

INFORMATION PACK

Blueberry and Almond Production and Inclusive Value Chains

Developed within the framework of the PROGRESS regional project, this factsheet series provides practical, accessible, and action-oriented guidance to support the transition toward more sustainable, climate-resilient, and competitive agricultural systems in Eastern Partnership countries.

Aligned with the objectives of the European Green Deal, the series covers key aspects of blueberry and almond production, value chain development, and female entrepreneurship, with a particular focus on innovative and resource-efficient practices. Topics include integrated pest management, precision agriculture, drone-based application of agrichemicals, organic production, fertigation techniques, high-density orchards, windbreak establishment, as well as aggregation, collection, and distribution systems.

In addition to technical solutions, the series highlights inclusive economic opportunities, including female entrepreneurship in action, emphasizing the role of women in strengthening resilient and sustainable agri-food systems.

Designed for farmers, agribusinesses, extension services, and sector stakeholders, these factsheets aim to bridge knowledge gaps, promote the adoption of modern technologies, and support informed decision-making across the value chain. By combining practical insights with a regional perspective, the series contributes to advancing sustainable economic development and climate resilience across the Eastern Partnership region.



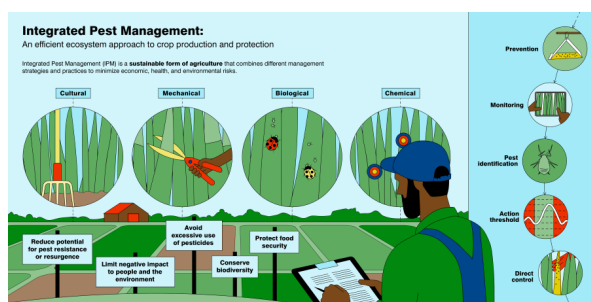
INTEGRATED PEST MANAGEMENT

Information Sheet

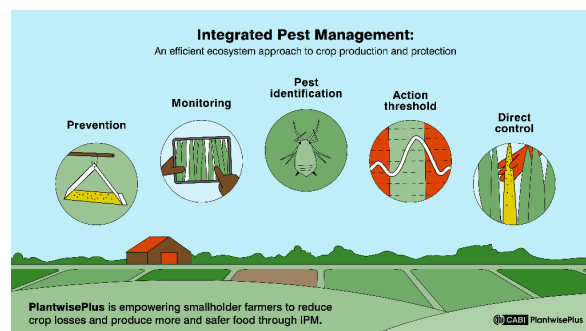
Integrated Pest Management (IPM) is a sustainable approach of managing pests (insects, diseases, weeds, nematodes, etc.) that combines biological, cultural, physical, and chemical tools in a coordinated way. The goal is to minimize economic damage from pests while reducing risks to human health, beneficial organisms, and the environment. Instead of relying only on pesticides, IPM focuses on prevention, monitoring, and control, applying chemical measures only when necessary and in targeted, efficient ways.

Integrated Pest Management (IPM)

The core principles of IPM begin with (i) prevention, which involves selecting resistant crop varieties, practicing crop rotation, choosing proper planting dates, and managing irrigation, soil, and nutrients effectively to reduce the likelihood of pest problems; (ii) monitoring and early detection, achieved through regular scouting, the use of traps, and predictive models to identify pest populations before they cause significant damage; (iii) threshold-based decision making is another key principle, where control measures are applied only when pest populations reach a specific economic threshold, ensuring interventions are necessary and cost-effective. IPM also emphasizes the use of (iv) multiple control methods, combining cultural, mechanical, biological, and, when needed, chemical approaches to manage pests in an integrated and sustainable manner. Finally, evaluation is essential, providing continuous feedback to assess the effectiveness of management strategies and improve the system over time.



Picture 1. IPM Agricultural Management Strategies in a 5-step Process, source: [Bioprotectionportal](https://bioprotectionportal.org/)



Picture 2. Key elements of Integrated Pest Management, source: [Bioprotectionportal](https://bioprotectionportal.org/)

IPM in almond and blueberry orchards: tools, technologies, and best practices for Georgia

For almond and blueberry production, IPM relies on a broad set of tools and practices tailored to orchard environments. Monitoring and detection play a central role, with pheromone traps and lures used to track key pests such as the navel orangeworm and peach twig borer for almonds and the spotted wing drosophila (*Drosophila suzukii*) for blueberry, while sticky traps provide insights into populations of leafhoppers, thrips, aphids and moths.

Pheromone traps release synthetic sex attractants that lure male moths of key pest species such as navel orangeworm (NOW) and peach twig borer. By capturing these insects, the traps provide growers with valuable information on pest activity and population trends,

helping them decide when management measures are needed. For best results, traps should be placed on average 2 meters above the ground in the northern section of the tree canopy, a few trees inside from the almond orchard edge and at approximately 1.5–2 meters above ground, in shaded sections of the blueberry canopy, and inspected regularly. The records collected from these traps are used to establish biofix, the reference point for initiating degree-day models, which is essential for accurately timing insecticide applications or other control strategies.



Picture 3. Pheromone traps and lures for Navel Orangeworm/Peach Twig Borer | Sticky Traps for Aphids and Moth Populations, source: [Semios.com/solutions/insect-pest-management/](https://semios.com/solutions/insect-pest-management/)



Picture 5. Pheromone traps and lures for Spotted Wing Drosophila/Blueberry Maggot, source: www.koppert.ca | [Semios.com/solutions/insect-pest-management/](https://semios.com/solutions/insect-pest-management/)

Meteorological stations and modeling systems are widely applied in orchards to forecast pest development and disease risk, enabling proactive interventions. Meteorological stations measure the orchard's microclimate, and modeling systems translate that data into pest/disease risk forecasts. Together, they allow almond growers to shift from reactive pest control to proactive, precision-based orchard management. Modeling systems take the weather data collected by meteorological stations and use mathematical models or algorithms to simulate the development of pests and pathogens in almond orchards.

These models are designed for the most significant threats to almonds. For example, (i) the Navel Orangeworm (NOW) model relies on degree-day calculations, which measure accumulated heat units, to predict critical stages such as egg laying, larval development, and adult emergence. (ii) Similarly, degree-day models for the Peach Twig Borer (PTB) help forecast the timing of moth flights and larval hatching, enabling growers to schedule control measures more effectively. (iii) Spotted Wing Drosophila (SWD): degree-day models track seasonal development, forecasting adult activity and egg-laying peaks; (iv) Fungal diseases (mummy berry, anthracnose, Botrytis gray mold): infection models integrate rainfall, humidity, and leaf wetness data to identify high-risk infection periods.

By combining these data-driven forecasts, growers can anticipate pest and disease pressure and plan timely interventions that are both efficient and cost-effective.



Picture 4. Meteorological stations, source: [Sensors & Smart Technologies](https://sensorsandsmarttechnologies.com) | www.sst.ge

Forecasting works: A weather station installed inside the orchard records data every 10–15 minutes, including temperature, humidity, rainfall, and leaf wetness. Once a biofix (first moth capture in pheromone traps) is established, the model begins accumulating heat units to predict when egg-laying and larval emergence will occur. At the same time, the system uses humidity and leaf wetness data to run a fungal disease risk model, indicating when infection conditions are favorable. The output may show that activity will peak in the next 5–7 days and that the risk of infection is “high” due to recent rainfall and extended leaf wetness.

With this forecast, the grower can make targeted decisions: (1) applying an insecticide just before egg hatch to maximize effectiveness; (2) scheduling a fungicide spray only if conditions truly favor infection; (3) delaying unnecessary treatments to reduce costs. They may also adopt orchard practices, such as adjusting irrigation timing to avoid prolonged leaf wetness, to reduce future risk. In this way, the station-plus-model approach turns raw weather data into practical, orchard-specific action plans that improve pest control, save money, and protect the crop.

Field scouting remains an essential part of IPM, supported by tools such as hand lenses, sweep nets, and soil probes, while drone-based monitoring and remote sensing are mostly used for large-scale stress detection. Field scouting is the core practice of IPM. It involves physically inspecting trees, bushes, soil, and nuts to detect pests, diseases, and other stress factors before they reach damaging levels. Even with advanced technology available today, field scouting remains indispensable because it provides direct, ground-truth observations that no sensor or model can fully replace.

Typical tools and techniques include:

- Hand lenses – farmers and scouts in Georgia can use hand lenses to identify mites, aphids, and fungal infections at early stages. This is a cost-effective tool appropriate for both small- and large-scale almond orchards.
- Sweep nets – used for capturing mobile insects such as leafhoppers or parasitoid wasps but is more limited in almond production in Georgia. Sweep nets are more common in field crops (wheat, alfalfa, vegetables), but they can be

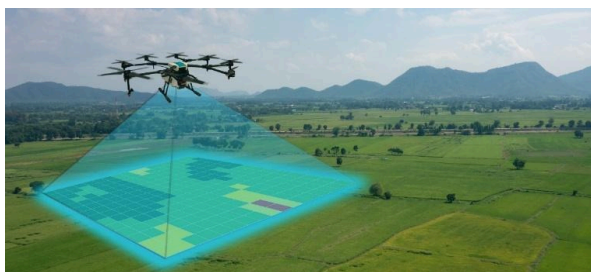
adapted for almonds to monitor leafhoppers and small mobile insects. This method may be underutilized in Georgian orchards but introducing it can strengthen pest monitoring.

- Soil probes – help scout for soilborne pests (e.g., nematodes), check soil compaction, or monitor soil moisture that influences pest and disease development. Almonds in Kakheti, Kvemo Kartli, and Shida Kartli are often grown on soils prone to compaction and with nematode risks. Soil probes can also help evaluate irrigation efficiency and moisture balance, which are critical for disease prevention (e.g., root rot, verticillium wilt).
- Traps (pheromone, sticky, baited) – complement scouting by detecting insect flights (e.g., oriental fruit moth and codling moth, navel orangeworm, peach twig borer) and establishing biofix dates for forecasting models.

While scouting is fine-scale and labor-intensive, drones and remote sensing technologies provide a broad, orchard-wide perspective, especially useful for larger orchards (50+ ha). These tools are not usually employed for detecting small insect pests directly, but rather for identifying plant stress patterns that may signal pest, disease, or irrigation problems. Applications include:

- Multispectral and thermal imaging – detect early canopy stress, such as water deficiency, nutrient imbalance, or fungal infection hot spots, before they are visible.
- NDVI (Normalized Difference Vegetation Index) mapping – highlights variability in canopy vigor, helping growers identify underperforming blocks or trees that might be stressed due to pests, root disease, or irrigation issues.
- Early defoliation detection – useful for spotting areas affected by mites, rust, or scab.
- Precision spraying with drones – in some regions, drones are also being piloted for targeted pesticide applications once scouting or remote sensing has identified problem areas.

As a conclusion, field scouting is the foundation of IPM, you cannot replace the “boots on the ground.” But in large-scale orchards, drone and satellite tools enhance scouting by identifying stress at scale, making pest and disease management more precise and resource efficient.



Picture 6. Drone and satellite tools and imagery, source: <https://www.planetwatchers.com>

Biological and ecological strategies complement these efforts, including the release of beneficial insects such as parasitoid wasps or predatory mites, which help suppress pest populations naturally. Biopesticide application equipment, often sprayers with fine misting systems, is used to apply microbial and botanical

formulations against insect and fungal pests, offering a reduced reliance on conventional chemicals.

Cultural and mechanical approaches are also fundamental in IPM. Weed management is achieved through mulching, mechanical cultivation, or flame weeder, while soil solarization is occasionally practiced in nurseries or new orchard plantings to reduce soil-borne pathogens. Proper pruning and orchard sanitation further contribute by removing pest harborage sites.

When chemical interventions are required as a last resort, precision spraying technologies are used to optimize efficiency and minimize inputs. Tractor-mounted, drone-based, or handheld sprayers enable targeted applications, while electrostatic sprayers improve droplet adhesion to almond leaves and nuts.

Fertigation and drip irrigation systems also support IPM by delivering soil-applied biopesticides or nematode control products directly to the root zone with minimal waste.

A mating disruption dispenser, often used in almonds, mounted in an orchard to release pheromones that interfere with pest mating cycles.

Useful information on funding opportunities for farmers

The Loan Annual Interest Rate Subsidy Preferential Agri-Credit Program, implemented by the NNLE Rural Development Agency (RDA), supports farmers in adopting climate-smart technologies by financing the installation of agricultural meteorological stations and related sensors for IPM and precision farming practices. The program subsidizes commercial loans over multiple years by covering most of the annual interest rate, thereby reducing farmers' financial burden and lowering upfront investment costs. Its primary objective is to accelerate the uptake of smart agricultural practices among current and potential farmers and agro-producers. By facilitating access to affordable credit, the program enables growers to integrate advanced technologies that improve yields, extend harvest periods, and ensure compliance with export-quality standards, ultimately enhancing Georgia's competitiveness in regional and international berry markets.

Additional information

→ Additional information can be obtained by visiting the links: [ISOUT](#) [Pheromone Opportunities](#)

Examples from other countries

Case Study: Navel Orangeworm (NOW) Forecasting in California Almonds

In the Central Valley of California, one of the biggest threats to almond production is Navel Orangeworm (NOW). The insect damages kernels directly and also exposes nuts to aflatoxin contamination, which is a serious export barrier.

Traditionally, many growers applied calendar-based insecticide sprays, for example, every 3–4 weeks during the season, without knowing if treatments aligned with pest activity. This often led to high costs, reduced effectiveness, and unnecessary chemical use.

When meteorological stations and modeling systems were introduced, the approach changed. A biofix (first moth capture) was established in pheromone traps, and stations began collecting temperature data every 15 minutes.

The forecasting model calculated degree-days to predict when the next generation of NOW eggs would hatch. The system indicated that peak egg hatch would occur in 7–10 days, and that untreated nuts would be at their most vulnerable stage.

Armed with this forecast, the grower applied an insecticide just before larval emergence rather than following a rigid calendar spray. This precise timing increased the effectiveness of the treatment, reducing crop damage by 30–40% compared to the previous season, while also cutting insecticide use by one full application.

Additionally, weather station data showed prolonged periods of leaf wetness after late spring rains, which triggered a shot hole disease risk alert. The grower responded with a targeted fungicide application timed during the infection window, preventing disease spread while avoiding blanket spraying later in the season.

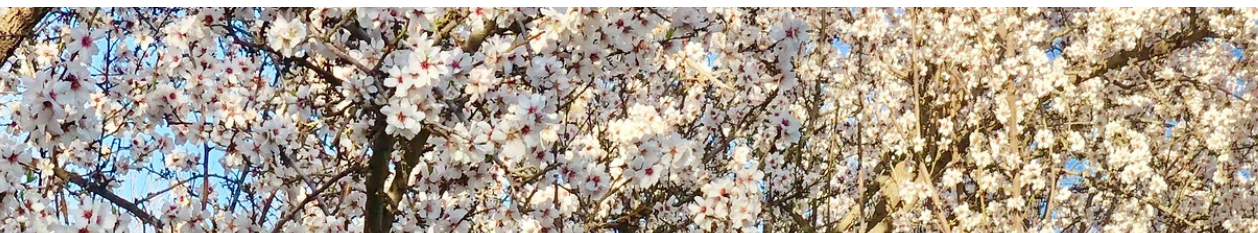
The grower saved on input costs, reduced chemical use, lowered aflatoxin risk, and achieved higher-quality almonds for export markets. This demonstrates how forecasting transforms pest and disease management from a reactive, calendar-based approach into a data-driven, proactive strategy.

Spotted Wing Drosophila (SWD) Forecasting in European Blueberries

In Germany and Italy, *Drosophila suzukii* (Spotted Wing Drosophila, SWD) is a major threat to blueberry and soft fruit production. Unlike other fruit flies, SWD attacks healthy ripening berries, causing direct yield losses and reducing fruit quality for fresh and export markets. Traditionally, growers relied on calendar-based insecticide sprays, which often led to overuse and increased resistance. With integrated monitoring and forecasting systems, management has shifted toward precision timing.

Traps with attractants are placed in fields to capture adult SWD, and trap counts are combined with local temperature and humidity data. Degree-day models then predict adult emergence and peak egg-laying periods, allowing growers to apply control measures only when the risk is high. IPM also includes cultural practices such as removing overripe fruit, using exclusion netting, and maintaining good sanitation to reduce breeding sites.

As a result, growers have been able to reduce insecticide applications while maintaining yields, improve fruit quality for fresh consumption and export, and lower environmental impact and pesticide resistance risk. This approach is highly relevant to Georgia, where SWD is already present and European monitoring and forecasting methods can be adapted to optimize spray timing and integrate with local IPM strategies.



PRECISION AGRICULTURE IN ALMOND AND BLUEBERRY PRODUCTION

Information Sheet

Precision Agriculture (PA) is a modern, technology-driven approach to crop management that optimizes the use of resources, enhances yields, improves product quality, and reduces environmental impact. Unlike conventional methods, which apply water, fertilizers, and pesticides uniformly across entire fields, PA relies on site-specific, data-driven interventions.

In Georgia, where almonds and blueberries are high-value crops with growing export potential, PA provides a framework for sustainable and profitable farming. While Integrated Pest Management (IPM) is a key component of PA, focusing on pest and disease control, PA also addresses irrigation, fertilization, soil management, climate adaptation, yield monitoring, and cost optimization, offering a holistic strategy for orchard management.

PA Approaches for Almond and Blueberry Growers in Georgia

Smart irrigation and water management focus on applying water only where and when it is needed to maximize crop growth, reduce plant stress, and prevent diseases. A key tool is the use of soil moisture sensors, which should be installed at multiple depths (15 cm, 30 cm, and 50 cm) in representative zones of the orchard.

Daily monitoring of these readings helps schedule drip irrigation effectively, with thresholds set at 25–35% volumetric soil moisture for blueberries and 30–40% for almonds. This approach reduces water use by 20–25%, prevents root rot, and improves berry and nut size.

Another important practice is Evapotranspiration (ET) monitoring, which uses weather station data such as temperature, humidity, solar radiation, and wind speed to calculate crop water demand.

Irrigation should be adjusted weekly or even daily depending on combined ET and soil moisture trends. Distance-controlled drip irrigation further enhances efficiency by enabling variable-rate watering across different orchard blocks. For example, in Kakheti blueberry orchards, ET-driven drip irrigation improved

blueberry orchards, ET-driven drip irrigation improved berry uniformity by 15% while also saving labor and water.

Finally, frost monitoring systems are essential in vulnerable areas. Sensors installed at canopy height can alert growers to activate sprinklers or heaters when temperatures approach 0–2°C during flowering, preventing yield losses. In pilot almond orchards in Shida Kartli, this system successfully reduced potential frost-related yield losses by 10–15%:

Fertilization and nutrient management should follow the principle of applying nutrients only when and where plants truly need them, ensuring efficiency and sustainability. Soil nutrient sensors can be used to measure nitrogen, phosphorus, potassium, and pH across different soil zones, allowing farmers to map deficient areas and apply variable-rate fertilization instead of uniform applications. For example, in blueberry production, this approach has reduced nitrogen use by 15%, while improving leaf health and berry size. Foliar fertilization can also be targeted to nutrient-deficient zones identified through drone-based

multispectral imaging, where blue or Normalized Difference Vegetation Index (NDVI) imagery highlights areas of stress. This method not only enhances yield uniformity but also reduces unnecessary chemical use. Additionally, integrating fertilization with irrigation through fertigation enables real-time adjustments of nutrient delivery based on soil moisture levels and ET data, ensuring that crops receive precise amounts of nutrients at the right time. This combined approach improves both resource efficiency and overall crop productivity.

Precision agriculture in soil management ensures healthier soils by maximizing efficiency of nutrient and water use. Soil temperature sensors guide planting and irrigation schedules, with blueberries performing best at 18–22°C and almonds at 20–28°C for optimal root growth. Additionally, pH and salinity sensors help maintain optimal soil conditions, ensuring blueberries thrive in acidic soils (pH 4.5–5.5) and almonds in slightly neutral soils (pH 6–7). Variable-rate soil amendments, such as lime or compost, are applied only to deficient areas, which improve root health while reducing unnecessary inputs. By combining these tools, PA allows farmers to manage soils more precisely, improving sustainability and productivity.

Precision agriculture significantly enhances IPM by enabling targeted, data-driven pest control. Pheromone traps, placed at 1.5–2 meters in shaded canopy areas and inspected weekly, monitor key pests—Spotted Wing Drosophila (SWD), blueberry maggot (*Rhagoletis mendax*), and leafhoppers in blueberries; peach twig borer (*Anarsia lineatella*) and navel orangeworm (*Amyelois transitella*) in almonds. Data from these traps establish a biofix for degree-day pest models, ensuring more accurate timing of interventions. Agro-meteorological stations that measure temperature, humidity, rainfall, and leaf wetness support disease and pest forecasting, such as predicting Spotted Wing Drosophila (SWD) emergence or mummy berry infection.

In Kakheti, blueberry farms using these systems reduced insecticide use by 40% and fungicide use by 30%. Drone monitoring with NDVI and multispectral imaging helps detect stressed plants or pest hotspots, allowing targeted sprays instead of whole-block applications. Complementing these technologies, cultural practices such as removing fallen leaves, mummified berries, or damaged nuts, and maintaining canopy airflow through pruning further lower pest and disease pressure.

Green, Sustainable, and Smart Farming Technologies: Precision agriculture also plays a central role in strengthening climate adaptation. Weather sensors that track temperature, rainfall, wind, and solar radiation provide early warnings of drought, heat stress, or frost. Decision-support systems using real-time and predictive data allow farmers to adjust irrigation, fertilization, pruning, and harvest schedules in response to changing conditions. Wind sensors help guide pesticide spraying by reducing drift and improving application efficiency.

Together, these tools build resilience to climate variability, allowing farmers to maintain yields, reduce risks, and improve long-term sustainability.



Picture 1-3. Meteorological Station and Sensors (Source: www.tms-lab.com | [GECSA - a digital platform for innovative agro-meteorological services](#))

Precision agriculture tools such as drones and satellite imagery play a vital role in yield monitoring and optimization by detecting canopy stress, nutrient deficiencies, or water shortages across orchards. NDVI mapping helps identify underperforming zones, enabling farmers to target interventions where they are needed. Yield maps generated during harvest support better planning of labor allocation and harvest timing, ensuring maximum crop quality while minimizing losses and waste. Noteworthy, on pilot blueberry farms, the use of these technologies improved harvest efficiency by 15–20%, demonstrating the potential of data-driven monitoring to optimize both productivity and resource use.

The adoption of precision agriculture delivers significant economic and environmental advantages. Input savings are one of the most immediate benefits, with water, fertilizer, and pesticide use reduced by 20–45%, depending on the level of technology adoption. Labor efficiency also improves, as drone-based scouting can reduce field labor requirements by 20–30%. Consistent and uniform irrigation and nutrient application enhance crop quality, leading to larger berries, higher nut quality, and an overall marketable yield increase of 10–15%.

Environmental impacts are reduced as well, with less chemical runoff, lower pesticide usage, and reduced greenhouse gas (GHG) emissions contributing to more sustainable production systems. From a financial perspective, investment in precision agriculture technologies often pays back within just 2–3 seasons. For example, pilot blueberry orchards achieved an internal rate of return (IRR) exceeding 18%, underlining the strong business case for adoption.

Useful Information

Precision agriculture in Kakheti and Shida Kartli is being advanced through a modern extension initiative spearheaded by the Rural Development Agency (RDA) which, in collaboration with the National Environment Agency (NEA), the Scientific-Research Center, and under the support of UNDP and the Green Climate Fund, has introduced GECSA, a web-based agro-meteorological platform. This system integrates readings from 15 newly established and 19 rehabilitated weather stations in both regions to deliver weather-adjusted agro-recommendations directly to farmers cultivating apples, grapes, peaches, nectarines, wheat, and corn, thereby enabling climate-tailored crop management, and potentially improving both quality and yields.

More information: gecsa.nea.gov.ge/login.do | [How to register on Georgian Climate Service for Agriculture GECSA](#)

Funding Opportunities in Georgia

Farmers in Georgia can access tailored financial instruments that make the transition to precision agriculture more affordable and less risky. One of the key mechanisms is the Preferential Agro-Credit Program, administered by the LEPL RDA, which provides a loan annual interest rate subsidy.

This program supports investments in advanced technologies such as soil and climate sensors, automated weather stations, drones for crop monitoring, and precision irrigation systems. By reducing the financial burden of high upfront costs, the subsidy enables farmers to adopt innovations that would otherwise remain out of reach.

The program accelerates the implementation of precision agriculture (what), helps optimize the use of water, fertilizer, and pesticides (how), and improves yields, quality, and profitability while reducing environmental impact (why). Ultimately, this funding opportunity bridges the gap between technology availability and on-farm adoption, fostering sustainable intensification and increasing the competitiveness of Georgian agriculture both domestically and internationally.

International Best Practices

Experiences from leading agricultural regions worldwide demonstrate how precision agriculture can effectively enhance productivity, reduce costs, and minimize environmental impact: approaches highly relevant for Georgian farmers. In Europe, particularly in Germany and Italy, blueberry producers have successfully integrated pheromone traps with weather station data and degree-day modeling to predict SWD activity. This targeted system reduced insecticide use by 30–50%, cutting costs while protecting pollinators and ensuring higher fruit quality.

Similarly, in California, USA, almond growers have combined soil moisture sensors, frost monitoring, drones, and precision irrigation scheduling to optimize resource use and protect orchards against climate stress. These practices led to a 15–20% improvement in nut quality and net revenues, while also conserving water in a drought-prone region.

In Georgia, where blueberries and almonds are becoming increasingly important, these examples offer valuable models for adaptation, showing how precision tools can support sustainable intensification, climate resilience, and export competitiveness.

DRONE APPLICATION OF AGRICHEMICALS

Information Sheet

Drone-based spraying systems are rapidly transforming modern agriculture by providing precise, efficient, and environmentally responsible solutions for crop protection and fertilization. Equipped with GPS navigation, multispectral imaging, and variable-rate nozzles, these systems enable farmers to target specific orchard or field zones, reducing over-application, minimizing drift, and optimizing the use of agrichemicals.

For Georgian farmers, particularly those cultivating almonds, blueberries, strawberries, and tangerines, drones offer practical advantages in overcoming terrain challenges, labor shortages, and rising input costs.

Drone-based spraying is increasingly adopted in almond orchards in Kakheti and Kvemo Kartli regions to improve efficiency and sustainability. Tall trees and dense canopies make conventional spraying labor-intensive and inefficient.

Drone Application of Agrochemicals

Blueberry farms in Guria, Imereti, and Adjara regions are often characterized by fragmented plots and steep terrain, making ground-based spraying difficult. In Samegrelo region, where production has expanded rapidly, the humid subtropical climate and frequent rainfall increase pest and disease risks, while irregularly shaped orchards limit the use of traditional machinery.

In both cases, drones equipped with GPS navigation, multispectral imaging, and variable-rate nozzles enable farmers to target specific plant clusters, reducing chemical waste, saving water, minimizing labor costs, and preventing soil compaction in sensitive blueberry root zones.

How it works

Drones operate based on pre-programmed GPS or GIS maps, flying accurately along orchard or field boundaries to minimize chemical waste. Smart sensors and imaging cameras assess canopy density, pest pressure, and plant health, enabling variable-rate application that delivers higher doses to infected areas while sparing healthy zones. Farmers can monitor drone routes in real time via mobile apps, verify spray coverage, and adjust droplet size, height, or speed dynamically as needed.

The spraying mechanism typically produces fine droplets for almond trees (50–200 microns) through rotary atomizers or pressure nozzles. Such mechanism balances canopy coverage with reduced drift, ensuring thorough coverage of Georgia's typically low, bushy blueberry shrubs. By employing rotary atomizers that generate ultra-fine droplets (around 80–

100 microns), the system maximizes coverage while minimizing drift.

Practical benefits for farmers

Drone spraying significantly reduces agrichemical and water use, often by 20–30%, thanks to precise targeting and minimal overlaps. Operational efficiency is another major advantage: a single drone can cover 10–15 hectares per hour, far outpacing manual or tractor-based spraying, and particularly valuable in steep or fragmented orchards. Labor requirements are reduced, as one trained operator can manage spraying across multiple blocks, which is increasingly important given rural labor shortages in Georgia. Health and safety also improve, since operators remain distant from toxic sprays. Furthermore, drones enable better canopy penetration in tall crops like almonds and allow access to areas where tractors cannot operate.

Drone-based spraying systems are well-suited to West Georgia's blueberry belt, where fragmented blocks and hilly, wet ground often limit tractor access. Multispectral or canopy maps enable variable-rate passes that focus inputs on denser rows or pest "hotspots," particularly where spotted-wing drosophila (SWD) and humidity-driven fungal diseases are present.

Integration with precision agriculture

Drone spraying is not simply a mechanical replacement for sprayers but a core element of data-driven farm management.

Scouting drones equipped with NDVI or pest-mapping tools can directly feed data into spraying drones, ensuring that chemicals are applied only where necessary. Scheduling applications around favorable weather conditions reduces drift and enhances efficiency, while digital logs of each spraying session strengthen traceability and compliance with organic, Global G.A.P., or EU export requirements.

Practical tips for farmers

When spraying almonds, farmers should use slightly larger droplet sizes, around 120–150 microns, to achieve good penetration into the dense canopy while minimizing drift. Drones should typically fly 2–3 meters above the tree canopy at a speed of 3–5 m/s to ensure even coverage across the orchards.

For optimal results in blueberry orchards, farmers should calibrate drones to produce droplet sizes of 80–100 microns, ensuring thorough coverage of fruit clusters. Care must be taken to avoid drift under windy conditions. Flights should be maintained at about two meters above the canopy with speeds of 3–5 meters per second to achieve uniform application.

Because not all agrichemicals are suitable for drone application, it is important to check product labels or seek advice from suppliers before mixing and spraying. Battery management also plays a key role: orchards should be divided into 3–5-hectare blocks, with spare batteries charged and rotated during operations. Finally, farmers must observe Georgian regulations on drone use, which may require operator certification or registration with the Civil Aviation Agency.



Picture 1. Drone application of agrichemicals, Source: [Agrometa - Georgia](#)

International Best Practices

In Canada, drone technology has been employed to enhance the management of wild blueberry fields, particularly in challenging terrains. Drones equipped with high-resolution cameras and multispectral sensors are utilized for field mapping, enabling the identification of areas with pest infestations or fungal diseases. This approach allows for targeted pesticide application, reducing overall chemical use and minimizing environmental impact. For instance, drones have been used to detect and map infestations of yellow hawkweed, a common weed in wild blueberry fields, facilitating precise herbicide application and improving weed management strategies.

The Netherlands is a global leader in agricultural drone adoption, including for blueberry production. Dutch growers use drones for spraying, yield estimation, disease detection, and targeted weed management, integrating multispectral cameras and robotic systems to improve efficiency and sustainability. Precision spraying reduces chemical use, while drones enable timely interventions against pests and diseases. Such widespread adoption is supported by a strong agtech ecosystem, Research and Development (R&D) institutions such as Wageningen University, and investment in precision farming technologies, making the Netherlands a benchmark for high-tech, sustainable blueberry cultivation.

In China and Japan, drone spraying in rice, tea, and berry crops has reduced pesticide use by 25–40% while maintaining yields and improving worker safety. In Spain, drones integrated with NDVI mapping are widely used in vineyards and soft fruit production, cutting input use by 20–30% and improving crop quality for export. South Korea has demonstrated success in blueberry orchards, achieving both input savings and higher efficiency. These global experiences are highly relevant for Georgia, particularly for almond orchards, blueberry plantations in Kakheti and Shida Kartli regions, and steep valley plots where conventional machinery is limited.

Ket takeaway for Georgian farmers

Drone spraying should be viewed as a precision agriculture tool that combines smart targeting, reduced inputs, improved safety, and integration with digital farm records. By adopting this technology, Georgian farmers can lower costs, enhance productivity, and meet the quality and certification requirements of international markets. The recommended approach is to start with small pilot trials on 2–3-hectare blocks, compare results with conventional spraying, and gradually scale up. Training with certified drone operators or partnering with cooperatives can further reduce costs and accelerate adoption.

Additional information can be obtained by visiting the links:

- [The use of drones in agriculture - the latest agricultural drone | Agro Drone Application](#)
- [Using an agrodrones in "Undabno" Almond orchards](#)

ORGANIC PRODUCTION IN GEORGIA

Information Sheet

Organic production presents a strong opportunity for Georgian farmers to access premium export markets while reducing chemical inputs and enhancing soil health and biodiversity. The approach is well-suited to Georgia's small and medium farm structures, where adopting organic methods can improve competitiveness in high-value markets such as the EU and Gulf region. Transitioning to organic requires strict adherence to certification standards, including EU Organic or national schemes such as Caucascert, but with appropriate training, monitoring, and adaptation, farmers can achieve sustainable growth and higher price premiums.

Blueberries are particularly attractive in this regard, as international demand for organic berries is rising, with fresh, frozen, and dried forms all enjoying stable markets. Georgia's humid subtropical lowlands and cooler mountain regions provide favorable conditions for organic blueberry cultivation, provided that soil conditions, pest control, and post-harvest logistics are properly managed. For small and medium growers, blueberries offer high returns per hectare and benefit from relatively limited domestic competition in the organic fruit segment.

Core principles of organic blueberry production

Soil health: In Georgia, blueberry orchards are often established in acidic soils, but maintaining the ideal pH (4.5–5.2) requires constant management. Long-term fertility should be built with compost, green manures, and organic fertilizers, while amendments such as pine bark mulch, composted sawdust, and elemental sulfur are important for sustaining soil acidity and structure.

Pest and disease management: Preventive and biological measures are essential in organic systems. Monitoring and trapping for Spotted Wing Drosophila (SWD) and other fruit flies are critical as these pests are widespread in Georgia. Netting and exclusion protect against both fruit flies and bird damage. Biological fungicides such as *Bacillus subtilis* and *Trichoderma* spp. help reduce Botrytis and mummy berry risks. Good orchard sanitation, including the removal of infected berries and careful pruning for airflow, reduces disease pressure.

Weed management: Effective weed control is vital, as unmanaged weeds can rapidly compete with blueberries. Thick organic mulching (8–10 cm) using

pine bark or straw conserves soil moisture and suppresses weeds. Manual or mechanical weed removal around the plant base is often required, especially in small and medium farms. Flame weeding is not recommended due to shallow root system of blueberries.

Biodiversity: Enhancing biodiversity strengthens the resilience of the orchard ecosystem. Establishing pollinator-friendly habitats, planting inter-row cover crops, and maintaining natural vegetation buffers can improve ecosystem balance, pollination services, and the orchard's ability to withstand pests, diseases, and climatic stress.

Certification and traceability: To access EU and other premium organic markets, growers must maintain accurate records of all inputs, practices, and yields for compliance with organic standards. Cooperative-based certification schemes and group certification can help reduce costs for smallholders, making organic production more accessible in Georgia.

Key challenges and opportunities

Organic blueberry production in Georgia faces several key challenges and opportunities. Pest and disease pressure is a major concern, with threats including SWD, blueberry maggot, mummy berry, and anthracnose. In organic systems, managing these pests relies heavily on prevention, monitoring, and timely intervention using bio-alternatives and cultural practices.

Soil acidity management is another critical factor, as blueberries require a pH of 4.5–5.2; maintaining this through organic-certified amendments such as elemental sulfur and pine bark mulch is essential for healthy growth and fruit quality. In organic systems, weed and fertility management is essential, as intensive mulching, composting, and manual or mechanical weed control are needed to prevent weeds from reducing yields.

On the market side, organic blueberries offer significant opportunities, with EU importers paying price premiums up to 30% for certified organic fruit, provided that cold chain logistics, post-harvest handling, and strict adherence to certification standards are consistently maintained.



Picture 1-3. Organic blueberry production research project,
Source: [Organic Blueberry Production Research Project](#)

How to implement organic blueberry production

Implementing organic blueberry production in Georgia requires a combination of preventive pest management, soil fertility care, weed control, and proper post-harvest handling.

- Pest and disease control relies on bio-alternatives and cultural practices, including mass trapping and monitoring for SWD using vinegar- or yeast-based traps, netting and exclusion to protect fruit from flies and birds; and preventive applications of biological fungicides such as *Bacillus subtilis* and *Trichoderma spp.* against Botrytis (Gray Mold). Sanitation practices, such as removing mummified berries and pruning to improve airflow, are also essential.

- Soil fertility and acidity management involves annual applications of pine bark mulch and composted sawdust, use of organic-certified sulfur amendments and humic acids, and fertilization with fish emulsion and approved organic potassium sources to maintain optimal growth and fruit quality.
- Weed management is achieved through thick organic mulching (8–10 cm) to suppress weeds and retain moisture, combined with manual or mechanical removal around plants, while flame weeding should be avoided near shallow blueberry roots.
- Post-harvest handling is critical to maintaining organic integrity and market value, requiring rapid pre-cooling, storage at 0–2°C with 90–95% relative humidity, strict organic labeling and batch traceability, and investment in organic-certified packhouses for sorting and packaging.

Post-harvest handling of organic almonds

Maintaining organic integrity after harvest is vital for market access. In Georgia, where many farms combine organic and conventional production, nuts must be strictly separated during harvest, drying, and storage to comply with certification standards. Proper drying prevents aflatoxin risks, while cold storage or CO₂ fumigation ensures pest-free nuts without chemicals. Since smallholders often lack facilities, shared infrastructure and cooperatives play a key role. These measures help Georgian organic almonds retain quality and meet export requirements for premium markets.

Practical recommendations for Georgia

Promoting cooperative-based organic certification schemes can significantly reduce costs for small farmers and make organic almond production more accessible. Establishing demonstration orchards in regions such as Kvemo Kartli, Kakheti, and Shida Kartli would showcase effective organic practices and provide hands-on learning opportunities. To ensure sustainable production, integration of climate-smart irrigation systems offered by companies such as Netafim, Rivulis, and local providers is essential, as it allows efficient water and nutrient management under organic conditions. Finally, close collaboration with processors and exporters such as Udabno and Almond Orchards LLC can help build a traceable organic almond value chain, ensuring compliance with certification standards and strengthening Georgia's position in premium EU and Middle Eastern markets.

Key support actors for organic Transition in Georgia

Elkana (Biological Farming Association of Georgia) is the leading NGO in Georgia promoting organic agriculture and sustainable rural development. It provides training, technical assistance, farmer field schools, and demonstration plots on organic production methods, including soil health management, biological pest control, and certification preparation. For blueberry growers, Elkana offers practical guidance on soil acidity management, organic fertilization strategies, and biological pest and disease control. Elkana also supports farmers in connecting with export opportunities.

and actively contributes to policy advocacy for the organic sector.

Caucascert is the first Georgian certification body accredited to issue EU Organic, USDA NOP, and other international organic certificates. It ensures compliance with global organic standards, which is essential for accessing premium export markets.

For blueberry producers, certification through Caucascert establishes credibility with buyers by ensuring traceability, proper documentation, and compliance with organic standards. This certification is especially critical for farmers targeting EU and Gulf markets, where organic blueberries command significant price premiums.

The Rural Development Agency's (RDA) Bioproduction Promotion Program in Georgia offers significant financial assistance to farmers—including blueberry producers—transitioning to organic production by reimbursing up to 70% of certification and consulting expenses, with a maximum of 7,000 GEL per beneficiary; if a donor organization contributes, RDA's share is reduced to 40%, capped at 4,000 GEL.

While this support does not extend to organic inputs for blueberry cultivation (those are currently covered only for viticulture and apiculture), the program substantially eases the financial burden of obtaining organic certification and expert guidance, thereby facilitating the adoption of organic standards by blueberry growers across Georgia.

International best practices – Organic blueberry production

United States (Oregon, Washington, Michigan): Raised beds with sawdust/bark mulching keep soils acidic and productive. Drip fertigation with organic nitrogen (fish hydrolysate, feather meal) improves yields. Exclusion nets and field hygiene effectively control pests like SWD.

Spain (Huelva, Asturias, Galicia): Protected cultivation (tunnels, net houses) reduces disease and improves quality for export. Organic-certified substrates (pine bark + peat) overcome unsuitable soils. Centralized pre-cooling and packhouses ensure freshness for EU markets.

Poland: Small farms cooperate through group organic certification schemes and stronger market access. Mechanical harvesting and processing (frozen, juice) stabilize prices and reduce waste.

Chile: Strong cold chain management supports long-distance exports. Biofungicides (*Bacillus*, *Trichoderma*) combined with canopy management control major fungal diseases.

Italy (Piedmont, Trentino): Biodiversity strips and pollinator habitats enhance ecosystem services. High-density trellised systems with organic fertigation improve yields on small farms.

Relevance for Georgia: Adapting practices such as mulching and raised beds, drip fertigation with organic inputs, composting, cooperative marketing, and cold chain improvements can help Georgian organic blueberry growers strengthen soil health, meet EU organic standards, and access export markets.

International best practices – Organic almond production

United States: Organic & integrated almond systems

Key technologies / practices

- Mating disruption & pheromone systems for navel orangeworm (NOW): aerosol dispensers, passive meso dispensers and micro-encapsulated formulations deployed orchard-wide to reduce mating and egg-laying.

This is a core non-chemical tactic in California organic and low-input IPM. Almondsiobc-wprs.org

- Winter sanitation + hull/mummy management: aggressive removal of mummy nuts, shredding and burying prunings to reduce overwintering sites and inoculum.
- Orchard hygiene + harvest timing: coordinated regional management, timely harvesting and rapid on-farm processing to reduce infestation risk.

How to adapt in Georgia

Use pheromone traps and consider pilot mating-disruption trials if/when NOW becomes a threat: meanwhile maintain trap surveillance as an early-warning system (NOW is not established in Georgia but is a quarantine risk).

Prioritise winter sanitation and coordinated harvest timing in Kvemo Kartli, Kakheti and Shida Kartli to cut pest and fungal inoculum.

Spain: Mediterranean rainfed & irrigated almonds

Key technologies / practices

- Rain-fed/low-input organic models & intercropping: many Spanish producers rely on rainfed, lower-input organic systems, using cover crops/intercropping and landscape-level practices to maintain soil and biodiversity.

Studies report modest yield penalties but improved quality parameters under organic management.

- Soil/landscape adaptation: use of multispecies cover crops, reduced tillage, and water-conscious planting designs that suit marginal Mediterranean slopes.

How to adapt in Georgia

For marginal or rainfed sites (hills in eastern/central Georgia), adopt multispecies cover crops and intercropping to build soil organic matter and reduce erosion (VALMEDALM-style approaches).

Consider lower-input cultivars and spacing to match local terrain and labour availability.

Italy: Traditional & organic smallholder systems

Key technologies / practices

- Low-input, extensive organic orchards and value from landscape/heritage production: In Sicily and parts of southern Italy, organic almond production relies on low input, extensive systems with limited mechanisation. Producers use traditional varieties, intercropping, and minimal pruning, adding value through landscape and heritage branding: producersmarket.com.

How to adapt in Georgia

In smallholder contexts (older orchards / marginal lands), leverage traditional / locally adapted cultivars for organic niche markets; focus on quality, terroir/brand storytelling for EU/Middle East buyers.

Additional information

- [Farmer Tornike Mchedlishvili's almond orchards, Ninotsminda lands, Sagarejo. Almond orchards of Avikhuri and Penta varieties are planted on 50 hectares.](#)
- ["Slight yield reduction, but improved quality under organic management."](#)

ORGANIC FERTILIZATION IN BLUEBERRY PRODUCTION

Information Sheet

Organic fertilization is particularly important for blueberry production in Georgia, as blueberries have very strict requirements for soil acidity and nutrient balance. The crop thrives best in acidic soils with a pH between 4.5–5.5, conditions often found in parts of Imereti, Guria, Samegrelo, and Adjara regions. Maintaining such acidity and soil organic matter is essential for high yields, plant vigor, and resilience against pests and diseases.

Conventional mineral fertilizers may temporarily stimulate growth, but at the same time they can raise soil salinity, reduce acidity, and disrupt soil microbiology. By contrast, organic fertilizers, such as composts, sawdust-based blends, and biofertilizers - help preserve soil acidity, enrich organic matter, and sustain healthy microbial activity. This approach also supports the growing market demand for organic-certified blueberries in the EU and beyond, giving Georgian farmers a competitive advantage.

Locally feasible practices

- Conifer sawdust and wood chips: By far the most common and practical amendment for Georgia is conifer sawdust and wood chips. They are affordable, widely available from local sawmills, and effective in maintaining soil acidity while building organic matter.
- Composted poultry manure and farmyard manure blends: Many farmers can use composted poultry manure and farmyard manure blends. These must be well-composted and applied carefully, since raw or alkaline manures can harm blueberries. Mixing with sawdust helps balance pH and reduce risks.
- Liquid organic fertilizers and biofertilizers: Farmers increasingly use fermented plant extracts, seaweed-based products, or microbial solutions to improve soil life and provide foliar nutrition. These are applied in small amounts and can be integrated into drip irrigation systems.
- Peat: Imported peat could be applied, mostly in larger plantations to establish young plants as it is

more costly. While effective, its high cost means it is not widely used by small and medium farmers. Where possible, blending peat with sawdust compost reduces expenses.



Picture 1. Organic-origin fertilization in blueberry production
(Source: [University of Florida](#))



Picture 2. Organic-origin fertilization of blueberry production
(Source: [ATTRA Sustainable Agriculture](#))

Nota Bene: Many Georgian composts are too alkaline or high in salts, therefore they must be tested and adjusted (pH, EC) before applying to blueberries.

Application (Practical Steps):

- Soil preparation and mulching: Incorporate composted pine bark or sawdust before planting to increase organic matter and acidify the soil. Mulching with wood chips or peat-based organic matter reduces weed pressure, maintains soil moisture, and improves root health.
- Base fertilization: Apply organic manures (e.g., composted poultry or cow manure) in early spring, ensuring they are well-decomposed to avoid ammonia toxicity. Preference is given to low-pH compost sources.
- Fertigation based on monitoring: In Georgia, organic-origin fertilization for blueberries is most effective when combined with fertigation through drip irrigation systems. Liquid organic fertilizers are applied directly with irrigation water, ensuring precise delivery to the root zone. The dosage and timing should be guided by regular leaf tissue analysis, which helps determine nutrient needs of a plant at different growth stages. Nitrogen supply is particularly important and should primarily come from slow-release organic sources such as blood meal or fish hydrolysate. The amount applied should be adjusted according to the nitrogen concentration in the leaves, ensuring balanced nutrition without over-application.
- Seasonal adjustment: During flowering and fruit set, apply foliar sprays with seaweed extract or humic acids to enhance nutrient uptake and plant resistance. Post-harvest, focus on potassium and organic calcium sources to strengthen plant reserves.

- Circular economy integration: In organic blueberry systems, pruning residues, weeds, and cover crop biomass can be composted on-site and reapplied, reducing dependence on external inputs.

Benefits of Organic Fertilization in Blueberry Cultivation:

- Help maintain the acidic soil conditions that blueberries require.
- Enhance soil microbial activity, supporting natural nutrient cycling.
- Reduce environmental impact by recycling organic matter on-farm.
- Strengthen compliance with organic and sustainable certification standards.
- Improve berry quality, shelf life, and consumer acceptance in export markets.

International Best Practices

United States (Oregon, Washington): Organic blueberry growers widely use fertigation with liquid organic fertilizers (fish hydrolysate, seaweed extracts) applied through drip systems. Fertilizer rates are guided by regular leaf tissue analysis to avoid nutrient deficiencies while keeping soil pH low.

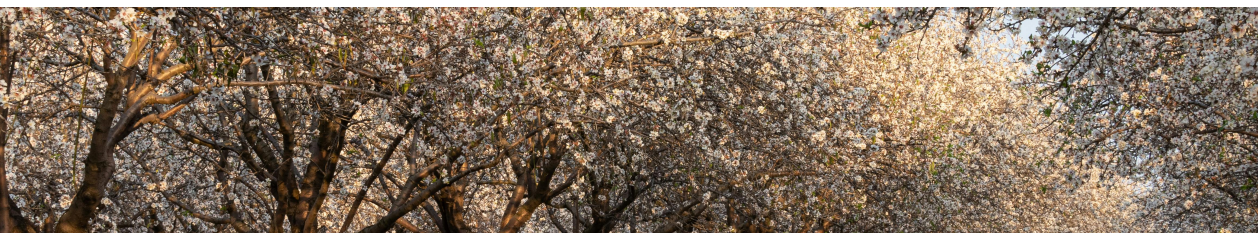
Spain (Huelva region): Farmers integrate fertigation with acidified irrigation water to maintain optimal pH (4.5–5.5) and combine it with composted pruning residues. Cover crops (e.g., clover, vetch) are incorporated as green manure to improve soil organic matter.

Poland: Organic producers apply composted poultry manure and peat-based amendments in spring to sustain nitrogen supply. They rely on mulching with sawdust or pine bark to preserve acidity and enhance microbial activity.

Chile: Growers use slow-release organic fertilizers (guano, bone meal) and combine them with locally produced compost from pruning residues. Fertilization schedules are adjusted in accordance with seasonal growth stages and export quality requirements.

Additional information:

- Additional information can be obtained by visiting the links: [Fertilizing Organic Blueberries](#)





Picture 1-2. High-density orchard establishment (source: [Udabnogroup | www.irta.cat](http://Udabnogroup.com))

High-density almond orchard in Georgia

The Udabno Ltd company, the largest almond producer in Georgia and part of the Adjara Group, manages an extensive almond orchard spanning 2,300 ha. The company cultivates late-flowering varieties of Spanish and Italian origin, including Guara, Soleta, Supernova, and Lauren/Avijor. Committed to sustainable agriculture, the company is transitioning to organic production methods, with the organic certification process already underway. This transition is part of Udabno's broader commitment to regenerative agriculture, which includes significant investments in digital agriculture and advanced irrigation systems to optimize water usage and support sustainable practices.

Funding Opportunities for Almond Orchard Establishment

RDA Grant Program "Plant the Future" supports the expansion of almond orchards across Georgia, providing co-financing for modern orchard establishment, including dwarf rootstocks, drip irrigation, and mechanized harvesting.

This grant helps boost productivity and shorten the return on investment, particularly in strategic regions such as Kakheti and Kvemo Kartli.

Farmers can further enhance orchard viability by combining the grant with Preferential Agrocredit, which provides funding for infrastructure and working assets. Such dual support enables investments in high-density, high-efficiency orchards while reducing upfront costs and financing risks.

International Best Practices

Spain is one of the world leaders in almond production, particularly under semi-arid Mediterranean conditions very similar to Kakheti and Shida Kartli regions in Georgia. Spanish producers shifted towards high-density almond orchards (up to 2,000 trees/ha) with dwarf rootstocks and super-intensive systems.

These orchards provide early yields (within 2–3 years) and allow mechanized harvesting, reducing labor costs. The main lesson: careful rootstock selection for drought tolerance and nutrient-efficient fertigation systems.

Almond growers in California implement precision fertigation and irrigation in high-density orchards to optimize water use, addressing water scarcity and soil salinity issues. Subsurface drip irrigation combined with dwarfing rootstocks ensures both yield stability and environmental sustainability.

Australian almond producers adopt windbreaks and high-density orchards in hot, dry regions. Their practice shows how integrating orchard design with environmental buffers maximizes orchard longevity and minimizes damage from heatwaves: a strategy highly relevant to Kakheti's windy valleys.

WINDBREAK ESTABLISHMENT IN ORCHARDS

Information Sheet

Orchards are highly vulnerable to wind damage, particularly during flowering and nut development. Strong winds can cause shoot breakage, blossom loss, nut/fruit drop, and branch damage, reducing yields and orchard longevity. Establishing windbreaks (whether natural, man-made, or artificial) provides an effective strategy to safeguard orchards and enhance their productivity.

Why windbreaks are needed in orchards

Windbreaks play a crucial role in maintaining the stability, productivity, and long-term sustainability of orchards. They protect trees by reducing wind speed, preventing pollination disruption, nut/fruit drop, and mechanical damage to branches and scaffolding structures. Beyond protection, windbreaks improve the orchard's microclimate by lowering evapotranspiration and conserving soil moisture, key factors for efficient irrigation management.

Windbreaks also contribute to soil conservation by reducing wind erosion and preserving topsoil fertility, particularly in lighter and more erosion-prone soils. Economically, windbreaks help minimize nut losses and tree damage, resulting in higher yields, lower maintenance and replanting costs, and overall improved orchard profitability.

Types of Windbreaks

Natural Windbreaks (Living Barriers): Created by planting rows of tall, fast-growing trees such as cypress, poplar, or eucalyptus (the eucalyptus only suitable in specific western humid regions, with caution) — species well adapted to Georgia's conditions.

Natural windbreaks offer long-term and environmentally friendly protection for almond orchards. In addition to reducing wind speed, they enhance biodiversity by providing habitat for pollinators and beneficial insects, supporting a healthier orchard ecosystem.

Man-Made Structural Windbreaks: Fences or screens made from wood, bamboo, or synthetic panels. Structural windbreaks establish protection much faster than natural tree barriers and can be flexibly positioned according to orchard layout and prevailing wind directions. They are particularly useful in newly established orchards where immediate protection is needed before trees mature.

Artificial Windbreak Nets: Specialized windbreak nets are mounted on poles around the orchards to provide instant protection against strong winds. These nets can reduce wind speed by 40–60% while still allowing sufficient airflow for pollination and ventilation. They are ideal for exposed areas and protecting young seedlings.

How to Establish Windbreaks in Orchards

Windbreak Planning and Management:

Planning: (i) Position windbreaks perpendicular to prevailing winds to ensure optimal protection. (ii) Design spacing to safeguard orchard zones, the protected area typically extends 8–10 times the windbreak height downwind.

Natural Barriers: (i) Establish multiple staggered rows to increase density and wind resistance. (ii) Ensure access for irrigation, pruning, and maintenance.

Artificial Barriers (Nets): Use durable, UV-resistant windbreak nets, ideally 2–3 meters higher than the canopy for maximum effectiveness.

Maintenance: (i) Prune natural windbreak trees regularly to maintain lower-level foliage density. (ii) Inspect nets periodically, especially after storms, and repair any damage promptly.

Key Benefits for farmers

- Reduction in fruit drop and wind-related damage.
- Improved pollination efficiency as bees perform better in calmer microclimates.
- Extended orchard lifespan by preventing mechanical damage.
- Soil and water savings due to reduced evaporation and erosion.



Picture 1. Windbreak establishment in almond orchards, source: <https://www.nutsinc.ge/>

Funding Opportunities for Windbreak Establishment in Almond Orchards

The Preferential Agro-Credit Program by the Rural Development Agency (RDA) supports almond growers in establishing orchards and planting windbreak trees by subsidizing most of the annual interest on agro loans. This reduces upfront costs and increases access to affordable credit, enabling farmers to implement climate-smart orchard practices, protect trees from wind damage, improve long-term productivity, and strengthen competitiveness in regional and international markets.

International Best Practices

United States: In the U.S., particularly in California, windbreaks are integral to orchard conservation planning. They are typically positioned perpendicular to prevailing winds, the sheltered zone extends 10–20 times the windbreak height downwind. Multi-row systems combining evergreen and deciduous species are preferred for year-round shelter, biodiversity benefits, and reduced pest risks. Proper density (about 40–60%) ensures effective wind reduction without turbulence.

Australia and New Zealand: In Australia and New Zealand, windbreaks focus on native, drought-resistant species arranged in two to five staggered rows. Planting orientation often follows a north–south direction to minimize shading of orchard trees. During establishment, adequate irrigation and early pruning are emphasized to achieve rapid canopy closure and uniform density, ensuring long-term effectiveness under strong coastal and inland winds.

Mediterranean Europe (Spain, Italy, Greece): In Mediterranean almond-growing regions, windbreaks protect against hot, dry winds and soil erosion. Common species include cypress, olive, and poplar, planted in semi-permeable rows to allow airflow for pollination while reducing wind speed by up to 50%. Barriers are usually 6–7 meters tall and placed 80–100 meters apart, helping stabilize microclimates and conserve soil moisture.

Chile (Central Valley): Windbreaks protect blueberry plantations from strong Pacific winds. Farmers often use eucalyptus or fast-growing pines in staggered, multi-row arrangements. Barriers are 5–6 meters high and spacing is designed to cover multiple orchard blocks efficiently.

China (Shandong, Liaoning Provinces): Orchards employ mixed-species windbreaks with poplar, willow, and local shrubs. Rows are staggered and designed to reduce sand and dust infiltration in semi-arid regions while maintaining airflow for pollination.

Turkey (Aegean and Marmara regions): Windbreaks for small fruits and berries use cypress, pine, and native shrubs. Multiple rows with varying heights create a gradient barrier that protects from cold northern winds and reduces evapotranspiration during hot, dry summers.

FERTIGATION USING MONO-FERTILIZERS IN BLUEBERRY AND ALMOND PRODUCTION

Information Sheet

Fertigation, the application of nutrients through drip irrigation, is one of the most precise and efficient methods for supplying plants with essential elements directly to the root zone. Using water-soluble mono-fertilizers enables growers to tailor nutrient composition to each crop's developmental stage, enhancing uptake efficiency and minimizing losses.

Blueberries

For blueberries, fertigation precision is especially important due to their shallow, fibrous root system, narrow pH tolerance (4.5–5.5), and continuous demand for nitrogen (N), potassium (K), magnesium (Mg), calcium (Ca), and various micronutrients. Fertilizers such as urea $[(\text{CO}(\text{NH}_2)_2)]$, potassium nitrate (KNO_3), ammonium phosphate, calcium nitrate $[\text{Ca}(\text{NO}_3)_2]$, and magnesium sulfate (MgSO_4) are commonly used to deliver targeted nutrition while avoiding over-application or nutrient antagonism.

In high-tunnel or container systems, where root zones consist of substrates such as peat, cocopeat, or perlite, fertigation becomes even more critical because these substrates have low buffering capacity and require frequent, precisely balanced feeding to maintain optimal growth conditions.

Almonds

For almonds, fertigation with mono-fertilizers is equally beneficial, particularly under Georgia's semi-arid climatic conditions, where precise nutrient management determines both yield and kernel quality. Almond trees have deep but sensitive root systems and specific nutrient demands at different phenological stages.

Applying urea (N), potassium nitrate (K), ammonium phosphate (P), calcium nitrate (Ca), and magnesium sulfate (Mg) through fertigation ensures that each nutrient is supplied at the correct concentration and timing.

This approach enhances nutrient uptake efficiency, reduces leaching losses, and supports balanced vegetative and reproductive development.

Why Mono-Fertilizer Fertigation is Essential in Blueberry and Almond Production

The adoption of mono-fertilizer fertigation systems offers significant agronomic, economic, and environmental advantages for both almond and blueberry producers in Georgia. By enabling precise nutrient delivery through drip irrigation, these systems optimize plant nutrition, improve resource efficiency, and strengthen the resilience of high-value orchard crops under the country's semi-arid and subtropical climatic conditions.

Mono-fertilizer fertigation: The precise application of individual nutrients through drip irrigation—offers significant agronomic, economic, and environmental advantages for both blueberry and almond production systems. These two crops, though distinct in root structure and nutrient dynamics, both require highly controlled, stage-specific nutrition to achieve optimal yields and quality.

Targeted Nutrient Supply: Blueberries and almonds have distinct nutrient demands at each phenological stage. Using mono-fertilizers enables growers to deliver each nutrient independently and precisely, avoiding antagonistic reactions (e.g., Ca–P precipitation) that can occur with compound fertilizers.

Enhanced Nutrient Use Efficiency: Fertigation with mono-fertilizers can achieve nutrient uptake efficiencies of 80–90%, compared to 40–60% typical of conventional soil applications. Nutrients are delivered directly to the root absorption zone, minimizing losses due to volatilization or surface runoff, particularly important for blueberries with shallow root systems and almonds cultivated in semi-arid soils.

Resource and Cost Efficiency: By matching nutrient delivery to real-time crop needs, fertigation reduces total fertilizer use by 15–40% and improves water-use efficiency by 10–30% when integrated with drip irrigation. In blueberries, it also lowers labor requirements and enables rapid correction of deficiencies based on weekly soil or leaf tissue analyses.

Climate-Smart and Environmentally Sustainable: Mono-fertilizer fertigation minimizes nutrient leaching and groundwater contamination, reducing the risk of soil salinization, a growing concern in Georgian orchards with shallow water tables. Moreover, the system supports climate-resilient farming by supplying nutrients and water precisely under drought or heat stress conditions, sustaining productivity even during variable weather patterns.

How to Use Mono-Fertilizer Fertigation in Blueberry and Almond Production

System Setup, efficient fertigation for blueberries and almonds requires a drip irrigation system equipped with fertigation injectors capable of sequential or proportional nutrient injections.

- Separate nutrient tanks should be maintained for calcium, phosphate, and other potentially reactive fertilizers to prevent precipitation (e.g., Ca–P interactions).
- For blueberry container systems, use low-volume emitters (1–2 L/h) to ensure uniform distribution across all pots. Maintain a 10–20% leaching fraction per irrigation cycle to prevent salt buildup in the substrate.
- In almond orchards, ensure even emitter spacing along drip lines for uniform soil wetting across the root zone.
- After each fertigation event, flush irrigation lines thoroughly with clean water to prevent clogging or chemical residue accumulation.

Stage-Specific Nutrient Applications - Nutrient demands in blueberries and almonds vary in accordance with their phenological stages; precise stage-based fertigation enhances productivity, quality, and long-term plant health:

- **Early Growth (Bud Break to Flowering):** Apply urea or ammonium nitrate for nitrogen (N) to promote vegetative growth and use calcium nitrate $[\text{Ca}(\text{NO}_3)_2]$ to improve flower set, strengthen cell walls, and minimize blossom-end or tip burn disorders.
- **Fruit Set to Fruit/Nut Development:** Use potassium nitrate (KNO_3) to enhance fruit size, kernel filling, and sugar accumulation. Apply magnesium sulfate (MgSO_4) to support chlorophyll synthesis and maintain leaf health. Supplement with ammonium

phosphate $[(\text{NH}_4)_3\text{PO}_4]$ to provide phosphorus (P) for energy transfer and early kernel or berry development.

- **Post-Harvest Stage:** Apply a balanced N–K fertigation regime to replenish nutrient reserves, encourage post-harvest leaf retention, root regeneration, and flower bud differentiation for the next season.
- **Container Systems (Blueberries):** Maintain lower nutrient concentrations (EC 1.2–1.5 dS/m) but higher application frequency (daily or multiple short fertigation cycles) to ensure stable root-zone moisture and nutrient levels.

Monitoring and Adjustments - Continuous monitoring is essential to maintain optimal nutrient balance and prevent physiological stress:

- Conduct Leaf tissue and soil/substrate analyses monthly (or biweekly in container systems) to detect deficiencies and guide nutrient adjustments.
- In high-tunnel blueberries, regularly monitor drainage EC and pH to prevent nutrient buildup or root stress.
- Adjust fertigation volumes and concentrations according to rainfall, evapotranspiration rates, and crop growth stage to ensure efficient water–nutrient delivery under changing climatic conditions.

Integration with Complementary Practices - Integrating fertigation with broader soil and water management strategies enhances system performance and sustainability:

- Combine fertigation with composted organic matter or organic mulches (e.g., pine bark, sawdust) to conserve moisture, reduce surface evaporation, and maintain soil structure.
- Schedule irrigation based on evapotranspiration rates to optimize the air–water balance in the root zone and minimize nutrient leaching.
- In orchards, periodic incorporation of organic matter improves soil microbial activity, supporting nutrient cycling and long-term soil fertility.



Picture 1. Blueberry fertigation in Peru (Source: itc.se)

Funding Opportunities for Orchard Establishment

Under the Preferential Agro-Credit Program, the Government of Georgia, through the Rural Development Agency (RDA), subsidizes the dominant share of commercial agro-loan interest for the productive life of new orchards to support the establishment of new almond orchards. The program also offers a credit guarantee scheme covering up to 80% of loan amount, reducing the need for traditional collateral and facilitating farmers' access to finance. During the non-productive years, RDA additionally covers essential orchard management and treatment costs, including the application of mono-fertilizers, ensuring proper tree establishment and supporting the adoption of efficient fertigation and nutrient management practices until the orchard reaches full productivity.



Picture 2. Fertigation in almond and blueberry production with mono-fertilizers (source: [Haifa-group](#))

International Best Practices

California, USA: California, the world's leading almond producer, has extensively adopted fertigation techniques. Studies indicate that over 78% of almond growers in the region utilize fertigation for N application.

This method has enhanced nitrogen use efficiency and reduced environmental impacts. Additionally, a case study revealed that extending fertigation beyond the traditional June 1st cutoff increased yields and reduced nitrogen waste.

Zamora, Spain: In Zamora, Spain, almond growers have successfully implemented fertigation using Haifa Poly-Feed™, a premium water-soluble mono-fertilizer developed by Haifa Group, a global leader in plant nutrition and precision fertigation solutions. The Poly-Feed™ formulations provide balanced nutrients (N, P, K, Ca, and Mg) tailored to different phenological stages of almond trees, ensuring efficient uptake through the irrigation system.

Israel: Israel has conducted extensive research on fertigation in almond orchards. Studies have focused on optimizing nitrogen and potassium application through fertigation, leading to improved almond growth and yield.

Chile (South America): Chilean blueberry farms (especially in the Ñuble and Araucanía regions) use Netafim or Automat fertigation units with 4–6 mono-fertilizer tanks. Calcium nitrate, potassium nitrate, ammonium phosphate, and magnesium sulfate are injected sequentially and adjusted weekly according to leaf tissue analysis. Noteworthy, climate and soil conditions (acidic volcanic soils, 900–1500 mm rainfall) are very similar to western Georgia.

Poland: Polish high-bush blueberry growers apply mono fertigation under low-pH sandy soils using Venturi or Dosatron systems. Programs often include urea + magnesium sulfate early season, potassium nitrate + phosphoric acid during fruiting, and calcium nitrate post-harvest, matching recommendations for Georgia.

Spain (Huelva region, Andalusia): Blueberry fertigation is entirely mono fertilizer based due to tight EC and pH control. Fertilizer tanks A–D: A (calcium nitrate), B (potassium nitrate + magnesium sulfate), C (ammonium phosphate), D (acidifying solution). These models are used in training materials by Netafim and can be directly replicated by Georgian farms.

Additional information

→ Additional information can be obtained by visiting the links: [Optimal Fertigation Techniques - Ensuring Success](#)

BLUEBERRY AGGREGATION / COLLECTION / DISTRIBUTION HUBS

Information Sheet

Blueberry production in Georgia is growing rapidly, but most farms are small (1–5 hectares), making post-harvest handling a critical challenge. Blueberries are highly perishable and can lose quality within 24–48 hours without proper cooling, storage, and packaging.

The lack of affordable pre-cooling, cold storage, sorting, and packaging facilities limits farmers' access to high-value domestic and export markets, forcing many producers to sell locally at low prices or suffer significant losses during transportation. Establishing aggregation and distribution hubs would provide centralized handling, improve quality, reduce losses, and enable smallholders to access lucrative markets more effectively.

Proposed Solution: Regional Aggregation Hubs for Small-Scale Farmers

Establishing regional blueberry aggregation hubs will provide shared access to modern post-harvest infrastructure and services. Each hub will include:

- **Pre-Cooling and Cold Storage Units (0–2°C):** (i) Rapidly reducing the temperature of freshly harvested berries from approximately 25°C to optimal storage levels prevents quality loss and microbial spoilage. (ii) Extends shelf life from 3–5 days under ambient conditions to 2–3 weeks in cold storage, allowing farmers to store produce safely and sell later when market prices are more favorable, improving overall profitability.
- **Sorting and Grading Lines:** (i) Ensures uniform berry size, firmness, and color for export compliance. (ii) Enhances product consistency and branding for collective marketing.
- **Individually Quick Frozen (IQF) Facilities:** (i) Enables value addition through frozen blueberries that retain shape, flavor, and nutrients. (ii) Expands market opportunities by supplying year-round frozen products.

- **Packaging Stations:** (i) Provides access to retail-ready formats (clamshells, MAP packaging). (ii) Reduces losses during handling and transportation.
- **Quality Control and Traceability Systems:** (i) On-site inspection of disease, bruising, or pesticide residues. (ii) Ensures compliance with Good Agricultural Practices (GAP) and EU phytosanitary standards.

Key Operational Benefits

- **Reduced Investment Burden:** Shared facilities eliminate the need for individual farmers to invest capital in equipment.
- **Improved Quality and Shelf Life:** Centralized cold chain reduces spoilage and post-harvest decay.
- **Higher Incomes:** Access to export and frozen markets increases farm-gate prices by 20–40%.
- **Collective Market Power:** Aggregation enables collective negotiation with processors and exporters while maintaining farmer independence.



Picture 1. Cold storage facility for blueberry post harvesting
(source: <https://agrolane.ge/>; <https://www.bluebird.ge/>)

Funding Opportunities - Co-Financing of Processing and Storage Enterprises

The Rural Development Agency's (RDA) "Co-Financing of Processing and Storage Enterprises" program provides targeted financial support to stimulate the establishment and modernization of post-harvest infrastructure.

Under this initiative, beneficiaries receive a one-time grant covering a significant portion of the total investment costs for constructing, renovating, or equipping facilities with essential fixed assets such as cold storage units, sorting equipment, and packaging lines.

Importantly, this grant component works in synergy with the RDA's "Preferential Agrocredit Project," which enables farmers and agribusinesses to access affordable financing. Through this complementary mechanism, the RDA co-finances a large share of annual loan interest rates, significantly reducing the financial burden on investors. Together, the grant and low-interest credit create strong incentives that make long-term capital investments in blueberry aggregation, storage, and processing facilities both feasible and attractive.

International Best Practices

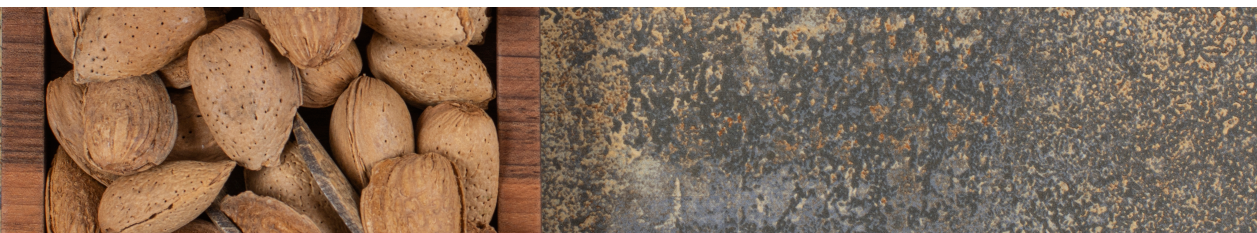
Poland: Farmer-Managed Storage Cooperatives: In Poland, smallholders jointly operate cooperative cold storage centers offering pay-per-use services for cooling, sorting, and packaging. Shared ownership and cost-sharing make modern post-harvest facilities accessible, while collective management strengthens farmers' market position.

Chile: IQF Blueberry Hubs for Export Stability: Chile has developed regional Individual Quick Freezing (IQF) hubs that aggregate fruit from small farms, ensuring consistent supply for export. These facilities provide rapid cooling, freezing, and packaging, reducing losses and enabling off-season sales to international markets.

Spain (Huelva Region): Public-Private Distribution Platforms: In Spain's Huelva region, public-private partnerships (PPPs) support shared packaging and distribution centers linking small growers directly with EU supermarket chains. Integrated sorting, labeling, and logistics services improve efficiency, quality compliance, and export readiness.

Additional information:

→ Additional information can be obtained by visiting the links: [Blueberry calibrating, sorting and packaging](#)



ALMOND AGGREGATION / COLLECTION / DISTRIBUTION HUBS

Information Sheet

Almond production in Georgia is growing, particularly in Kakheti, Kvemo Kartli, and Shida Kartli regions, but post-harvest challenges limit profitability. Most farms are small (1–10 hectares) and lack access to mechanized drying, cracking, sorting, and storage equipment, which requires significant investment.

Consequently, almonds are often sold raw, resulting in lower prices, higher post-harvest losses, and restricted export opportunities. Establishing aggregation and processing hubs would provide centralized infrastructure, improve kernel quality to meet EU standards, extend shelf life, and increase market access for smallholders.

Steps and Equipment Used in Almond Storage and Processing

Efficient almond aggregation and processing hubs rely on a coordinated set of specialized equipment designed to maintain product quality, reduce post-harvest losses, and ensure food safety.

Pre-Cleaning and Grading: The process begins with pre-cleaning, using equipment, such as de-stoners, aspirators, blowers, and mechanical graders to remove dust, sticks, stones, and other impurities from incoming almonds. Size graders and classifiers are then used to separate nuts by size, improving the efficiency of the downstream shelling process.

Hulling and Shelling: After cleaning, almonds enter the hulling and shelling stages. Pre-huller and huller machines remove the outer hull, while shellers or crackers break the hard shell to release the kernel without causing damage. Modern multi-stage systems allow gentle processing and high recovery rates of whole kernels.

Separation and Cleaning: Once the shells are cracked, shell-kernel separators and air aspirators separate kernels from shell fragments. This step is critical for achieving high kernel purity before moving to further processing. Dust and debris removal systems maintain hygienic working conditions.

Blanching, Peeling, and Drying: Depending on product requirements, almonds may be blanched and peeled to remove the thin brown skin (pellice). This involves soaking or steam blanching followed by mechanical peeling. The kernels are then passed through dryers and cooling units to reduce moisture content to safe storage levels and stabilize product quality.

Roasting and Pasteurization: Some processing hubs include roasting or pasteurization stages. Roasting enhances flavor, color, and texture, while pasteurization systems ensure microbial safety and compliance with international food standards, particularly important for export-oriented products.

Sorting and Quality Control: After primary processing, almonds go through grading and optical sorting machines that detect and remove discolored, broken, or defective kernels, as well as foreign materials. These are complemented by metal detectors and manual picking tables to guarantee high quality of product and safety before packaging.

Packaging and Storage: Processed almonds are weighed, packed, and sealed using automated filling and labeling systems. Long-term storage takes place in silos, bins, or temperature- and humidity-controlled warehouses, which help maintain kernel freshness,

prevent pest infestation, and maintain product value for export.

Conveying and Handling Systems: Efficient material flow between stages is ensured by bucket elevators, belt and screw conveyors, and vibratory feeders, which transport almonds gently and minimize mechanical damage. Dust collection and air filtration systems maintain hygiene and safety across the facility.

Value Addition: Optional roasting, blanching, and slicing allow access to higher-value snack and confectionery markets.

Automation and Control: Modern almond hubs often integrate automation, monitoring, and control systems using PLC (Programmable Logic Controller) or SCADA (Supervisory Control and Data Acquisition) technologies. These systems enable operators to monitor performance, energy use, and product flow in real time. Additionally, sampling and laboratory equipment are used to test moisture, aflatoxin, and other quality parameters for traceability and certification.

Operational Benefits

- **Reduced Investment Burden:** Farmers can access professional-grade equipment without bearing the full individual upfront costs.
- **Increased Market Access:** Premium kernels for domestic and EU markets can fetch 30–50% higher prices.
- **Lower Post-Harvest Losses:** Centralized drying and storage reduce losses from mold, pests, and spoilage.
- **Quality Standardization:** Enables compliance with export and food safety regulations.

Funding Opportunities - Co-Financing of Processing and Storage Enterprises

The Rural Development Agency's (RDA) "Co-Financing of Processing and Storage Enterprises" program provides targeted financial support to promote the establishment and modernization of post-harvest infrastructure.

Under this initiative, beneficiaries receive a one-time grant covering a significant portion of total investment costs for constructing, renovating, or equipping facilities with essential fixed assets such as cold storage units, sorting equipment, and packaging lines.

Importantly, this grant component works in synergy with the RDA's "Preferential Agrocredit Project," which enables farmers and agribusinesses to access affordable financing. Through this complementary mechanism, RDA co-finances the large share of annual loan interest rates, significantly reducing the financial burden on investors. Together, the grant and low-interest credit create strong incentives that make long-term capital investments in almond aggregation, storage, and processing facilities both feasible and attractive.

International Best Practices

California, USA: Centralized Almond Processing Plants: In California, centralized hulling and shelling facilities allow smallholders to deliver raw almonds for uniform processing, ensuring consistent kernel quality and compliance with export standards.

Spain (Valencia and Andalusia): Farmer-Owned Cracking Cooperatives: Farmer cooperatives operate shared cracking and processing centers, which reduce individual investment costs while improving efficiency and product consistency for small producers.

Turkey (Anatolia): Regional Drying and Cracking Centers: In Anatolia, regional centers provide shared drying, shelling, and storage infrastructure, enabling smallholders to access domestic and international markets with minimal individual capital investment.

Additional information:

- Additional information can be obtained by visiting the links: [Almond Processing: Pre-Cleaning, Hulling/Shelling & Processing \(in California\)](#)

alternative collateral mechanisms for loans.

Access to finance and markets: Develop gender-sensitive credit lines, business development services, and market linkages tailored for women farmers.

Skills and technology: Provide vocational education, training on modern agricultural techniques, greenhouse management, crop production, and access to machinery and digital platforms.

Care and social infrastructure: Expand childcare, transportation, and health services to reduce time poverty and enable women's economic participation.

Inclusive decision-making: Ensure women's participation in cooperatives, village committees, and policy design to amplify their voices and agency.

Success Story



Picture 1. Mzevinar Shanidze showcasing her strawberry harvest, source: [EU NeighboursEast](#)

Ms. Mzevinar Shanidze, a farmer from Guria, illustrates how women-led agricultural enterprises can succeed despite systemic barriers. She runs a thriving strawberry business, employing modern production techniques and selling produce to local and regional markets.

Although the land was not registered in her name, the legal landowner formally authorized her to operate the strawberry business, and this agreement was documented through a notary-issued certificate, providing the necessary legal assurance for her activities.



Picture 2. Ms. Shanidze's Greenhouse and Harvest

In the early stages, Ms. Shanidze made several mistakes due to limited technical knowledge and experience with strawberry cultivation. She emphasizes that access to practical guidance, market information, and initial production support, covering planting, greenhouse management, and crop care, was crucial to her success.

Ms. Shanidze's experience shows that, even when formal land ownership is limited, women can successfully manage productive farms through flexible family agreements formalized with official recognition, creating a legitimate and practical pathway to operate without legal obstacles. Her journey also underscores the critical importance of early-stage support, access to technical knowledge, training, and market guidance, which can help women avoid common initial mistakes, improve productivity, and accelerate the growth of their agricultural enterprises.

Conclusion

Empowering women in agriculture is essential for rural development, poverty reduction, and sustainable food systems in Georgia. Structural challenges, such as land ownership disparities, caregiving responsibilities, limited technical knowledge, and market access, persist, but success stories such as Ms. Shanidze's show the transformative potential of women-led initiatives when supported with appropriate training, resources, and programmatic flexibility. Holistic interventions that address social, economic, and cultural barriers can ensure women are not only participants but leaders in agricultural growth.

On behalf of:



Federal Ministry
for the Environment, Climate Action,
Nature Conservation and Nuclear Safety



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Disclaimer

This publication has been prepared in the framework of the project 'Promoting Green Deal Readiness in the Eastern Partnership Countries' (PROGRESS), which is implemented on behalf of the International Climate Initiative (IKI) of the Federal Government of Germany. Within the Federal Government, the IKI is anchored in the Federal Ministry for the Environment, Climate Action, Nature Conservation and Nuclear Safety (BMUKN). Selected project is also the responsibility of the Federal Foreign Office (AA). PROGRESS is implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, as the lead agency, in partnership with the Organisation for Economic Co-operation and Development (OECD), the Regional Environmental Centre for the Caucasus (REC), the European Business Association (EBA) Moldova and the Institute for Economics and Forecasting of the National Academy of Sciences of Ukraine (IEF).

Published by:

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

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Programme/project description:

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

On behalf of

Federal Ministry for the Environment, Climate Action, Nature Conservation and Nuclear Safety (BMUKN)

Tbilisi, Georgia, 2026

Photo source:

Produced by Freepik.

Website:

<https://progress-eap.org>

