenhouse, hydroponics), which restricts the adoption of high-efficiency practices that could increase yields and profitability.

Needs to find proper macro-zones for successful cultivation: Identifying suitable growing regions is crucial to avoid climatic conditions that may hinder yield, therefore poor management of this aspect can reduce productivity.

Climate change: Shifts in weather patterns, including unexpected frosts or extreme heat, can disrupt strawberry cultivation, leading to lower yields or crop failure. As strawberries are climate-sensitive, unpredictable weather changes create significant risks.

Evolving pests and diseases: New or resistant pest strains and diseases may increase, putting additional pressure on producers to invest in more costly or unavailable pest

management solutions.

Post-Harvesting Phase

Highly perishable fruits require precise management: Poor post-harvest handling, storage, and transportation infrastructure significantly reduce shelf life, resulting in financial losses due to spoilage. The absence of proper cold chain systems exacerbates these challenges.

Competition from neighboring countries (Turkey): Turkey produces strawberries at a lower cost and exports them to Georgia, creating a strong competition for local producers. Their superior post-harvest and transport systems provide longer shelf life and access to larger markets, increasing competition in both domestic and international markets.

Sales

Perishable nature impacts sales: The limited shelf life of strawberries, especially without a proper cold chain, reduces the ability of farmers to reach distant markets or store their product for extended periods. This restricts market opportunities.

Increasing competition from neighboring countries: Turkey, as a major competitor, can flood the Georgian market with cheaper strawberries, making it difficult for local producers to compete on price.

Challenges in labor availability: Limited availability of skilled labor for harvesting during peak times can lead to operational inefficiencies, affecting the ability to meet sales demands and deadlines, particularly when large volumes are required for markets or processing.

Limited exploration of export markets: Lack of emphasis on improving product quality, handling, and packaging hinders ability of Georgian strawberry producers to tap into neighboring or international markets where demand is higher.

Underdeveloped strategies for import substitution and meeting rising local demand: Despite growing local consumption, there is insufficient focus on reducing reliance on strawberry imports and expanding domestic production to capitalize on increasing consumer trends.

Insufficient integration of agritourism with strawberry farming: There is a gap in leveraging agritourism opportunities, such as the farm tours and “pick-your-own” experiences, which could increase direct sales and create additional income streams for producers.

Value Adding Phase

Lack of expertise in value-added production: Currently, local knowledge about producing and marketing products such as strawberry jams, juices, or dried strawberries remains limited, reducing the opportunity to diversify income streams.

Production costs are quite high: Developing processing facilities for value-added products requires substantial investment, and few small-scale farmers can afford this without substantial governmental support.

Lack of local processing facilities for value-added products: There is a gap in the development of facilities for producing strawberry-based products such as jams, juices, and dried strawberries, which limits the ability of farmers, particularly small-scale producers, to diversify income and increase profitability.

Limited adoption of advanced cultivation techniques: The underutilization of greenhouse and hydroponic systems prevents producers from extending the growing season, minimizing pest exposure, and improving overall efficiency, leading to missed opportunities for higher yields and reduced long-term costs.

Insufficient transition to organic farming: There is a gap in the shift towards organic strawberry production, which limits access to high-value domestic and international markets where demand for organic products is growing rapidly.

Lack of strong policy advocacy for sector support: There is a gap in engaging with government agencies to advocate for policies that provide targeted support, such as subsidies for smallholder strawberry farmers and increased investment in agricultural research.

Insufficient institutional support for farmer associations: Existing farmer associations lack the institutional capacity to help farmers pool resources, share knowledge, and improve their collective bargaining power in the marketplace. Strengthening these associations could significantly benefit the sector.

Weaknesses of State Support Programs

Limited focus on establishment support: While current preferential agro-credit programs provide subsidies for strawberry orchard establishment, they often do not fully address the full spectrum of needs during the critical early stages. This includes gaps in covering comprehensive support for infrastructure, technology adoption, and effective land preparation.

Lack of demonstration orchards: There is a significant need for the creation of demonstration orchards where farmers can observe best practices firsthand. These orchards would serve as a practical learning environment for local producers, showcasing advanced techniques and innovative technologies in strawberry cultivation.

Insufficient research and development (R&D) support: The sector suffers from inadequate investment in R&D, which is vital for improving strawberry yields, pest resistance, and sustainable farming methods. Without a strong focus on R&D, farmers lack access to the latest advancements that could enhance their productivity and competitiveness.

Indirect support for farmer associations: Current support programs do not sufficiently target the institutional strengthening of farmer associations, which are crucial for resource pooling, knowledge sharing, and improving market access. Indirect funding or capacity-building support for these associations could significantly enhance the collective power of strawberry farmers, helping them overcome production and marketing challenges.

Inadequate extension services: There is a gap in specialized agricultural extension services tailored to the strawberry sector. Farmers need continuous advisory support to implement modern techniques, address disease and pest management, and effectively navigate market trends.

The Georgian strawberry production sector presents significant potential for growth, driven by rising local demand and opportunities for import substitution, export market expansion, and value-added product development. However, current state support programs, while offering some subsidies for orchard establishment, fall short in addressing critical gaps. There is a pressing need for more comprehensive support mechanisms, including the establishment of demonstration orchards, enhanced R&D investment, and stronger institutional backing for farmer associations. Addressing these shortcomings will not only improve productivity and competitiveness but also create a more resilient and sustainable strawberry VC in Georgia.

4.8. Recommendations and interventions

Recommendations for strawberry development in Georgia

Primary Production

Optimize production costs: Facilitate access to financial assistance for small farmers to invest in modern technologies such as drip irrigation and mulching, minimizing costs and enhancing yields.

Improve pest and disease management: Promote integrated pest management (IPM) strategies and conduct training for farmers on pest prevention, identification, and environmentally friendly control methods.

Conduct research on suitable cultivation zones: Collaborate with research institutions to map ideal zones for strawberry cultivation and provide guidance on planting techniques.

Harvesting and Post-Harvesting Technologies

Enhance post-harvest management: Invest in training for proper post-harvest handling and establish cold chain infrastructure to reduce spoilage and extend shelf life.

Adapt to climate change: Encourage the use of climate-smart practices such as high tunnels and shade structures, and research resilient strawberry varieties to withstand extreme weather.

Implement high tunnels and soilless technologies: Transition to high tunnels and hydroponic systems to improve yield, reduce soil-borne diseases, and ensure efficient nutrient management.

Sales and Marketing

Leverage market opportunities: Promote locally grown strawberries through marketing campaigns emphasizing freshness and quality. Develop value-added products such as jams and juices to diversify revenue streams.

Monitor and analyze market trends: Regularly assess market trends to adjust production strategies and address emerging consumer demands.

Processing and Value-added Products

Develop value-added products: Encourage processing into products such as dried strawberries, juices, and jams to increase profitability and cater to niche markets.

Strengthen agritourism initiatives: Establish agritourism experiences such as pick-your-own activities and collaborate with local restaurants for farm-to-table offerings.

Other Supportive Mechanisms

Foster local expertise and knowledge transfer: Establish training programs through partnerships with universities and mentorship opportunities to share best practices among farmers.

Advocate for policy support: Engage government agencies to support the strawberry sector with subsidies, research funding, and institutional strengthening of farmer associations.

Strengthen collaboration among producers: Facilitate cooperation between farmers to share insights, pool resources, and collectively respond to market challenges.

By implementing these recommendations, Georgia can strengthen its strawberry production sector, address existing challenges, and capitalize on opportunities for sustainable growth.

4.9. Environmental assessment and green opportunities

Environmental assessment in strawberry production is crucial for identifying sustainability challenges and opportunities. By evaluating factors such as soil health, water usage, and pesticide impact, farmers can implement practices that minimize ecological harm. Embracing green opportunities can lead to a more sustainable and profitable strawberry industry, while promoting environmental stewardship.

4.9.1. Environmental sustainability - Climate change in the strawberry production sector

The relationship between temperature and strawberry yield is critical to understanding how climate change impacts strawberry farming in Georgia. Analyzing temperature data from the past two decades and its correlation with yield can shed light on the specific challenges farmers face due to climate change. Predicted climate models suggest that Eastern Georgia, the primary strawberry production region, may see daily temperatures rise by 0.4 to 0.6 °C between 2020 and 2050, along with more frequent heat waves, altered precipitation patterns, stronger winds, milder winters, and extreme weather events.

These changes are expected to negatively impact strawberry production. Irregular rainfall may disrupt soil moisture levels, affecting strawberry quality, harvest size, and pathogen resistance. Strong winds can physically damage plants, while heat waves and drought conditions may reduce plant activity and lower yields. Additionally, climate change could alter pest and disease dynamics, creating new challenges for farmers. On the positive side, milder winters could shorten dormancy periods, enabling earlier harvests.

To adapt, farmers should adopt strategies such as using solar protection products like zeolites and kaolins to reduce heat stress and selecting resilient strawberry varieties. Adjusting planting dates, implementing efficient irrigation systems, and investing in protective structures such as greenhouses can help mitigate weather impacts. Integrated pest management strategies and precision agriculture tools can further support adaptation by providing real-time data and minimizing pesticide reliance. By embracing these measures, farmers can overcome climate challenges and sustain strawberry production in Georgia.

4.9.2. Proposal of green solutions in strawberry production sector

Green solutions for strawberry production

Green solutions are essential for sustainable food production and environmental conservation. Innovative technologies are transforming agricultural practices, incorporating organic methods, smart technologies, and agrivoltaics. As the strawberry sector strives to balance productivity with ecological stewardship, the following approaches represent effective and necessary solutions.

Interventions	Activities
Organic strawberry production	**Reduce synthetic inputs**: Avoid synthetic pesticides and fertilizers to ensure chemical-free crops and healthier produce. **Enhance soil fertility**: Use organic compost and natural soil amendments to promote nutrient-rich and productive soil. **Promote biodiversity**: Attract beneficial insects and support healthy soil microorganisms to foster a natural balance. **Adopt sustainable practices**: Conserve water and preserve soil to ensure long-term agricultural productivity. **Ensure safer working conditions**: Eliminate harsh chemicals to protect farm workers and minimize water source contamination. **Optimize market opportunities**: Take advantage of better market prices for organic strawberries to enhance economic viability. **Focus on flavor quality**: Grow strawberries with healthier soil for enhanced taste, preferred by many consumers. **Build agronomic expertise**: Develop advanced knowledge and techniques required for effective organic farming practices.
Agrivoltaics in strawberry production	**Install photovoltaic systems**: Combine solar panels with farming to optimize land use and generate green electricity. **Maintain shading threshold**: Ensure a 30% shading level to achieve optimal strawberry yield and quality. **Utilize specific light spectra**: Apply targeted light wavelengths to enhance plant growth and water efficiency. **Improve water management**: Use agrivoltaic setups to conserve water and support efficient irrigation practices.

	Reduce fuel consumption: Minimize reliance on traditional energy sources during strawberry production. **Enhance land sustainability**: Integrate agrivoltaic systems to maximize land productivity and longevity. **Adopt cost-effective solutions**: Leverage recent advancements to make agrivoltaic technology more affordable for farmers.
Drone-based monitoring of strawberry fields	**Monitor crop stress**: Detect stress areas in strawberry fields by using the drones with thermal sensors. **Detect pathogen hotspots**: Map disease risk zones for timely treatment by employing drone imaging. **Assess soil moisture**: Optimize irrigation and prevent water wastage based on drone data. **Identify irrigation issues**: Detect uneven water distribution and resolve problems promptly. **Provide yield forecasts**: Predict harvest volumes for efficient resource allocation by using the drone imagery. **Map strawberry flowers**: Estimate future yields accurately through counting and mapping the flowers. **Optimize resource use**: Minimize chemical inputs and maximize efficiency using drone-based insights.
Additional sustainability measures	**Resource Optimization**: Reduce reliance on harvesting boxes and other materials. **Waste Management:** Minimize single-use plastics and shift focus to circular, bio-based, and biodegradable packaging. Developing sustainable alternatives to plastics and implementing circular technologies in water management are shared objectives within the sector. **Cost-Efficient Irrigation**: Establish smart, digital irrigation methods for the sustainable intensification of crop production. These tools will play a vital role in the future development of the sector.

Incorporating green solutions into strawberry production is essential for fostering sustainability and enhancing environmental stewardship. By adopting organic farming practices, utilizing agrivoltaics, and leveraging drone technology, the strawberry sector can significantly improve both its ecological footprint and economic viability. These innovative approaches not only address current challenges in production but also pave the way for a more resilient agricultural system that can adapt to the impacts of climate change.

Furthermore, implementing resource optimization, effective waste management, and cost-efficient irrigation methods will enhance overall efficiency and sustainability. Together, these strategies not only promise better yields and quality for farmers but also contribute to the long-term health of our ecosystems, ensuring that strawberry cultivation remains viable for future generations.

CHAPTER 5.
VALUE CHAIN ANALYSIS OF TANGERINE PRODUCTION

5.1. Introduction to the tangerine value chain

Tangerine production in Georgia, particularly Satsuma varieties, began in the mid-20th century. During the Soviet era, production increased to over 300,000 tons annually. Following the collapse of the Soviet Union, production declined and later stabilized at 60,000 to 80,000 tons per year.

Tangerines thrive in Georgia's climate, with cold-resistant varieties and non-irrigated orchards located on flat to medium slopes (0-20°) up to 350 meters above sea level. The best orchards are found in deep, humus-rich red soils and medium to light carbonate or alluvial soils.

5.2. Tangerine value chain visualization

The tangerine value chain in Georgia involves various stakeholders. It starts with farmers who rely on input suppliers (e.g., nurseries, chemical providers, packaging companies) and on family or seasonal labor for cultivation. After harvest, tangerines are sold to collectors or sorters, who separate high-quality fruit for export and direct lower-grade fruit to local markets. Supporting this chain are government agencies, associations, donors, and financial institutions that offer policies, financial aid, and technical assistance to strengthen the sector and improve global competitiveness.

A detailed chart visualizes this VC from production to consumption.

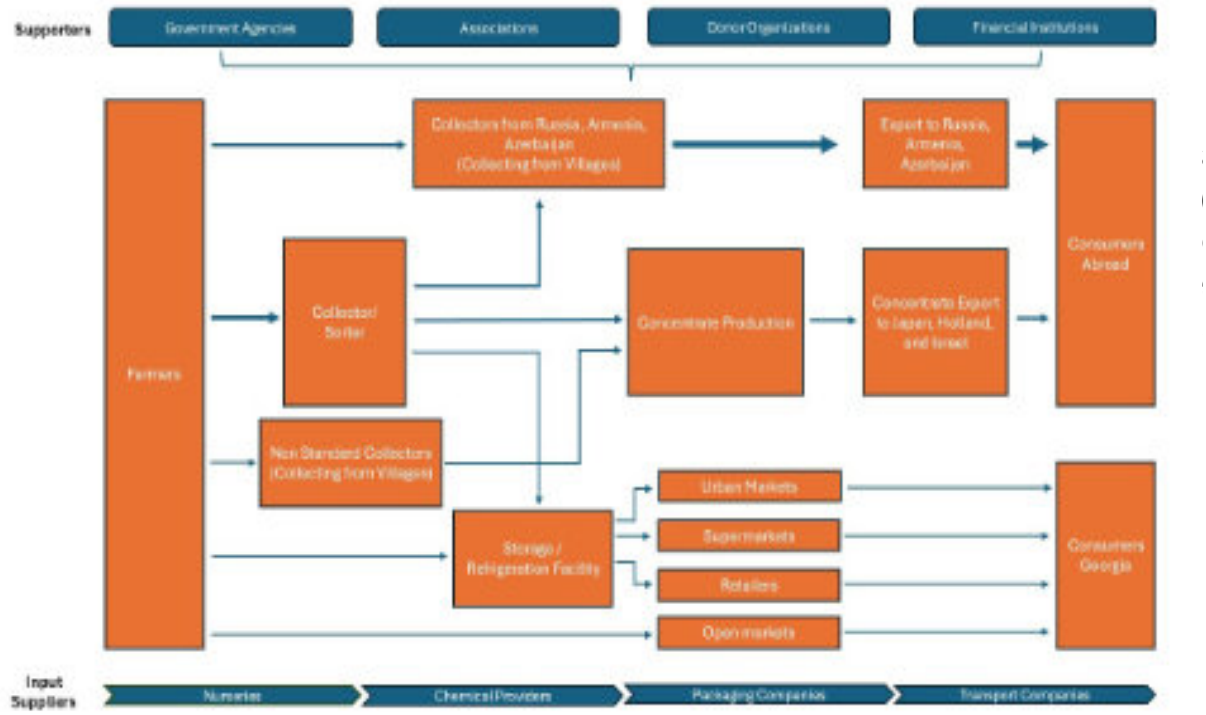

Figure 4: Tangerine value chain visualization

5.3. Tangerine value chain information

The tangerine value chain encompasses all the stages involved in bringing this citrus fruit from farm to consumer, highlighting the interconnectedness of various actors and processes. This section will dive into the key components of the tangerine value chain, assessing current practices and identifying areas for development and innovation.

5.3.1. Geographical coverage, production statistics

Regional Distribution and Production Volumes: Regional Distribution: Adjara leads with 55.1k tons (83% of total production in 2023), followed by Guria (9k tons, 14%), Samegrelo-Zemo Svaneti (1.6k tons), and Imereti (0.5k tons).

Key production areas: Kobuleti, Khelvachauri, Ozurgeti, Khobi, and Zugdidi. Yields: Properly managed orchards can yield 25-30 tons/ha, but the national average remains 6-10 tons/ha. Best-quality tangerines is typically produced in hillside orchards. Tangerine trees fruit biennially, causing yield fluctuations. Small-Scale Production: Over 42,000 households grow tangerines on 0.2-0.3 ha plots, often mixed with other crops (pears, apples, hazelnuts).

Economic Role: Despite challenges, tangerines remain vital for smallholder livelihoods and the agricultural economy.

The tangerine (mandarin) sector in Georgia, especially in the Adjara region, is divided into two main categories: standard and nonstandard tangerines. This classification influences how the fruit is marketed, sold, and exported.

Tangerine varieties in Georgia: Citrus production in Georgia is concentrated along the Black Sea coast, the northernmost limit for citrus cultivation. Cooler conditions favor “Easypiller" tangerines, which are frost-resistant and early-maturing - unlike traditional varieties grown in warmer regions such as Turkey and North Africa.

Georgia's tangerine harvest is limited to a two-month window (late October to December), unlike major producers such as Spain and Turkey, where harvesting extends from September to May, presenting a key opportunity for industry development.

The current tangerine varieties, introduced in the early 20th century and selected for adaptability in the 1940s-50s, now require replacement with elite, early-maturing, and high-yield cultivars to address current challenges. Traditional citrus breeding programs often overlook cold hardiness, crucial for Georgia’s climate. Promising new varieties like Nichinan 1, Taguchi Wse, Mikho Wase, Miyagawa Wase, and local selections such as Tiakhara Unshiu are undergoing testing and show potential for adaptation.

Standard tangerines: Standard tangerines are classified into two subcategories: "Super" and Class 1. Super tangerines have a diameter of over 55 mm and an undamaged surface, while Class 1 tangerines are slightly smaller (50-55 mm) and may have minor surface imperfections. These tangerines are sold both domestically and internationally. Export-grade tangerines are typically calibrated for size, waxed to preserve freshness, and packed in suitable plastic, cardboard, or wooden containers before being shipped to various markets.

Nonstandard tangerines: Nonstandard tangerines in Georgia refer to fruit under 50 mm in diameter or with surface imperfections, often resulting from old, poorly maintained orchards. On average, 20% of the annual harvest in Adjara is classified as nonstandard, which is double the rate in leading producers such as Turkey (8-10%).

To support farmers and reduce waste, the Georgian government provides subsidies for nonstandard fruit, which is purchased at 0.20 GEL/kg for processing into concentrate. Annually, around 11,000 tons of nonstandard tangerines are processed, with most concentrate exported to high-value markets such as Israel and Japan.

Over 80% of orchards in Adjara, Guria, and Samegrelo date back to the 1950s-60s, with many aging or diseased. Limited use of modern agro-technological practices, financial constraints, and low farmer awareness result in low yields (8-10 tons/ha) and 25-30% non-standard fruit. Additionally, early maturing varieties are scarce, shortening the harvest season and reducing income. A comprehensive orchard rehabilitation program, replacing 300-500 hectares with new plantations and introducing elite varieties, is essential to extend the harvest season, boost quality and yields, and improve farmers' economic outcomes.

5.3.2. Employment in the tangerine production sector

Employment in Georgia's tangerine sector is crucial for rural livelihoods, particularly in Adjara, where smallholder farms dominate. The harvest season from late October to December drives a surge in seasonal labor demand for tasks such as harvesting, packing, and transportation. Approximately 42,000 farms, averaging 0.25 hectares each, rely heavily on family labor, with seasonal workers hired for peak periods. Seasonal workers earn GEL 40-50 daily, while physically demanding roles such as "megodre" earn up to GEL 150 per day.

Challenges include labor shortages due to youth migration to cities or abroad and variable working conditions. Tangerine income typically constitutes 5-20% of household earnings, depending on orchard maintenance. For example, a minimally managed orchard yields 2.25 tons, generating GEL 1,125 annually, whereas improved practices can increase yields to 6 tons, earning GEL 4,500. Household income in tangerine-growing

regions is often diversified with horticulture, livestock, and non-agricultural activities, supplementing revenues from tangerines.

5.3.3. Processing - Value addition and sales channels in tangerine production

In 2023, Georgia exported tangerines to eight countries, including Russia, Armenia, Ukraine, Kazakhstan, Belarus, Azerbaijan, Turkey, and Germany. Russia remained the dominant market, with exports exceeding 34,000 tons valued at USD 24.2 million, while Armenia imported over 9,400 tons worth USD 4 million. Ukraine's imports declined in recent years due to regional instability, but other Central Asian markets such as Kazakhstan and Belarus maintained steady, smaller demands. Emerging opportunities in the EU, particularly in Lithuania, Latvia, and Poland, suggest growth potential, alongside exploratory efforts in the Middle East and Asia. Georgia also imports tangerines during the off-season, predominantly from Turkey, which supplied over 9,000 tons valued at USD 5.74 million in 2023. Egypt and Iran provide additional import options at competitive prices, while the Netherlands serves a niche premium market. Diversifying export destinations, improving fruit quality, and reducing reliance on imports are key strategies to strengthening Georgia’s tangerine trade.

5.4. Tangerine value chain actors

The tangerine industry in Georgia plays a vital role in the agricultural economy and supports many smallholder farmers. Regions such as Adjara and Guria, with their favorable climate and fertile soils, produce high-quality tangerines for domestic and international markets. Key players, including companies and cooperatives, drive the sector by focusing on cultivation, processing, marketing, and exports. Their work enhances the reputation of Georgian tangerines and promotes sustainable agricultural practices that benefit local communities.

5.4.1. Producers (farmers, businesses, cooperatives)

- **Georgian Industrial Asset Management Group Ltd**, based in Kobuleti, focuses on managing agricultural assets, particularly tangerine production, with a goal to improve quality and sustainability.
- **Georgian Mandarin Ltd**, located in Chakvi, is dedicated to cultivating and exporting high-quality tangerines that meet international standards.
- **Cooperative "Gonio”**, based in Batumi, supports local tangerine farmers through collaborative marketing and shared resources.

- **Agroexport Ltd**, based in Kobuleti, works with local farmers to export tangerines efficiently to international markets.
- **Konchkati 2018 Ltd**, located in Ozurgeti, uses modern techniques to enhance tangerine quality and expand its market, including processed products.

5.4.2. Input suppliers (functions, needs, problems related, development opportunities)

Nursery and seedling production for tangerines in Georgia: The nursery and seedling production sector for tangerines in Georgia is underdeveloped, with limited capacity to meet the demand for certified, virus-free seedlings. Currently, there are fewer than ten small-scale family nurseries and only 2-3 organized commercial nurseries operate in the country, producing between 25,000 and 35,000 seedlings annually, which is insufficient for large-scale orchard establishment. The Agroservice Center under the Ministry of Environmental Protection and Agriculture produces around 10,000 certified seedlings annually, but its capacity is limited. Both small-scale and qualified nurseries face challenges in meeting international standards due to shortages of certified mother plants and virus contamination.

The main issues include the lack of certified budwood and the prevalence of virus infections, hindering the production of high-quality seedlings. Investment in nursery production is uncertain due to limited market demand beyond initial orchard replacements. To address these challenges, collaboration between the public and private sectors is essential to improve seedling quality, access to certified mother plants, and apply the virus management measures, ensuring the growth and sustainability of Georgia’s tangerine industry.

Knowledge suppliers: Knowledge gaps are limiting the productivity and profitability of Georgia's tangerine producers. Many farmers lack information on advanced cultivation techniques, such as varietal selection, soil management, and efficient irrigation. There's also a need for better understanding of integrated pest management, disease control, and nutrient management. Post-harvest practices, including handling, storage, and transportation, require improvement, and many farmers lack knowledge on market access and value addition strategies.

To address these gaps, strengthening agricultural extension services, providing targeted training, and investing in research and development for new varieties and cultivation methods are essential. In addition, improving infrastructure for irrigation, storage, and transportation, and promoting collaboration among farmers, researchers, and stakeholders, will foster knowledge sharing and innovation. These efforts will help increase productivity, improve product quality, and enhance profitability, boosting the competitiveness of Georgia’s tangerine industry.

5.4.3. Market intermediaries and distribution channels

The sales channels for Georgian tangerines are influenced by the structure of the industry, market dynamics, and logistical constraints. Tangerines, especially those from the Adjara region, are marketed both domestically and internationally, with exports serving as a significant driving force for the sector. However, various factors—including the prevalence of smallholder farmers, inadequate post-harvest infrastructure, and reliance on a few export markets—impact the distribution and pricing of tangerines.

Domestic market - Though smaller than the export market, it remains a crucial sales channel, particularly for smallholder farmers and those producing nonstandard fruit:

Local markets and roadside stands: Many farmers sell their produce directly to consumers at local markets or roadside stands, particularly in regions such as Batumi and Kobuleti. While this provides immediate sales and cash flow, it lacks long-term stability, and nonstandard fruit often fetches lower prices through these channels.

Wholesalers and intermediaries: Farmers also sell to wholesalers or intermediaries who distribute tangerines to urban markets, supermarkets, and retailers. This bulk-purchasing method benefits farmers with larger quantities, but it can lead to lower prices due to limited bargaining power, particularly for lower-quality fruit.

Supermarkets: Larger retail chains and supermarkets are emerging as significant domestic sales channels. While they offer stable sales and better pricing, smaller farmers often struggle to meet the quality and volume requirements due to logistical barriers, including a lack of access to cold storage and reliable transportation.

Processing for juice and concentrates: Nonstandard or smaller-sized tangerines, which cannot be sold as fresh produce, are frequently processed into juice or concentrate. This channel is facilitated by intermediaries who collect and deliver this lower-quality fruit to processing plants. Although prices are lower, government subsidies help alleviate some of the financial burdens on farmers.

Export market - Exports play a vital role in the Georgian tangerine sector, with Russia being the largest destination.

Russia as the Primary Export Destination: Georgia's tangerines are well-suited for the Russian market due to their cold-resistant nature, which enables them to endure long-distance transport and storage. However, heavy reliance on Russian market presents risks related to geopolitical tensions, trade restrictions, and potential embargoes. Past disruptions in exports underscore the need for market diversification.

Other CIS markets and Ukraine: Georgian tangerines are also exported to Ukraine and other CIS countries, but recent conflicts have affected trade routes, highlighting the necessity for exploring new markets.

Nonstandard fruit for juice export: Nonstandard fruit that fails to meet export-quality standards is often processed into juice or concentrate, which is then exported to markets such as Japan, the Netherlands, and Israel. While this practice helps reduce waste, income from juice exports is significantly lower than from fresh fruit sales.

Sales channels for export and domestic markets - The sales channels for Georgian tangerines can be further categorized based on the actors involved and the available infrastructure:

Mini trucks from Armenia and Azerbaijan: During the harvest season, mini trucks frequently collect high-quality tangerines directly from villages. However, nonstandard fruit is often left behind and must be sold locally or to processing facilities.

Local collectors and processing facilities: Local collectors gather nonstandard tangerines from farmers, selling them to processing facilities that produce juice concentrate for export. Although this channel effectively manages nonstandard fruit, farmers receive lower prices, with the profit margin for consolidators averaging 10% of the purchase price. The purchase price for export-quality tangerines typically ranges from GEL 0.60 to GEL 1.00, depending on harvest volumes and conditions in target markets.

Processing facility collection: Some processing facilities send staff directly to villages to collect tangerines, reducing logistical pressure on farmers.

Large trucks from Russia: Russian trucks are essential for the export of fresh tangerines, particularly to the Russian market. These trucks purchase large quantities directly from villages for export.

Household cellars and modern refrigeration: Household cellars can store several tons of fruit, but their lack of temperature and humidity control limits long-term storage. Modern refrigeration facilities are limited and can store up to 7,000 tons of citrus, addressing some post-harvest logistical challenges.

5.5. Assessment of Common Agricultural Practices in Tangerine Cultivation

Tangerine production in Georgia is predominantly concentrated in the Adjara region, where approximately 37,500 smallholder (out of over 42,000 all over the Georgia)

farmers manage small, fragmented orchards, typically no larger than 0.25 hectares. There are also some commercial orchards in Guria (Ozurgeti) and Samegrelo (Khobi) regions. This sector faces unique challenges and opportunities compared to large-scale commercial citrus operations in other countries.

5.5.1. Assessment of current agricultural practices in tangerine cultivation

Establishment of orchards: The cost of establishing a tangerine orchard in Georgia ranges from GEL 11,000 to GEL 13,000 per hectare, covering saplings (GEL 5-7 per tree), soil preparation, and labor. The recommended planting density is 1,000 trees per hectare. Many existing orchards, especially those dating back to the 1950s, are less productive, with 60-70% yielding lower quality fruit. The primary variety, 'Unshiu,' is grafted onto cold-hardy trifoliate rootstock, with some orchards growing other varieties such as 'Kovano-Vase' and 'Thiakhara Unshiu,' though these have limited market value.

Orchard layout and maintenance: Orchards are typically small (0.2-0.3 hectares), with many farmers producing 1-5 tons per year. The average yield is 6-10 tons per hectare, much lower than the potential 25-30 tons with proper management. Farmers spend GEL 1,500-2,000 annually on pesticides and fertilizers but largely rely on manure and do not use organic fertilizers. Most farmers manage pest control and fertilizers independently without agronomic advice. Soil and leaf analysis is rare (conducted by only 30% of farmers), and labor is often provided by family members.

Soil management and fertilization practices: The soils in Georgia's tangerine-growing regions are favorable, but irrigation is scarce due to sloped terrain. Farmers rely on organic fertilizers such as manure, with limited use of nitrogen fertilizers. Fertilizers are generally applied only once in the spring, and there is a lack of climate-smart technologies such as fertigation and solar panels.

Pruning and cultivation: Pruning practices are inconsistent and typically done in March. Poor pruning and winter damage can result in uneven fruit quality. Some farmers prioritize quantity over quality, leading to both high- and low-quality fruit. Subsidy programs help mitigate financial losses from nonstandard fruit, but there is a lack of professional pruners and mechanization.

Pest and disease management: Tangerine crops suffer significant damage from pests, particularly sucking insects and mites, which affect 30-35% of the crop. Current pest management is minimal due to high chemical costs, with farmers typically applying only one treatment per season. More effective pest control and agronomic measures are needed to improve yield, quality, and marketability.

5.5.2. Harvesting, post-harvesting, processing, and value-adding practices

Harvesting practices: The harvest season for tangerines in Georgia runs from late October to mid-December. Due to aging orchards and outdated varieties, the average yield is 8-10 tons per hectare, well below the global benchmark of 25-35 tons. Nonstandard-sized fruits, often under 50 mm, are common and typically sold at a discount for juice production. Farmers are interested in renewing orchards with early-ripening varieties to extend the harvest season and improve competitiveness.

Value-added production: The tangerine industry in Georgia has limited value-added production, with tangerine juice concentrate being the primary product. This process uses lower-quality tangerines and involves washing, juicing, filtering, pasteurizing, and storing the juice for export. This method reduces waste, maximizes fruit usage, and supports economic and environmental sustainability.

Diversification potential: There is a significant potential for diversifying tangerine by-products into items such as tangerine puree and essential oils.

- **Tangerine puree:** Made from the leftover peel and fiber after juicing, it can be used in culinary applications or as a food ingredient.
- **Essential oils:** Extracted from tangerine peels, these oils can be used in aromatherapy, cosmetics, and flavorings.

By expanding into these products, Georgia's tangerine industry can boost profitability and sustainability while reducing waste.Bottom of Form.

5.6. Prime cost calculation and farmers' profitability estimates of tangerine production

Tangerine production is vital to Georgia's agricultural economy, contributing to both domestic consumption and export opportunities. Understanding the financial aspects of tangerine farming is crucial for farmers, policymakers, and stakeholders. This section focuses on calculating the prime costs of tangerine production, considering all direct and indirect expenses.

By analyzing these costs, the study assesses farmers' profitability, providing insights for better decision-making on production practices, investment, and resource allocation. Key factors affecting profitability, such as input costs, yield rates, and market prices, will be identified to empower farmers and stakeholders to improve productivity, optimize financial outcomes, and ensure the sustainability of the agricultural sector.

5.6.1. Orchard establishment investments

Establishing a tangerine orchard in Georgia is a significant investment that requires careful planning and financial analysis. The region's favorable climate and soil conditions offer great potential for citrus cultivation, supporting agricultural growth and economic development.

This section provides a detailed breakdown of the investment required for establishing a tangerine orchard, covering essential activities such as soil preparation, planting, and initial growth inputs. By categorizing expenses into soil preparation and planting phases, it highlights the financial commitments necessary for a productive orchard.

Understanding these costs is crucial for farmers and investors to assess project feasibility, secure funding, and plan for operational expenses, enabling informed decisions to maximize yields and profitability in Georgia's agricultural market:

Table 10: Cost of establishing a tangerine orchard per hectare

Tangerine Cultivation Budget, 2024					
Approximate garden planting and maintenance budget, 1.0 ha / 4 meters x 2.5 meters / (without drip irrigation)					
N	Works to be done	Unit of measure	Unit price	Quantity	Total (GEL)
Soil Preparation					
1	Plantation	Ha	650.00	1	650.00
2	Plowing	Ha	300.00	1	300.00
3	Milling	Ha	250.00	1	100.00
4	Purchase of mineral fertilizer (NPK) @ 400 kg/ha	kg	1.20	600	720.00
5	Purchase of organic fertilizer	kg	1.30	840	1,092.00
Total of Soil Preparation					2,862.00
Plantation					
1	Seedling price	piece	7.00	1000	7,000.00
2	Removing pits, planting saplings, pruning	piece	1.30	1000	1,300.00
3	Purchase of temporary sarees	piece	0.40	1000	400.00
4	Arrangement of temporary sarees	piece	0.30	1000	300.00
5	Irrigation by hand	Ha	120.00	1	120.00
Total of Plantation					9,120.00
Total planting investment					11,982.00

5.6.2. Orchard operational expenses

Once a tangerine orchard is established, managing ongoing operational expenses is essential for sustainability and profitability. Effective management of costs such as labor, irrigation, pest control, and fertilization are key to maximizing yield and ensuring long-term orchard viability. This section outlines the expenses associated with daily orchard management, including activities such as irrigation, weed control, pruning, and fertilization, which are essential for optimal tree growth and fruit production. Understanding these costs helps farmers and stakeholders to effectively assess financial commitments and budget. In addition, by analyzing operational expenses, stakeholders can identify areas for improvement, optimize resource use, and develop strategies to enhance profitability. This overview equips farmers and investors with the insights needed for informed decision-making and successful tangerine production:

Table 11: Key operating expenses for tangerine orchard (2023) orchard per hectare

	First and second year garden maintenance	Unit of measure	Unit price	Quantity	Total (GEL)
1	Purchase of fungicide (score, anthracol, chlorine dioxide)	Ha	260.00	1	260.00
2	Purchase of insecticide (Karate, Vertimek, Masai)	Ha	340.00	1	340.00
3	Purchase of herbicide (fascinate, glyphosate)	liter	40.00	10	400.00
4	Purchase of nitrogenous and complex fertilizer, N 30	kg	2.00	500	1,000.00
5	Application of fertilizer	Ha	1.00	100	100.00
6	Purchase of sole bleach	kg	120.00	1	120.00
7	Whitening	Ha	250.00	1	250.00
8	Medicine, 50 GEL @ 8 times	Ha	400.00	1	400.00
9	Baking the bases @ 2 times	piece	0.40	1000	400.00
10	Application of herbicide, 3 times	Ha	300.00	1	300.00
11	Inter-row cultivation/mowing @ 3 times	Ha	150.00	1	150.00
12	Conducting green operations	Ha	100.00	1	100.00
13	Covering the soles against snow	Ha	250.00	1	250.00
14	Calling the roots - the invasion of the roots that have come	Ha	300.00	1	300.00
15	Pruning - from the second year	Ha	700.00	1	700.00
	Total (maintenance)				4,370.00
	Treatment of the third and subsequent years				6,118.00

5.6.3. Profitability estimates

Profitability estimates are crucial for evaluating the economic viability of tangerine production in Georgia. This section provides an analysis of potential returns, considering revenues from sales and various production costs. Factors such as yield per hectare, market prices, and operational expenses are examined to offer a comprehensive view of expected financial outcomes. Profitability estimates help farmers, investors, and policymakers assess the financial risks and potential rewards of orchard investments. The section also explores different scenarios, illustrating how market conditions and production practices can impact profitability. This analysis helps stakeholders develop strategies to optimize financial outcomes and improve resilience in Georgia's competitive agricultural sector:

Table 12: Profitability estimates of tangerine orchards

Profit and Loss, Tangerine, 1 ha								
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8
QTY of plants	-	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Yield kg/tree	-	1	4	7	15	18	21	25
Yield kg/ha	-	1,000	4,000	7,000	15,000	18,000	21,000	25,000
Price, GEL/kg	-	1	1	1	1	1	1	1
Income	-	1,000	4,000	7,000	15,000	18,000	21,000	25,000
Cost of Maintenance	-	4,370	4,370	6,118	6,118	6,118	6,118	6,118
Picking price	-	150	600	1,050	2,250	2,700	3,150	3,750
TOTAL expenses	-	4,520	4,970	7,168	8,368	8,818	9,268	9,868
Profit EBITDA	-	-3,520	-970	-168	6,632	9,182	11,732	15,132

5.7. Development barriers, gaps and hindering factors

SWOT of tangerine value chain in Georgia:

Key Strengths	Key Weaknesses
Established export market: Georgia's tangerines have a strong foothold in key export markets, particularly Russia and Armenia. **Natural product appeal:** Low agrochemical usage and natural growing conditions make Georgia's tangerines attractive to health-conscious consumers. **Cold-resistant varieties:** The Satsuma-type tangerines grown in Georgia are among the most frost-resistant varieties globally. **High quality product:** Recognized as nutritious and flavorful, Georgian tangerines are competitive in domestic and international markets. **Government support:** Subsidies and development programs assist farmers, especially for non-standard fruit and orchard maintenance.	**Aging orchards:** Over 80% of orchards are old, with declining productivity and high rates of non-standard fruit. **Small-scale production:** Fragmented land ownership limits efficiency, economies of scale, and access to high-quality inputs. **Low interest in farming:** There is a lack of interest in farming among local population, contributing to stagnation in the sector. **Biennial bearing:** Alternating high and low yield years cause inconsistencies in production. **Tourism over agriculture:** Farmers in tourist zones often prioritize tourism over agricultural activities, affecting production focus. **Sub-graded fruits:** A significant portion of the produce is classified as subgrade, reducing its marketability and overall quality. **Infrastructure gaps:** Insufficient cold storage, sorting, and packaging facilities hinder export potential and reduce product quality. **Knowledge and technological gaps:** Many farmers lack access to advanced farming techniques and agronomic support. **Limited market diversification:** Heavy reliance on the Russian market increases vulnerability to geopolitical risks. **Weak farmer associations:** Tangerine grower associations require institutional strengthening in areas such as capacity building, leadership development, and climate resilience.
Key Opportunities	**Key Threats**
Domestic market expansion: Opportunities exist to strengthen the domestic market through import substitution, particularly in the off-season (February and March).	**Growing competition:** Neighboring countries such as Turkey are increasing their market share, presenting a challenge for Georgian exports.

Market diversification: Expanding into Gulf countries, Central Asia, and the EU can reduce dependence on traditional markets. **New varieties and orchards**: Introducing early-ripening, high-yielding varieties and planting new orchards can boost productivity and extend the harvest season. **Agrotourism:** Promoting the tangerine industry through agrotourism can create additional income streams for farmers. **Value-added products:** Developing products such as tangerine puree and essential oils offers potential for diversification and higher profitability. **Climate change adaptation:** Warming trends may allow for the cultivation of higher-demand, less frost-resistant citrus varieties.	**Political instability:** Regional conflicts and trade barriers pose risks to market stability. **Market dependency**: Heavy reliance on Russian market increases vulnerability to geopolitical and economic fluctuations. **Climate change:** Increased droughts, erratic rainfall, and pest pressures threaten yields and quality.

The SWOT analysis highlights several key challenges in Georgia's tangerine production value chain, including aging orchards, biennial production patterns, low farmer engagement, over-reliance on a single export market, and institutional weaknesses within farmer associations. However, the sector also presents significant opportunities for growth, particularly through new orchard development, market diversification, and agrotourism. Strengthening domestic market potential, capitalizing on government support, and adapting to climate change by introducing new varieties will be crucial for sustainable growth. Additionally, enhancing the capacity of farmer associations and preparing for increased competition and political risks will be critical for the sector's long-term resilience and success.

Gaps and hindering factors

Primary Production

Aging and diseased plantations: Around 45% of plantations have aging or diseased trees, reducing yields and productivity.

Low yield per hectare: With an average yield of just 10 tons per hectare, productivity is below global standards due to limited access to modern farming techniques and inputs.

Knowledge gaps: Farmers lack full implementation of agro-technological practices, resulting in 20% of yields being non-standard and decreasing market value.

Limited variety range: There is a shortage of early and late-season tangerine varieties, restricting the harvest window and revenue potential.

Land fragmentation: Small, fragmented plots hinder modern farming practices, reducing overall efficiency.

Pest and disease management: There is insufficient knowledge of integrated pest management, disease control, and nutrient management.

Certified seedling production: The absence of certified nurseries limits orchard rehabilitation and expansion. Around 2 to 4 million seedlings are needed for orchard renewal, but no certified nurseries currently exist to meet this demand.

Post Harvesting Phase

Aging and diseased plantations: Around 45% of plantations have aging or diseased trees, reducing yields and productivity.

High dependency on manual labor: The sorting process is mostly manual, with minimal mechanization, leading to inefficiencies in preparing tangerines for market and impacting productivity and quality.

Sales

Limited market diversification: Over 90% of tangerine exports are directed toward high-risk markets such as Russia, exposing the sector to geopolitical and economic uncertainties, with limited access to stable, higher-value markets such as the EU.

Inconsistent quality standards: Georgian tangerines often fail to meet the size and quality requirements for international markets, particularly the EU, and lack essential certifications like ISO and GLOBALG.A.P, limiting access to premium markets.

Seasonal sales dependency: Sales are concentrated around the New Year period, restricting revenue potential and hindering consistent market presence throughout the year.

Regulatory Framework

Insufficient certification: Many farmers and processors lack certifications like GLOBALG.A.P and ISO, making it difficult to access high-value markets due to high costs and complex administrative procedures.

Land registration issues: Unregistered agricultural land prevents farmers from accessing state support programs, financial services, and subsidies, limiting their ability to improve and scale operations.

Weak quality control enforcement: Inadequate enforcement of quality control measures allows substandard produce to reach the market, undermining sector quality and reputation, particularly in international markets.

Shortcomings of State Support Programs

Limited coverage: State programs like Agricultural Insurance and "Plant the Future" have limited reach, particularly for small-scale farmers. Many farmers are unaware or unable to meet the minimum participation requirements, leaving them without crucial support.

Subsidy programs: Although the state provides subsidies for non-standard tangerines, the support is minimal and fails to address broader sectoral challenges, such as replanting aging orchards or investing in modern technologies that could enhance productivity and quality.

Lack of focus on innovation: Current state support programs do not prioritize innovation or value-added processing, which stifles opportunities for sector modernization and product diversification, limiting growth and competitiveness.

Value Adding Phases

Limited processing capacity: Few processing companies focus primarily on tangerine concentrate from non-standard fruits, restricting opportunities for value addition and

product diversification.

Lack of innovation: The sector lacks innovation in developing value-added products such as juices and jams, limiting revenue diversification.

Low adoption of modern technologies: The processing sector uses minimal advanced technologies, resulting in inefficiencies in output, product quality, and post-harvest handling, leading to losses and reduced market potential.

Other Barriers

Access to finance: Small and medium-sized farmers struggle to access affordable credit due to high collateral requirements and elevated interest rates. This financial barrier limits investments in plantation modernization, improved inputs, and adoption of new technologies.

Shortage of skilled labor: There is a significant lack of skilled labor for critical agricultural tasks such as spraying, pruning, and other agro-technological activities, as well as for post-harvest handling and processing.

Youth disinterest in agriculture: A growing lack of interest among young people in pursuing careers in agriculture poses a risk to the long-term sustainability of the sector, raising concerns about workforce renewal and innovation in the industry.

5.8. Recommendations and interventions

Strengthening each link of the value chain: To address challenges and accelerate the growth of the tangerine sector, it is crucial to reinforce all components of the VC. Priority actions include planting new orchards, renewing existing capacities, and upgrading production practices. Introducing advanced, high-yielding, and early-season cultivars will extend the harvest period, allowing farmers to sell their produce at higher prices. Increasing productivity through modern agricultural technologies is essential. Demonstration plots should be used to showcase best practices and innovations drawn from leading tangerine-producing countries, providing farmers with hands-on learning opportunities.

Recommendations for tangerine development in Georgia

Primary Production

Strengthen certified seedling production by establishing and incentivizing certified nurseries, building capacity through workshops and financial support, and implementing disease-free propagation programs.

Improve orchard maintenance through better pruning, fertilization, irrigation, and plant protection. Enhance training for agronomists and extension workers, focusing on climate-specific research to improve local practices.

Increase cultivar variety by promoting research on promising new cultivars and enhancing the availability of tested varieties for orchard renewal. Collaboration with global breeding centers will help meet commercial needs and improve fruit quality and adaptability.

Support the tree nursery sector by improving local production and quality. In addition, assist in the establishment of professional nurseries with public funding programs.

Harvesting and Post-Harvesting Technologies

Enhance post-harvest infrastructure by developing cold storage, consolidation, and sorting facilities. Encourage farmer cooperation for vertical integration and direct market access.

Improve sorting and grading through collaboration among farmers, consolidators, and exporters.

Sales and Marketing

Diversify export markets beyond Russia by targeting Central Asia, the Far East, and the EU, while improving product quality and standards for competitive markets.

Promote Georgian tangerines domestically through awareness campaigns, citrus festivals, and agro-tourism development, particularly in Adjara.

Market tangerines as a natural, healthier alternative to European clementines, with potential in Scandinavian countries.

Processing and Value-added Products

Promote innovation in value-added products such as tangerine juices, jams, and other processed goods to diversify revenue streams.

Support the processing sector through modern technologies to enhance output and product quality.

Other Supporting Mechanisms

Focus on introducing early and ultra-early ripening tangerine varieties to meet market demands and improve competitiveness.

Support research on climate patterns and emerging micro-zones suitable for tangerine production.

Promote water management technologies, such as drip irrigation, and improve drainage systems to mitigate climate-related stress.

Encourage environmental protection measures such as windbreaks and bio-substances to reduce heat damage and improve orchard resilience.

5.9. Environmental assessment and green opportunities

Many orchards are located on hilly terrain, leading to soil erosion and low soil fertility due to inadequate agrochemical practices. Farmers apply fertilizers only once a year, and irrigation is rare, despite occasional droughts. Changing weather patterns and climate change present additional threats, requiring the adoption of modern practices and drought-resistant varieties.

5.9.1. Environmental sustainability - climate change in the tangerine sector

Climate change and its impact on tangerine production in Georgia

Environmental impact: Climate change is affecting Georgia's tangerine production, with soil erosion being a significant concern, particularly on hilly terrains. Increased rainfall intensity and uneven distribution contribute to this issue. The region also faces challenges in terms of water management, as the soil's high clay content can lead to water logging or excessive drying.

Agricultural Practices: Farmers are struggling with soil fertility and inconsistent frui quality due to inadequate soil management and pruning practices.

Climate change intensifies these issues, leading to lower yields and reduced fruit sweetness.

Adaptation and solutions: To adapt to climate change impacts, improving terrace construction, soil fertility management, and irrigation systems are vital. Education and better access to information can help farmers adopt adaptive practices. Introducing climate-resilient tangerine varieties will also be essential for long-term sustainability.

Climate change data and trends: Historical data suggests that severe frosts are becoming less frequent. While climate change may reduce frosty days and temperatures, it may also cause increased droughts, stronger storms, and pest outbreaks. However, warmer temperatures could benefit the industry by allowing earlier harvests and cultivation of new citrus varieties.

Recommended adaptation measures:

- Introduce early and ultra-early-ripening tangerine varieties.
- Promote drip irrigation and improve drainage systems.
- Construct windbreaks and use mulching to retain soil moisture.
- Study new tangerine varieties and ensure pest control through agro-meteorological stations.

While climate change poses challenges, adopting adaptive measures can improve tangerine production sustainability in Georgia. By addressing environmental and agricultural issues, the sector can enhance resilience and productivity.

5.9.2. Proposal of Green Solutions in Tangerine Production Sector

Implementing eco-friendly practices in tangerine production sector is essential for ensuring sustainability and promoting environmental stewardship. The following proposals can enhance sustainable practices in this sector:

Interventions	Activities
Organic Compost and Manure Use	**Utilizing organic compost and mature manure in tangerine production:** Organic compost and mature manure enhance soil fertility and structure, supporting healthier citrus orchards by providing essential nutrients and improving microbial activity.
Organic Compost and Manure Use	**Efficient irrigation methods:** Drip irrigation systems improve water use efficiency and reduce GHG emissions by delivering moisture directly to the root zones, conserving water and promoting optimal soil moisture for tangerine orchards.
Energy Efficiency	**Resource efficient production:** Implement energy-saving measures such as insulating condensate tanks and upgrading steam pumps to lower energy demand and improve performance. **Photovoltaic integration:** Integrate photovoltaic cells into processing and storage to generate clean energy, reduce costs, and support sustainable practices. **Optimize heating and cooling processes**: Use superheated water for heating and well water for cooling to minimize energy usage. Additionally, implement solar-powered cooling systems to reduce post-harvest losses.
Repurposing Waste	**Waste utilization:** Repurpose byproducts such as peels, pulp, and seeds for animal feed, natural fertilizer, or as a natural thickener in the food industry, promoting a circular economy. **Tangerine puree production**: Utilize peels and fibers from juice extraction to produce mandarin puree, reducing waste and adding value to by-products. **Essential oil extraction:** Extract essential oils from tangerine peels to create additional revenue streams and maximize the use of fruit by-products.

According to the assignment, the basic analysis of almond, blueberry, strawberry and tangerine value chains was conducted in Georgia, utilizing the 'ValueLinks 2.0' tool, aimed to identify the two most promising value chains in the project framework among these four crops. As a result, almonds and blueberries were selected for specific interventions, with a focus on exploring green opportunities and innovations within these value chains.

However, the tangerine and strawberry value chains could benefit from comprehensive standalone analysis with additional data and perspectives. Therefore, it is recommended to initiate an in-depth analysis for these two value chains, accompanied by further actionable recommendations and targeted interventions.

It is further suggested that the donor organizations and/or MEPA engage in discussions to assess the feasibility of conducting such in-depth analyses and developing tailored strategies for the tangerine and strawberry sectors.

CHAPTER 6.
VALUE CHAIN CONTRIBUTORS AND SUPPORTERS

In Georgia, the development and enhancement of the perennial primary production sector are significantly influenced by a variety of contributors and supporters, each playing a critical role in shaping the industry. This section covers the key players within the VCs, including industry associations, knowledge suppliers and extension services, and government and regulatory bodies.

6.1. Associations

Industry associations supporting the value chain for almond, blueberry, strawberry and tangerine:

Georgian Blueberry Growers Association (GBGA)	Established in 2022, the GBGA is pivotal in advancing Georgia's blueberry sector by promoting collaboration, modern farming techniques, and improved market access. The association provides training and connects producers to domestic and international buyers. GBGA has significantly contributed to production efficiency and export success - facilitating the shipment of 500 tons of blueberries to the EU, UK, and UAE. Partnering with organizations such as Enterprise Georgia, the Rural Development Agency, and the USAID Agriculture Program, GBGA continues to strengthen the sector's export potential.
Almond and Walnut Producers Association (AWPA)	Founded in 2018, the AWPA association brings together almond and walnut producers to strengthen their competitiveness, promote exports, and address shared challenges. The decision to integrate both crops under one association stems from their simultaneous introduction to Georgia and the common issues faced by farmers. With significant support from the USAID Agriculture Program, the association has launched numerous initiatives. These include inviting international experts, organizing field days, hosting trade missions, training young agronomists, creating a farmer information network via WhatsApp groups, now connecting up to 500 farmers. As a lobbying body, the association collaborates with the MEPA, contributing to the development of technical regulations for almond and walnut exports and addressing issues such as agro-insurance, anti-hail measures, and VAT exemptions.

Industry Associations Supporting the Tangerine Value Chain	Founded in 2010, the Association "Subtropic" has emerged as a cornerstone of support for citrus growers in the Adjara and Guria regions. With 150 members, including individual farmers and Agroeksport LLC, the Association focuses on improving expertise in citrus production and sales by promoting modern technologies and keeping members updated on market trends. A standout achievement of the Association is its introduction of GLOBALG.A.P certification to its members. This has significantly enhanced produce quality while ensuring compliance with food safety, labor safety, and environmental standards. It has also facilitated market expansion, including enabling tangerine exports to Austria, a milestone entry into the European market. The establishment of a cold-storage facility in 2013 improved post-harvest handling and reduced storage costs for growers. In 2015, a major grant allowed the Association to acquire advanced agricultural equipment and technology for cooperatives and to support quality certification for Agroeksport LLC. The Association continues to deliver impactful support through training programs, field demonstrations on orchard rehabilitation, and online consultancy services for tangerine growers. Annual training sessions focus on improving profitability, productivity, and quality, significantly advancing the citrus industry's capabilities in the region.
The Georgian Strawberry Growers Association (GSGA) and Regional Associations	GSGA established in 2020, is a nonprofit organization founded by a coalition of progressive and small-scale strawberry growers. Its mission is to support the development of organic strawberry production in Georgia by fostering innovation, improving industry practices, and advocating for policies that benefit growers. Through grower-applied research, education, and legislative advocacy, the Association works to enhance the competitiveness and sustainability of the strawberry sector in the country.

6.2. Knowledge suppliers and extension services

Georgia's agricultural sector has great potential, particularly in high-value crops such as strawberries, blueberries, tangerines, and almonds, which are key contributors to local and export markets. The growth of these sectors relies heavily on the availability of knowledge provided by educational institutions, research centers, extension services, and private consultancies. While strides have been made to modernize agricultural education and extension systems, challenges remain, including gaps between skills taught and farmers' practical needs in niche sectors. Government initiatives, supported by international donors, aim to bridge these gaps through improved vocational training and research. However, stronger adoption of international best practices and private sector expertise is crucial for further enhancing agricultural value chains:

Educational Institutions	Georgia's education system comprises 54 state and 42 private vocational institutions, along with 62 universities, but there is a disconnect between educational offerings and the needs of agricultural supply chain actors. Graduates often lack specialized skills required for sectors such as almond, blueberry, strawberry and tangerine cultivation. Since 2013, the Georgian government, with support from international donors such as FAO, UNDP, EU, USAID, and others, has worked to modernize Technical Vocational Education and Training (TVET). While improvements have been made, particularly in agricultural colleges and the Agricultural University in Tbilisi, stakeholders such as the Georgian Farmers Association suggest that public institutions may not fully address industry demands and advocate for greater private sector involvement in agricultural education.
Agricultural Extension - Information and Consultation Centers (ICCs)	Agricultural extension services in Georgia are evolving, with the establishment of 59 Information and Consultation Centres (ICCs) in 2013 marking a key development. These centers, staffed by around 260 employees, serve as a link between MEPA and the farming community. ICCs focus on disseminating knowledge on modern agricultural practices and market opportunities; Educating farmers on government policies and support programs; and collecting feedback and data on local agricultural challenges. While ICCs support sectors such as almond, blueberry, strawberry and tangerine cultivation, there is a need for more specialized, hands-on training to better address sector-specific challenges.

Agricultural Research - Scientific Research Center of Agriculture (SRCA)	The SRCA, established in 2014, leads agricultural research in Georgia, focusing on improving crop production, including fruit crops like strawberries, blueberries, tangerines, and almonds. With 17 departments and regional branches, it operates near Tbilisi in Mtskheta, though Western Georgia's facilities are limited. The SRCA's work includes evaluating fruit crop varieties to improve quality and yield, researching effective pruning and cultivation methods, and preserving indigenous crop varieties lost during the Soviet era. Collaborating with ICCs, the SRCA shares research findings through field days and demonstrations. International partnerships with countries such as the US, Italy, Germany, and the Netherlands have enhanced its global approach, though stronger communication between Georgian researchers and international experts is needed.
Private Sector in Knowledge Dissemination	In addition to public sector efforts, the private sector plays a key role in disseminating agricultural knowledge, with large businesses in strawberry, blueberry, tangerine, and almond production often seeking tailored solutions from international consultancy firms and specialized suppliers. Private consultancies such as Cartlis and Noblex have expanded to offer advisory services, focusing on crop management, pest control, irrigation, and market access, complementing public extension efforts by providing customized solutions for larger enterprises. TELAGRI, Georgia's modern platform for online agricultural consultations, connects farmers with agronomists for real-time expert advice on topics such as crop management, pest control, and soil health, bridging knowledge gaps, especially in remote areas. TELAGRI also connects Georgian farmers with international experts to access global best practices. Additionally, Agro Duo offers technical assistance focusing on sustainable farming and modern technologies, helping farmers, particularly in rural areas, improve productivity and resource efficiency.

In Georgia, educational institutions, agricultural extension services, research centers, and the private sector all contribute to the development and dissemination of agricultural knowledge. While improvements have been made in agricultural education and extension services since 2013, there is a continuous need to align these efforts more closely with the specific requirements of the strawberry, blueberry, tangerine, and almond sectors. A more coordinated and targeted approach, involving greater private sector participation and increased international collaboration, could significantly enhance the effectiveness of knowledge dissemination across Georgia's agricultural VCs.

6.3. Regulatory bodies

Analyzing regulatory bodies in Georgia's Agriculture Sector is essential for ensuring compliance with standards that promote safety, quality, sustainability, and fairness. These bodies regulate food safety, environmental protection, labor practices, and trade, enhancing market access and consumer trust. By aligning local production with international standards, they help stakeholders avoid legal issues, access regulatory support, and drive innovation, boosting competitiveness in export markets. Key regulatory bodies include:

MEPA	MEPA plays a key role in developing Georgia's agricultural VCs by fostering innovation, sustainability, and competitiveness across crops such as almond, blueberry, strawberry and tangerine. It creates policies that promote sustainable practices, supports farmers with modern technologies, and improves access to both local and international markets. Through these efforts, MEPA enhances productivity, market integration, and environmental stewardship, contributing to the growth and profitability of the agricultural sector.
The Ministry of Agriculture of Adjara	MEPA and the Ministry of Agriculture of Adjara work together to advance agricultural development in Georgia. MEPA sets national policies and strategies, promoting sustainable practices and innovation, while the Ministry of Agriculture of Adjara implements these policies at the regional level, providing localized support for key crops such as tangerines and investing in infrastructure. Their collaboration ensures a unified approach to agricultural growth, balancing national priorities with regional needs.

The NNLE Agroservice Center	The NNLE Agroservice Center, under the Ministry of Agriculture of Adjara, supports local farmers by providing access to modern technologies, high-quality inputs, and technical assistance. It focuses on enhancing productivity and sustainability for crops like tangerines, through training programs on innovative methods, pest control, and climate-smart agriculture. This center plays a key role in strengthening Adjara's agricultural value chains and boosting local economic development.
The NNLE "Rural Development Agency" (RDA)	RDA plays a vital role in advancing agricultural growth and rural development in Georgia by providing technical assistance, financial support, and grants for modernizing farming practices and developing value chains. It also facilitates market access for rural products, promotes rural entrepreneurship, and supports community-driven initiatives. Through its programs and collaborations, the RDA contributes significantly to the economic development and sustainability of rural areas in Georgia.
The LLEP "Enterprise Georgia" Agency	Enterprise Georgia, under the MoESD, plays a key role in strengthening agricultural value chains in Georgia by offering financial support, including a credit guarantee mechanism, and export promotion services. The agency assists agribusinesses with modernizing operations, expanding production, and accessing international markets through marketing, trade missions, and advisory services. Additionally, it provides training programs to enhance export management skills, helping businesses comply with global standards and improve competitiveness.
The LLEP National Food Agency (NFA)	NFA supports the value chain development of perennial crops such as blueberries, almonds, strawberries, and tangerines by ensuring food safety and quality standards, including certifying nurseries and overseeing cold storage and processing guidelines. Through technical assistance, inspections, training, and certifications, the NFA enhances product quality, market access, and competitiveness for Georgia's agricultural products.
The Scientific Research Center of Agriculture (SRCA)	SRCA enhances agricultural productivity and sustainability in Georgia by conducting research and providing practical solutions across crop production, plant protection, and soil management.

	It focuses on developing high-yielding, disease-resistant crop varieties, promoting integrated pest management, improving soil health, and introducing climate-smart practices, while also offering training and collaborating with international research institutions to support innovation in the agricultural sector.
The LLEP State Laboratory of Agriculture	The LLEP State Laboratory of Agriculture supports VC development for crops such as almonds, blueberries, strawberries, and tangerines by offering essential testing for soil health, plant diseases, and pest infestations. It also conducts quality control analyses, provides technical support on best agricultural practices, and helps enhance productivity, sustainability, and competitiveness in the sector.

6.3.1 Support programs available - Blended finance governmental support programs

Blended finance models in Georgia's blueberry, almond, tangerine, and strawberry production combine public and private investments, offering subsidies, grants, and concessional loans to encourage private sector participation. Government programs, financial institutions, and public-private partnerships provide critical support, including technical assistance, credit lines, and infrastructure development, to ensure sustainable growth in the agricultural sector:

"Plant the Future" program	Implemented by RDA, provides grants and subsidies aimed at enhancing agricultural production. This program offers financial assistance to farmers and agribusinesses for purchasing seedlings and planting materials, as well as for improving farm infrastructure. The support can cover expenses related to new plantings, irrigation systems, and other necessary agricultural technologies, helping to boost the overall productivity and quality of perennial crop farms.
Preferential agro credit program	Provides low-interest loans to farmers and agribusinesses involved in agriculture. This financial support helps cover the costs of equipment, infrastructure, and other essential inputs. By offering favorable credit terms, this program facilitates access to capital, enabling producers to invest in their operations and improve their productivity. To support Agro producers in meeting international standards, RDA offers technical assistance for obtaining certifications such as GLOBALG.A.P.

Technical assistance for certification (e.g., GLOBALG.A.P.)	This program provides both financial support for certification costs and technical training to help farmers comply with quality and safety requirements. Achieving such certifications is crucial for accessing international markets and enhancing the competitiveness of Georgian agri food products.
RDA storage and processing grant program	Provides financial support for the development of storage and processing facilities. This program aims to improve the post-harvest handling and processing of the crops, ensuring better preservation and quality of the fruit. Grants are available for constructing or upgrading storage facilities, investing in processing equipment, and implementing technologies that enhance the efficiency and capacity of storages and processing operations.
The agro insurance program in Georgia	Is designed to mitigate risks associated with agricultural production by providing state-supported insurance against natural disasters. It caters to both annual and perennial crops, helping farmers maintain stability and income in the face of adverse weather conditions. Key natural events covered under the program include hail, floods, storms, and autumn frosts (for citrus crops between September 1 and November 30).
Bioproduction promotion program	The Bioproduction Promotion Program supports the growth of organic farming in Georgia by offering financial and technical assistance to individuals and organizations transitioning to bioproduction. It covers costs related to certification, consulting, laboratory analysis, and essential organic farming inputs, fostering sustainable agricultural development and environmental conservation.
State co-financing program of refrigerated storage facilities for berry crops of agricultural cooperatives	The State Co-financing Program supports agricultural cooperatives in Georgia's berry sector by providing financial assistance for setting up refrigerated storage facilities for blueberry, blackberry, and raspberry crops. The program co-finances up to 70% of the storage costs, including refrigerator purchase, transportation, and installation, aiming to improve post-harvest management and ensure compliance with the agro-technological standards.

The Co-financing Program for harvesting agricultural machinery	The Co-financing Program for Harvesting Agricultural Machinery provides financial support to farmers for purchasing new, unexploited harvesting equipment, such as self-propelled and trailed harvesters or tea hand-picking machines. The program offers up to 30% co-financing for harvesting machinery (capped at GEL 150,000) and up to 50% for tea machines (capped at GEL 1,000), aimed at enhancing productivity and reducing post-harvest losses.
Enterprise Georgia's credit guarantee mechanism	Offers guarantees to financial institutions, thereby facilitating access to loans for agribusinesses, including those involved in blueberry, almond, tangerine, and strawberry production. By reducing the risk for lenders, this program makes it easier for agro producers to secure the financing needed for their operations, such as purchasing equipment and expanding their production facilities.

These support programs collectively provide a robust framework for developing the agriculture sector in Georgia, addressing various needs from initial planting and financing to certification and post-harvest processing. For detailed information on application procedures, eligibility criteria, and deadlines, directly contacting the RDA and Enterprise Georgia is recommended.

6.4. International partners - Donor programs and organizations

Over the past two decades, international organizations such as USAID, UNDP, ENPARD, and GIZ have significantly supported the development of Georgia's agriculture sector. Their efforts, promoting modern agricultural practices, expanding export channels, and investing in infrastructure, have greatly enhanced productivity, sustainability, and market competitiveness, contributing to the sector's growth and global market integration.

CHAPTER 7.

FEMALE FARMERS NEEDS ASSESSMENT AND RECOMMENDATIONS FOR EMPOWERMENT

7.1. Female farmers' needs in Georgia

Female farmers in Georgia face numerous challenges that limit their participation, productivity, and economic empowerment. These challenges include unequal access to resources such as land, financial support, and agricultural equipment, with only 38.4% of landowners being women[4]. Gender norms in rural areas often confine women to unpaid or subsistence-level work, restricting their involvement in decision-making and leadership roles. Additionally, women often have limited access to agricultural training, particularly in rural areas, and the training provided does not always address their specific needs. Women are also underrepresented in high-value agricultural activities due to smaller land holdings and limited access to financial resources. The manual labor involved in farming also poses significant health risks, especially from exposure to hazardous substances like pesticides. Furthermore, agricultural programs often overlook gender-specific considerations, leaving women at a disadvantage when it comes to financial tools, capacity-building, and support structures.

7.2. Gaps and challenges in agricultural programs for women

Land ownership and access: The disparity in land ownership between men and women remains a major barrier to female farmers' growth, as ownership is often linked to financial security and the ability to secure credit.

Access to capital and credit: Women are less likely to receive financing because of their smaller landholdings and inability to provide collateral. This limits their capacity to invest in farm expansion, equipment, and technology.

Training accessibility: Training programs are often designed without considering the specific challenges women face in rural areas, such as time constraints due to household responsibilities or the geographical distance to training facilities.

Market access: Women face difficulties in reaching both local and international markets, due to a lack of access to transportation, market networks, and knowledge about market demands.

Cultural norms: Gender stereotypes limit women's participation in leadership roles or high-income activities, perpetuating inequalities in decision-making and income generation.

Technology and equipment: Women farmers often lack access to modern agricultural technologies, such as irrigation systems, cold storage, and machinery, further reducing their productivity compared to male farmers.

[4] Plant the Future Grant Program GIA, https://iset-pi.ge/storage/media/other/2021-09-30/b5e0b5a0-21f9-11ec-835c-7991ebeb4127.pdf

7.3. Recommendations and interventions for empowering female farmers

To address the challenges faced by female farmers in Georgia, several key interventions are needed to enhance their participation and economic empowerment:

I**mproved land and credit access:** Policies should provide inclusive credit programs and prioritize women-led projects, offering flexible collateral and repayment terms.

Localized, gender-sensitive training: Training should be made accessible in rural areas, with content designed to address women's specific knowledge gaps, particularly in modern farming, business management, and leadership.

Support for high-value agricultural sectors: Encourage female participation in value-added agricultural activities, such as post-harvest processing and export certification, by providing targeted financial support and training.

Enhanced market access: Create gender-sensitive market linkages through digital platforms and improve transportation and information services, ensuring women can access broader, including international, markets.

Access to agricultural technologies: Provide women with subsidies or community access to modern farming technologies like drip irrigation, mechanized equipment, and storage facilities.

Gender-responsive policy design: Integrate gender-responsive budgeting into agricultural policies and design tailored support schemes that address the unique needs of female farmers, promoting their involvement in higher-value agricultural activities.

By implementing these measures, Georgia can significantly enhance the economic opportunities for women in agriculture, fostering a more sustainable and equitable agricultural system.

CHAPTER 8.

FARM TO FORK STRATEGY: PERSPECTIVES FOR SELECTED VC'S DEVELOPMENT

The EU Farm to Fork Strategy is a comprehensive plan aimed at creating a fair, healthy, and environmentally friendly food system. While it addresses common goals and principles across the agricultural sector, it also includes specific measures that may vary depending on the crop or subsector. The strategy takes into account the particular needs and challenges of different subsectors, offering tailored solutions to achieve its overarching goals of sustainability, food security, biodiversity, and economic viability.

Assessment of Almond, Blueberry, Strawberry and Tangerine Production in Georgia: Aligning with the Farm to Fork Strategy

Sustainability and Environmental Impact: Blueberry, almond, tangerine, and strawberry production in Georgia is an emerging sector with significant growth potential. However, the environmental impact of this growth is a key consideration. Currently, farming practices for these crops involve substantial water use and rely on pesticides and fertilizers. The Farm to Fork Strategy emphasizes reducing GHG emissions, promoting organic farming, and minimizing pesticide use. To align with these goals, several opportunities for intervention exist:

> Advanced irrigation technologies, such as drip irrigation, can significantly enhance water efficiency for all four crops.
>
> Transitioning towards organic farming practices will not only reduce environmental impact but also meet the growing demand for organic produce.
>
> Implementing Integrated Pest Management (IPM) will help minimize the use of chemical pesticides, fostering a more sustainable approach to the cultivation of blueberries, almonds, tangerines, and strawberries.

Food Safety and Quality: Ensuring the safety and quality of these crops is crucial, particularly for export markets. The Farm to Fork Strategy highlights importance of improved food safety standards and traceability. To align with these indicators, Georgia's producers of blueberries, almonds, tangerines, and strawberries can focus on:

> Obtaining international certifications, such as GLOBALG.A.P., to ensure compliance with high food safety and quality standards.
>
> Developing robust traceability systems to monitor the journey of these crops from the farm to the consumer, enhancing trust and transparency in the supply chain.

Resource Efficiency: Efficient use of water, soil, and other resources is critical for sustainable production of these crops. The EU's Farm to Fork Strategy advocates for reduced resource use and circular economy practices. Georgia's farms can:

> Implement soil conservation practices and precision farming techniques to optimize resource use.
>
> Adopt circular economy principles by recycling farm waste, such as composting plant residues, to contribute to resource efficiency and sustainability.

Biodiversity and Ecosystem Health: The impact of blueberry, almond, tangerine, and strawberry cultivation on local biodiversity and ecosystems must be considered to ensure environmental health. The Farm to Fork Strategy emphasizes biodiversity protection and ecosystem restoration. Farmers in Georgia can:

> Adopt agroecological practices, such as planting cover crops and creating wildlife habitats, which support biodiversity and improve ecosystem health.
>
> Monitor and assess the environmental impact of farming activities to mitigate any adverse effects on local ecosystems.

Economic Viability and Fair Income: Ensuring that farming these crops is economically viable and that farmers receive fair incomes is crucial for the sector's long-term success. The Farm to Fork Strategy supports fair incomes and sustainable economic practices. Georgia’s producers can enhance economic viability by:

> Improving market access and exploring export opportunities for fresh and processed products.
>
> Leveraging government and NGO support programs for financial and technical assistance, helping farmers to sustain and grow their operations.

Consumer Health and Education: Educating consumers about the health benefits of these fruits and the importance of sustainable practices is key to aligning with the Farm to Fork Strategy. Promoting the health benefits through marketing campaigns can encourage healthier dietary choices, and educational programs for both farmers and consumers about sustainable practices will support the strategy’s goals.

By focusing on sustainability, resource efficiency, biodiversity, economic viability, and consumer education, Georgia's blueberry, almond, tangerine, and strawberry production can align with the objectives of the Farm to Fork Strategy. This will foster a more sustainable, efficient, and equitable value chain that benefits both producers and consumers.

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