AgWest FARM CREDIT

Industry Perspectives

Almonds

This Industry Perspective was prepared by AgWest Farm Credit's Almonds and Pistachios Industry Team.
Please direct questions and comments to CustomerFeedback@agwestfc.com

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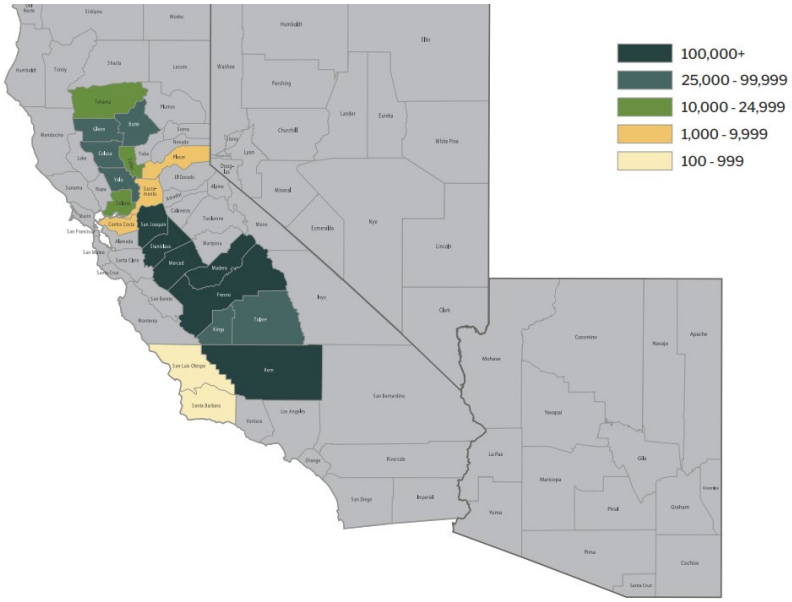
Introduction

Almonds grow in Mediterranean climates, which feature temperate weather with hot, dry summers and mild, wet winters. The U.S. is the largest producer of almonds with 77% of global production. Australia follows at 11%, Europe 9% and Turkey 2%. Almonds are the largest specialty crop in the U.S. and represent California's largest agriculture export product. Commercial almond production in the U.S. is almost exclusively concentrated in California. Production is concentrated in the Central Valley, primarily from Kern County up to San Joaquin County.

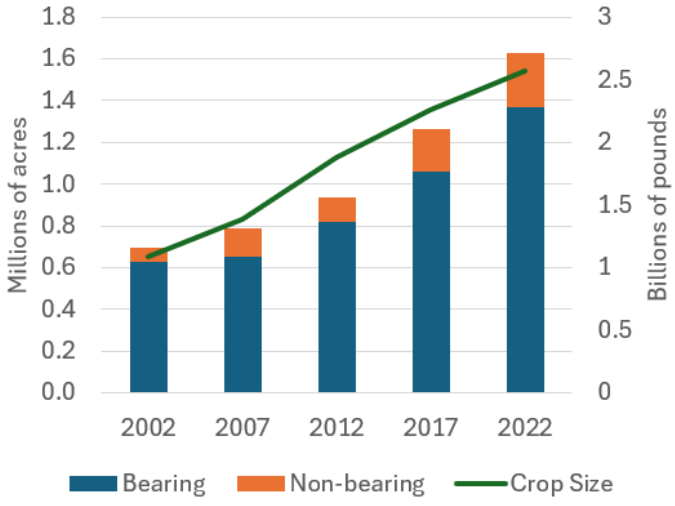
West Coast almond acres by county, planted acres in AgWest territory



Source: USDA NASS. Census of Agriculture, 2022.

Almond acres have more than doubled over the last 20 years, with the most gains occurring in the last 10 (see chart below). With more acreage has come higher production levels.

Almond acres and production



Source: USDA NASS. Census of Agriculture, 2022. California Almond Board.

Varieties

There are 13 main varieties of almonds in California, the most prized of which are nonpareils due to their soft-shell, attractive and medium size kernel, uniform shape, smooth surface and light-colored skin. Many other varieties have been developed as nonpareil pollinizers. Some of these share similar characteristics as nonpareils (including the Sonora, Independence and Supareil varieties), while others have a wide range of kernel shapes and sizes. The latter group is broken out into two types, Mission and California:

- **Mission** (varieties include Butte, Padre, Butte/Padre, Fritz, Mission, Ruby and Marcona). These varieties feature small, short and plump kernels with wrinkled surfaces and dark brown skin that are often marketed for natural roasted, salted and candy/chocolate applications.
- **California** (varieties include most Mission varieties as well as Carmel, Monterey, Wood Colony, Aldrich, Price, and Winters, among others). These varieties have a wide range of kernel shapes and sizes with wrinkled surfaces and brown color. Initially established as input feedstock for manufacturing processes, they are commonly used in snack products and can be sliced, slivered, roasted, salted and/or flavored.

Research on new varieties is ongoing and often focuses on developing self-pollinating trees that produce nuts similar in quality to nonpareils. Self-pollinating trees do not require pollen from other varieties to set nuts and can simplify horticulture operations. Two examples of this include Independence and Shasta varieties. One of the biggest challenges in this research is matching the quality characteristics of nonpareil nuts.

Primary almond varieties

Variety	Kernel	Shell	Type	Percentage of California's crop
Nonpareil	Medium size, flat shape, smooth surface	Soft, light color, high suture opening	Nonpareil	41%
Monterey	Large size, long narrow shape, deeply wrinkled surface	Hard, smooth surface, low suture opening	California	18%
Independence	Medium size, flat shape, smooth surface	Soft, light color, high suture opening	Nonpareil, California	14%
Butte/Padre	Small, short, wide and rounded, wrinked skin	Hard, good integrity, very low suture	California, MIssion	4.5%
Wood Colony	Medium size, narrow shape, slightly wrinkled surface	Soft, good integreity, fair suture opening	California, Mission	4.2%

Source: California Almond Board. True California. Arar.

Value chain

Growth and harvest

It takes about 3-4 years to produce nuts and another four to reach full production. The economic life, or the period in which an almond orchard is at or above break-even levels, ranges from about years 7-25.

The lifecycle of an almond tree depends on tree and rootstock variety, soil and cultural management practices (irrigation, fertilization, pest control and pruning). Rootstocks are grown in a nursery for a year and transplanted to the orchard from late spring to early summer at a spacing based on variety and site conditions. A young almond shoot or twig is then budded or grafted on. Some producers use a plant-in-place method where rootstocks are planted in the orchard and subsequently grafted. The process of grafting/budding specific almond cultivars onto rootstocks maximizes and/or ensures uniformity of crop characteristics, nutrient uptake, vigor, branching, anchorage, timing for crop maturity and bloom, and pest control. Multiple varieties are planted within an orchard to support pollination. Some almond varieties are not compatible with certain rootstocks. For instance, the Independence variety has shown to not be compatible with the Krymsk 86 rootstock. UC Davis provides a list of available rootstocks with their associated characteristics.

Trees are dormant between November and January, reach bloom and pollination between February and March, grow nuts between March and June, experience hull split in July, and are ready for harvest between August and October.

- **Dormancy**: Trees lose their leaves and store nutrients. Growers remove remaining nuts to minimize pest presence. Buds begin to swell towards the end of this period.

- **Bloom and Pollination**: Almond trees are bee pollinated, which improves the consistency of nut set over wind pollinated tree nuts such as pistachios and walnuts. Excessively cool and/or wet weather can delay bloom, damage flowers and/or slow pollination.
- **Growing**: Almond kernels grow, shells harden and irrigation begins as precipitation levels drop. Excessive heat during the summer can increase water requirements and/or stunt crop growth.
- **Hull Split**: Almond hulls split, allowing the kernels to begin drying. At this stage, trees become susceptible to a common pest called the Navel Orangeworm.
- **Harvest**: Almonds are mechanically harvested using a shaker, allowed to dry on the ground and picked up using a mechanical sweeper. Rain during harvest can increase costs and lead to mold and concealed damage.

Processing

Once harvested, almonds are sent to one of two types of processing facilities:

- **Hullers** preclean almonds and remove their hulls, creating an 'in-shell' product.
- **Hullers/shellers** preclean, hull and remove almond shells, creating a 'shelled' product.

Both facility types have low to medium processing capacity and are generally located within 30 miles of orchards. The extent of precleaning depends on harvest activities and is designed to remove debris such as dirt, pebbles, twigs and other unwanted materials. On average, field weight generates 13% debris, 50% hulls, 14% shells and 23% clean almond flesh and bits, though these ratios can vary quite a bit. The equipment used is extensive and may include screw conveyers, bucket elevators, (vibrating) screens, designers (removes large materials), retriggers, air stream systems, hulling cylinders, and shear rollers, among other types. Hulls are sold for cow feed, though significant research is underway to find higher value uses.

Hullers generally grade, sort and ship in-shell almonds directly to markets or warehouses. Hullers/shellers send shelled almonds to larger, regional based facilities called **handlers** who further process them into various final products based on USDA standards and customer specifications. Such products include whole almonds, meal/flour, defatted flour, almond butter, almond milk, slices/flakes, slivers/halves, diced/chopped, almond paste and almond oil. Almonds not immediately sold into the market will be stored in climate controlled, insulated warehouses until they're needed. Due to their low water and high oil content, almonds can store for over two years.

Processing and packaging technology has made significant progress. Automated processes reduce labor demand and allow for more uniform products, as well as facilitate sorting by size, shape, color and defects.

Cooperatives, brokers and traders

It is common for almond growers to process, market and sell their crops via cooperatives, or business organizations owned by grower members. Cooperatives can form at various levels of the value chain and better enable small farms to reach markets, direct research and connect with consumers. The largest cooperative is Blue Diamond Growers, which is owned by over half of the almond growers in California. Brokers and traders can act as a bridge between cooperatives, manufacturers and/or retailers and provide services such as repackaging and custom processing to meet the needs of certain markets.

Manufacturers and retailers

Almonds lend themselves to a vast array of products. Once packaged, whole, sliced or flaked almonds can go straight to retailers where they are sold to consumers. Alternatively, these and other products can head to manufacturers who process/incorporate them into confectionery, snack, bakery and dairy goods, which are then sold by retailers. The diversity of products means that consumers can find almonds throughout retailers' shelf space, including fresh produce, baking ingredients, snack bars and beverages.

Research increasingly shows that almonds are a healthy food choice due to their high protein and healthy fat content. Marketing efforts by **The Almond Board of California** are helping to increase consumers' awareness of this.

Drivers

Nutritional content and product diversity

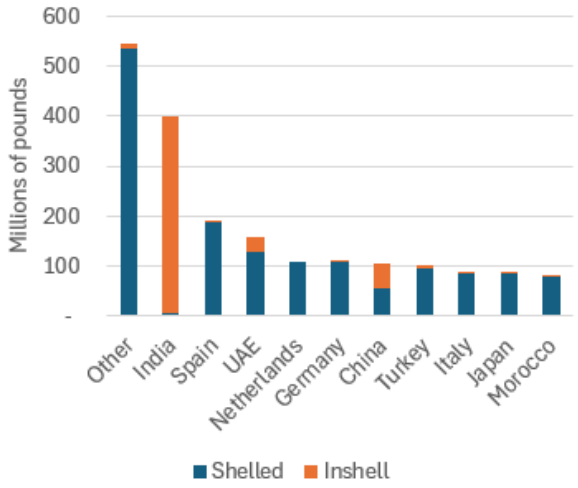
Perhaps the biggest advantage almonds have is their high protein, mineral and monounsaturated fat content. Extensive research over the years has shown it is among the healthiest food items available, supporting heart health, weight management, blood sugar, exercise recovery and skin health. The industry leverages this research to appeal to health-conscious consumers both domestically and abroad. Further, their physical properties allow almonds to be processed into a wide range of products including snacks, baking ingredients and beverages. They are often marketed as a vegetarian

and/or healthier alternative to conventional food items. Current research is focused on finding new, high value uses for almond hulls and results are promising.

International markets

California exports approximately 70% of its almond production to a wide array of countries (see chart below). India has a long history of nut consumption and is by far the largest foreign market; however, it only takes inshell nuts due to its government's financial support for domestic processing. Europe and Turkey are large importers despite also producing a total 11% of global production.

Almond exports by destination country, 2023 crop



Source: Almond Board's July 2024 Crop Position Report. "Other" includes about 80 other countries.

Bearing and non-bearing acres

Almond acreage has increased more rapidly than demand over the last decade, resulting in a sharp decline in prices and profitability over the last several years. Anecdotal reports and emerging data suggest that growers are no longer planting new acres. While production levels may increase over the next year or two as non-bearing acres begin to produce, the industry is likely at/near peak levels. This should support prices moving forward.

Technology

Technological advances in the almond industry are driven by the need to maximize labor, monetary and natural resources while increasing yields and productivity.

Producer

GPS and variable-rate technologies for fertilizer and water applications continue to gain acceptance among producers. Greater oversight over water management is leading to the increased adoption of digital irrigation systems.

Drone use continues to expand, improving the availability and quality of data for orchard managers. An array of camera and sensor options provide detailed analysis for soil, moisture, erosion and temperature conditions. Adoption of drone technology will likely increase in the coming years as producers increase focus on precision agriculture.

Processing facilities

Packing-line technology has expanded over the last several years to include sorting technology to detect internal defects, color and size, along with robotic palletizing and improved automated bagging machines. These technological advances serve as labor-management tools.

New sorting technology provides the ability to deliver high-quality products to the consumer while minimizing human error. Cameras and sophisticated software programs replace human defect sorting with machine defect sorting. Precise sorting technology allows processors to capture the highest possible returns for producers.

Packing technology comes at a significant cost. However, labor shortages are pressuring warehouses to adopt the technology. The elimination of human sorters on the front end of the packing line often reduces labor needs by 30-40% at the warehouse. However, the savings from cutting labor costs are generally offset by increased fixed costs associated with building modifications to accommodate larger lines and increased depreciation costs.

Diversified production

Many almond growers opt to diversify production into pistachios and walnuts.

Pistachios

The U.S. produces about 63% of the world's pistachios, with California making up about 99% of this amount (orchards are located primarily between Kern and Merced Counties). Iran and Turkey produce 15% each, followed by Syria at 5% and Europe at 3%. Pistachio trees have deep root systems and thrive in high-desert, arid climates. The main varieties are Kerman, Golden Hills, Lost Hills, Randy and Peters, though differences among them are slight and often not noticeable.

The value chain of pistachios (planting, production, sorting, packing, storing and marketing) operates similarly to almonds; however, peeling, drying, salting and roasting require different processes and equipment. Trees require 5-6 years to produce, 10 years to break even and 10 or more to reach full production. Pistachio orchards have a long economic life, or the amount of time in which they are financially viable, that can reach as high as 70 or more years depending on site conditions and management practices. Pistachios are considered very healthy and are sold whole (open inshell, closed shell or kernels) for processing into snacks, baking ingredients and beverages. About 80% of pistachios are exported, with top markets including China at 33%, Germany 11%, Turkey 7%, Spain 4%, Vietnam 4%, India 4% and Italy 3%.

See our **Pistachios Industry Perspective** for more information.

Walnuts

China produces 51% of the world's walnuts, most of which are consumed domestically. The U.S. follows at 28%, Chile 7%, Europe 5%, Ukraine 4% and Turkey 4%. In the U.S., most walnut production is north of the main pistachio growing areas. While walnuts are grown throughout the Central Valley in California, orchards are concentrated further north around Stockton and Yuba City. There are many varieties with distinct characteristics including Chandler, Hartley, Howard, Tulare, Serr and Vina.

The value chain of walnuts operates similarly to almonds, but with some differences in process and equipment required for harvesting and processing. In particular, walnuts require drying for up to 24 hours to remove moisture and prevent deterioration. Trees become productive between years five and seven and can last as long as 35 years. While walnuts are also considered a healthy food item, unlike almonds and pistachios they are generally not consumed whole but rather as ingredients in candies, cereals and baked goods. As such, the overall market is much smaller. About 70% of walnuts are exported, with top markets including Turkey at 29% of total, Germany 17%, Italy 12%, United Arab Emirates 9% and Japan and Korea each at 8%.

Appendix A

Best practices

The following summarizes the best practices common among successful and progressive tree nut growers, packers/shippers and marketers. These primarily relate to issues of production and warehousing.

Orchard production best practices

Have a strategic plan.

- Successful businesses have defined goals and continuously develop and execute on business strategies, which may include diversification, replication, integration, networking, downsizing/rightsizing or intensifying (i.e., improving efficiency).

Increase gross revenue per acre.

- Growers increase gross revenue through a combination of reaping high yields, producing desirable nut varieties and peaking on a demanded size profile. A desirable varietal mix and high-yielding orchard structure will continue to be critical to competitive top-line revenues.

Contain expenses.

- Growers manage fixed expenses, which allows for lower break-even levels.
- Focusing on orchards of an economic size is key to long-term cost competitiveness.

Diversify varietal mix.

- Growing multiple varieties stretches out the harvest season and smooths out production levels.

Mitigate risk.

- Successful growers diversify, when possible, by cultivating crops in differing geographic areas to hedge against widespread weather-related adversity.
- Growers use available risk-management tools, such as crop insurance, to mitigate the risk of adverse and unforeseen events that could drastically affect the business. Crop insurance options include three variations of coverage: production based, revenue based and named peril. Most producers use some combination of these products to tailor a protection strategy that matches the specific safety needs of their business.

Align with fellow growers.

- Growers may partner with other growers to leverage volume discounts for equipment, chemicals, fertilizers, fuel and other necessary inputs.

Have a labor-management strategy to secure and retain a skilled, adequate labor supply.

- Small and medium size growers often use custom harvesting companies given the high cost of specialized equipment.
- Producers have begun planting across different geographies to help alleviate labor shortages during peak harvest times.
- Larger producers are able to move labor forces from one orchard to another over larger geographic areas to ensure the labor force is retained.
- Many producers are successfully using the H-2A Temporary Agricultural Workers program. Although somewhat expensive, the program provides a feasible solution to labor needs.

Maintain accrual financial statements and use enterprise accounting.

- Successful operations use accrual-based reporting to assess true financial position and performance. These growers also use enterprise accounting to assess profitable and unprofitable business units, or orchard blocks.

Maintain a sound financial position.

- Orchardists with strong liquidity and lower leverage are able to absorb market down cycles and take advantage of strategic opportunities.
- A business should assess the adequacy of its financial position annually by using tools like financial ratios, peer financial benchmarks and historical trend analyses.
- Sensitivity analysis may also be used to give an accurate picture of the true financial position of the business given possible adverse scenarios.

Huller, huller/sheller and warehouse best practices

Have a strategic plan.

- Successful businesses have defined goals and continuously develop and execute on business strategies, which may include diversification, replication, integration, networking, downsizing/rightsizing or intensifying (i.e., improving efficiency).

Maximize facility use.

- Maximize the use of fixed assets to lower per-unit costs, which enables warehouses to maintain competitive grower returns.

Contain expenses.

- Understand fixed and variable costs to maintain competitive processing and packing charges and maximize income levels.
- Cost containment allows facilities to reduce the level of throughput needed to break even in short crop years.
- Break-even analysis is valuable for understanding and predicting earnings based on various throughput levels at the warehouse.
- Sensitivity analysis may also be used to give an accurate picture of the true financial position of the business given possible adverse scenarios.

Embrace new technology.

- New technologies, which increase capital costs, help to reduce labor needs. This could lead to more consistent operations and lower per-unit costs.

Align with growers.

- Packing warehouses align with growers to ensure their targeted product throughput.

Provide new value-added processes.

- When working with retailers, value-added processes may prove to be a competitive differentiator. Such processes include inventory management, labeling, traceability programs, promotions and other value-enhancing activities.

Maintain a sound financial position.

- Warehouses with strong liquidity and lower leverage are able to weather adversity and take advantage of strategic opportunities.
- A business should assess the adequacy of its financial position annually by using tools such as financial ratios, peer financial benchmarks and historical trend analyses.
- Stress case scenarios may also be used to give an accurate picture of the true financial position of the business.

Appendix B

Glossary

Bloom. A period of time that starts with the pink set and ends with petal fall about 10 days later. 'Full bloom' is defined as the day that 60% of 'king blossoms' are open on the north (shady) side of the tree.

Bud. Found in the axils (the upper angle between a leaf stalk or branch and the stem or trunk from which it is growing), a bud is basically a dormant and compressed shoot, which given the right conditions will resume growth.

Cambium. The thin layer of tissue, often green or greenish yellow, between the bark and the wood on a tree. It is important to line up the cambium in grafting between rootstock and scion.

Central leader. A tree where the main branch goes straight up the center.

Clonal rootstocks. Clonal rootstocks are vegetatively propagated. Degree of size control and anchorage varies among dwarfing rootstocks.

Clone. A genetically identical group of plants derived and maintained from one individual by vegetative propagation.

Cold hardiness (**hardy**). The ability of plants to withstand cold injury (autumn-winter).

Cold storage. A form of refrigerated storage.

Cross pollination. Pollen moving from one flower to another, on the same plant or among flowers on different plants. Pollen moved between different plants often results in fruit that is different from either parent (i.e., a hybrid of the two).

Cultivar. A plant variety that has been produced in cultivation by selective breeding.

Dormant. The inactive or sleeping state in which a plant stops growing but is still alive.

Drip irrigation. Watering through soaker hoses or emitters placing water at plant bases on the soil surface; least wasteful method of watering.

Drip line. The rough circle that may be drawn on the ground around a tree where rain would drip off the outermost leaves. The most active roots are often located along this line.

Frost damage. Cold-temperature injury during a stage of the growing season. Parts affected are flower buds, flowers and young fruit (spring), or near-mature fruit or other tissues (fall).

GLOBALGAP. An internationally recognized set of farm standards dedicated to Good Agricultural Practices (GAP). Through certification, producers demonstrate their adherence to GLOBALGAP standards. For consumers and retailers, the GLOBALGAP certificate is reassurance that food reaches accepted levels of safety and quality, and has been produced sustainably respecting the health, safety and welfare of workers and the environment, and in consideration of animal welfare issues. Without such reassurance, farmers may be denied access to markets.

Grafting. A way to propagate a plant by inserting a section of one plant (the scion) into another plant (the stock).

Handler. Facilities that receive semi-processed almonds from hullers and/or huller/shellers. Handlers are often set up as cooperatives and manage relationships with, and distribution to, buyers. Handlers will either sell almonds whole, or conduct further processing based on market demand.

Hardiness. Ability of a plant to withstand temperature extremes; usually refers to cold hardiness.

Huller and huller/sheller. Facilities that remove the hulls and/or shells of almonds, the initial processing stage. Afterwards, almonds are typically transported to handlers who then sell them whole or conduct further processing.

Internodes. A part of a plant stem between two of the nodes from which leaves emerge.

Organic certification. Verifies that a farm or handling facility complies with USDA organic regulations. This certification allows the holder to sell, label and represent products as organic. Farms all over the world may be certified to the USDA organic standards. Most farms and businesses that grow, handle or process organic products must be certified.

Pollination. The transfer of pollen from the male part of flowers (the anthers) to the female part (the stigma). Poor pollination results in a small nut crop.

Processing. Nuts that are not sold whole are processed (slices, flour, etc.) and sold into a variety of markets.

Pruning. The removal of living canes, shoots, leaves and other vegetative parts of the branch.

Rootstalk. Sometimes called “stock,” this is the root system (plant) propagated from seed (seedling) or vegetatively, as common in clonal rootstocks, on which various cultivars are budded or grafted. Many rootstocks are used and possess traits that relate to anchorage, size control, tolerance of light and heavy soils, “wet feet,” specific nematodes and other plants and diseases.

Scion. A detached stem, usually dormant, used in asexual propagation by grafting techniques. The scion is the actual nut variety, which is grafted onto root stock.

Set. The amount of blossoms or fruit/nuts held on the tree.

Shoot. Wood that is usually not over one or two years old and is longer than the short, stubby spur growth.

Spur. A short shoot with compressed internodes. Spurs grow from two-year or older branches and produce flowers.

Sucker. A cane that emerges from below the bud union, and therefore comes from the rootstock rather than from the variety grafted onto it. On other plants, a sucker is any unwanted, fast-growing, upright growth from roots, trunk, crown or main branches.

Sunburn. The damage caused by the hot summer sun on the branches, “cooking” and destroying the bark and tissues.

Thinning. Removal of flower clusters, immature clusters or part of immature clusters. (See also ‘blossom thinning.’)

Training. Certain practices that are supplementary to pruning and necessary for shaping the vine.

Variety. Variety and ‘named variety’ are commonly used to mean the same as ‘cultivar.’ Technically, variety means a naturally occurring variant of a species.

Vigor. Refers to the amount and rate of growth; relative among cultivars, climates and horticultural practices.

Whole. Nuts are minimally processed (hulled and shelled) and sold primarily into snack markets.