CROP REPORT PLUS *Series*

MONTEREY COUNTY AGRICULTURAL COMMISSIONER

Economic Contributions of

Monterey County Agriculture

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of Monterey County

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Commissioner's Letter

I am pleased to share **Economic Contributions of Monterey County Agriculture**. This report takes an important step beyond the Crop Report our department publishes each year. Instead of stopping at crop production values and acreage, it quantifies agriculture's total economic contributions through production, local processing, employment, and economic multiplier effects. In short, this report uses twenty-first-century economic tools to document agriculture's broader role in sustaining a thriving local economy.

The new study shows that in 2018, agriculture contributed a total of $11.7 billion to the county economy. This far exceeded the $4.3 billion figure from our 2018 Crop Report. It also marked a 43.6% increase from the $8.1 billion total in a similar report we published in 2015, based on data from 2013. Agriculture also supported 57,503 direct employees, which represented 22.8% of Monterey County's total employment, or about one out of every five jobs.

In addition, this report documents exceptional diversification within agriculture, which has implications for countywide economic resiliency. Finally, the study explores scenic beauty, wildlife habitat, wildfire protection and more than a dozen other non-market services that agricultural lands provide to society, with a rough estimated value ranging from $4.7 billion to $10.9 billion per year. Confirming and refining this initial estimate would require significant further research.

Agriculture has a long tradition in Monterey County. For more than a century, it has been a pillar of our economy and culture. With this report, we renew our commitment to sustaining that tradition well into the future.

Respectfully submitted,

Henry S. Gonzales
Agricultural Commissioner/Sealer

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published June 2020

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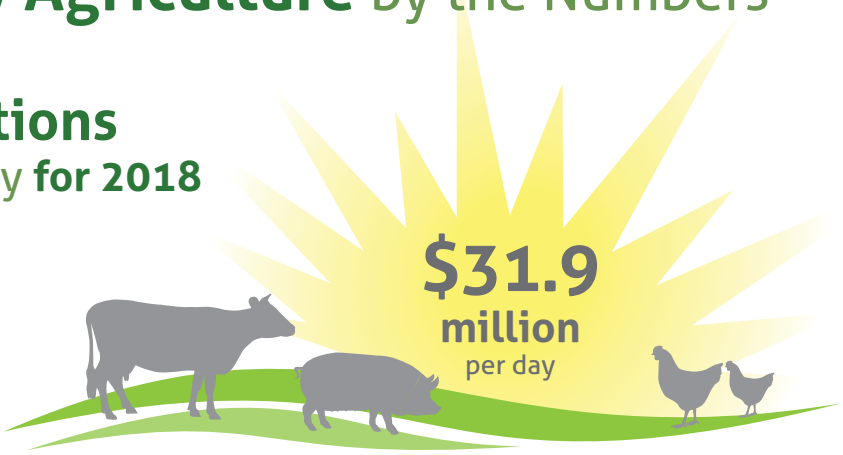
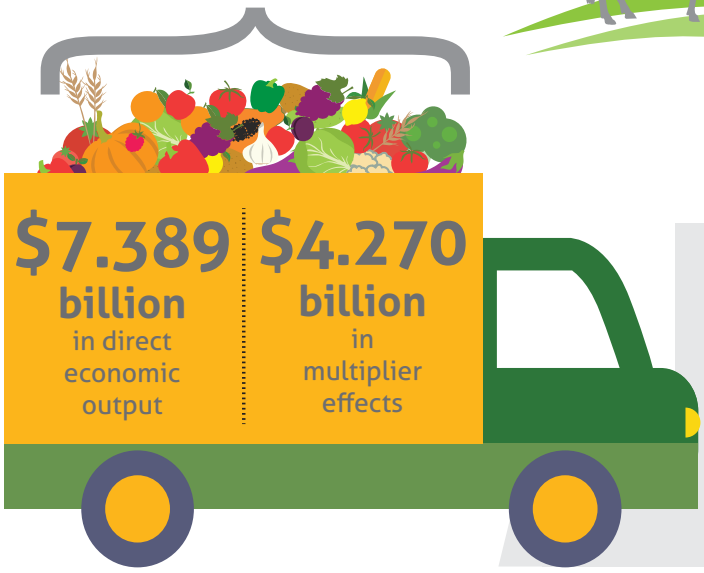
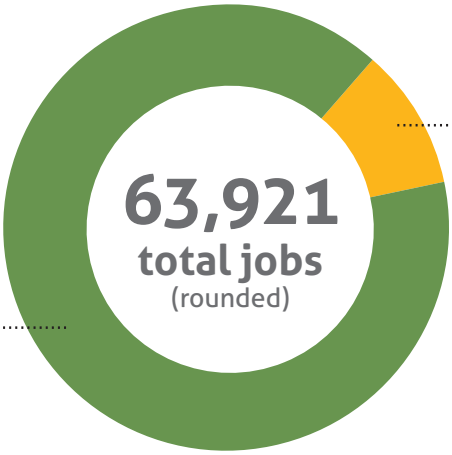
$11.659 billion
Monterey County Agriculture's total contribution to the local economy





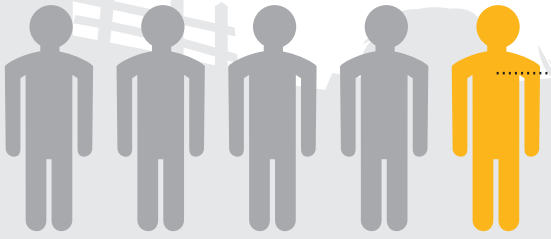
$4.7 to $10.9
billion
per year in
Ecosystem Services

Employment Effects
of the Agricultural Industry
for 2018



57,503
direct employees

6,417
additional jobs attributable to multiplier effects: expenditures by agricultural companies and their employees



ONE in five
jobs in Monterey County directly attributable to the agricultural industry

Introduction

In 2012 and 2015, we produced research reports that examined not just crop production values, but also wider economic contributions such as local food processing, employment and multiplier effects. Those documents generated tremendous positive responses, providing detailed assessments of agriculture's role in sustaining a healthy local economy. This document updates and expands upon those original reports.

Like before, we used multiple data sources and advanced economic modeling techniques to analyze agriculture's total contribution to the Monterey County economy. As with the 2015 report, this one also measures diversification within agriculture, which has implications for economic resilience. Finally, the new report explores ecosystem services provided by agricultural lands. Overall, the findings offer important information for policy makers, the public and anyone who values a vibrant and resilient local economy.

Our Approach

A *basic industry* is one that sells most of its products beyond the local area and thus brings outside money into local communities. Agriculture easily qualifies as a basic industry in Monterey County. Calculating a reasonable range of economic contributions by a basic industry entails quantifying three economic areas: 1) *direct* economic effects; 2) *indirect* economic effects; and 3) *induced* economic effects. This report covers all three, then explores a fourth area, ecosystem services, starting on page 14.

Direct economic effects include farm production, local processing, and their related employment. *Indirect* effects consist of local inter-industry, business-to-business supplier purchases. *Induced* effects reflect local consumption spending by employees. The **Multiplier Effects** section on page 5 explains this further.

To understand the furthest economic impacts of agriculture, one would also need to assess agricultural-related costs to society, such as net impacts on water and other natural resources. While important, these impacts lie beyond the scope of this study.

Our calculations draw from local and national data sources. The local sources include industry experts and the annual Monterey County Crop Report produced by the office of the Agricultural Commissioner and Sealer of Weights and Measures. The main national data source is IMPLAN, a widely used economic modeling program (see www.implan.com).

Originally created for the U.S. Department of Agriculture (USDA), IMPLAN uses econometric modeling to convert data from more than a dozen federal government sources into local values for every U.S. county and zip code, across 546 industry sectors. Because IMPLAN draws from multiple sources, including the latest USDA Census of Agriculture, its employment and economic output numbers often differ from those reported by individual state and federal agencies.

Except where otherwise noted, all figures are from the year 2018, the most recent IMPLAN dataset available. Where appropriate, we adjusted sector names for clarity and applied coefficients to IMPLAN values to reflect unique Monterey County conditions. Please contact the authors for additional details on the methods used.

Direct Effects of Monterey County Farm Production

This section focuses on the simplest measures of economic activity: production and employment. It describes total farm production and the number of agricultural jobs.

PRODUCTION

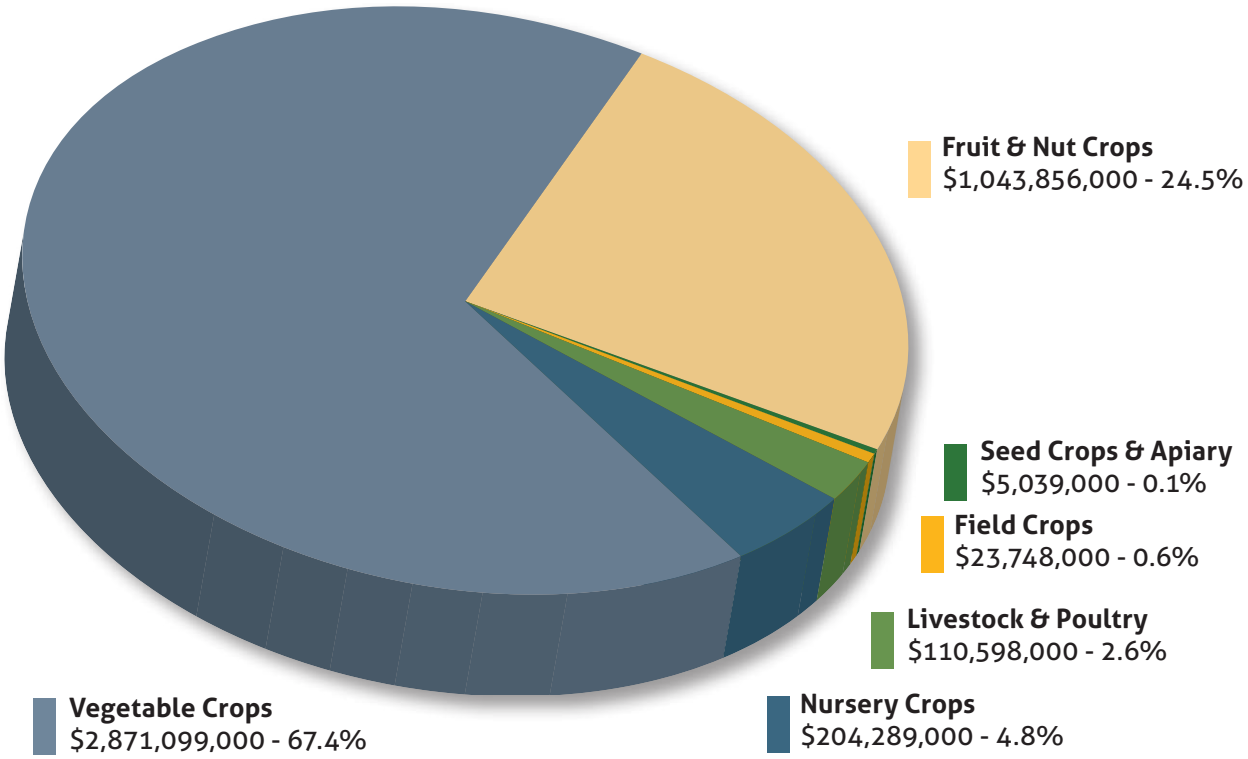
Figure 1 shows the various categories that made up Monterey County's farm production value. At $2.871 billion, Vegetable Crops was the single largest production category by dollar value, comprising 67.4% of the county total. Leaf lettuce dominated this category at $733.2 million, followed by head lettuce ($459.5 million), broccoli ($388.9 million), and cauliflower ($209.3 million).

At 24.5%, Fruit & Nut Crops represented the second largest category ($1.044 billion). Strawberries led this category with $698.5 million in production, followed by wine grapes at $247.8 million. These two categories, Vegetable Crops and Fruit & Nut Crops, accounted for 91.9% of all production.

The combined, total dollar value for all products rose a rounded $224.9 million over the previous decade (5.6%), from $4.034 billion in 2009 to $4.259 billion in 2018. Total values do not reflect net profit or loss experienced by individual growers or by the industry as a whole. Interested readers are encouraged to consult the Office of the Agricultural Commissioner's 2018 Crop Report for additional details on specific products and their value.

Figure 1. Distribution of Monterey County Farm Production

Source: 2018 Crop Report, Office of the Monterey County Agricultural Commissioner/ Sealer.



EMPLOYMENT

How many people work in agricultural production? In 2018, IMPLAN data indicate that agricultural production directly employed 27,293 people in Monterey County.[1] This figure encompassed a wide range of production-related jobs, including not just growing and harvesting, but also sales, marketing, and many other roles. It did not include food processing jobs, which are discussed on page 7. Nor did it include Monterey County's many public sector jobs in agriculture, across a wide range of local, state, and federal agencies.

Multiplier Effects of Monterey County Farm Production

This section quantifies the economic ripples that farm production creates in the local economy. These ripples take two forms: *indirect effects* and *induced effects*. The first consists of business-to-business supplier purchases. For example, when a grower buys farm equipment, fertilizer, pesticides, seed, insurance, banking services, and other inputs, the grower creates *indirect effects*.

The second ripple type, *induced effects*, consists of consumption spending by owners and employees of agricultural businesses and their suppliers. They buy groceries, housing, healthcare, leisure activities, and other things for their households. All of this spending creates ripples in the local economy.

Although agricultural companies and their employees certainly spend money in other counties, this study only reflects those expenditures that occur within Monterey County. Quantifying expenditures outside the county would be a complex effort that lies well beyond the scope of this report.

Figure 2 shows agriculture's *direct*, *indirect*, and *induced* economic effects within the county for major production sectors. The numbers use IMPLAN multipliers for each sector, which are rooted in the most recent U.S. Bureau of Economic Analysis input-output models.

Figure 2. Economic Effects of Monterey County Farm Production

Dollar values are in $ millions. Figures are for 2018 and come from IMPLAN and U.S. Bureau of Economic Analysis, with adjustments for local conditions. Not all columns and rows add exactly due to rounding.

FARM PRODUCTION	Output Effects ($ Millions) Direct	Indirect	Induced	TOTAL
Vegetable & Melon Farming	$2,878.3	$1,144.8	$743.7	$4,766.8
Fruit Farming	$1,044.3	$301.8	$321.8	$1,667.9
Support Activities for Agriculture	$588.3	$35.7	$252.2	$876.3
Greenhouse, Nursery & Floriculture	$204.4	$62.2	$45.4	$312.1
Cattle & Other Animal Production	$107.8	$43.8	$26.7	$178.3
All Other Crop Farming	$19.9	$7.5	$7.5	$34.9
Grain Farming	$3.9	$0.8	$1.7	$6.4
TOTAL ECONOMIC OUTPUT	$4,846.9	$1,596.7	$1,399.0	$7,842.7
	Employment Effects (# Jobs) Direct	Indirect	Induced	TOTAL
TOTAL EMPLOYMENT	27,293	3,164	2,024	32,481

[1] The total is lower than the 2015 study because we reclassified most of the employment in IMPLAN's "Support Activities for Agriculture" sector as "Light Processing of Fruits & Vegetables." For details, see **Figure 3** and its associated text.

Note that sector names and production values in **Figure 2** differ from the county's annual report. They closely follow a standard classification system used nationwide called the North American Industrial Classification System (NAICS), as adapted by IMPLAN. Each NAICS/IMPLAN category has an explicit definition.

NAICS and IMPLAN also combine familiar products in unfamiliar ways. For example, they put the county's hay crop (alfalfa & oat) under "All Other Crop Farming" and the county's pollination services under "Support Activities for Agriculture." They also spread the county's seed production across multiple sectors such as "Grain Farming" (bean seeds) and "Vegetable and Melon Farming" (e.g., broccoli, cauliflower, corn, cucumber, and other seeds).

The following list helps bridge NAICS and IMPLAN sectors with familiar Monterey County commodities listed in the annual Crop Report:

- **Vegetable & Melon Farming:** Anise, Artichoke, Asparagus, Bok Choy, Broccoli, Brussel Sprout, Cabbage, Carrots, Cauliflower, Celery, Chard, Cilantro, Garlic, Herbs, Kale, Leeks, Lettuce, Mushrooms, Napa Cabbage, Onions, Parsley, Peas, Peppers, Radicchio, Radish, Rappini, Spinach, Spring Mix, Squash, Misc. Vegetables;
- **Fruit Farming:** Avocados, Citrus, Blackberry, Grapes, Lemon, Raspberries, Strawberries, Misc. Fruit;
- **Support Activities for Agriculture:** Pollination, Soil Preparation, Planting, Cultivating, Harvesting;
- **Greenhouse, Nursery & Floriculture:** Bedding Plants, Cut Flowers & Foliage, Orchids, Poinsettias, Potted Plants, Vegetable Transplants, Misc. Nursery Products;
- **Cattle & Other Animal Production:** Cattle & Calves, Stockers, Sheep, Lamb, Hogs, Wool, Misc. Livestock & Poultry Products;
- **All Other Crop Farming:** Alfalfa Hay, Oat Hay, Pastureland, Rangeland;
- **Grain Farming:** Barley, Beans, Pasture, Wheat, Misc. Grain Crops.

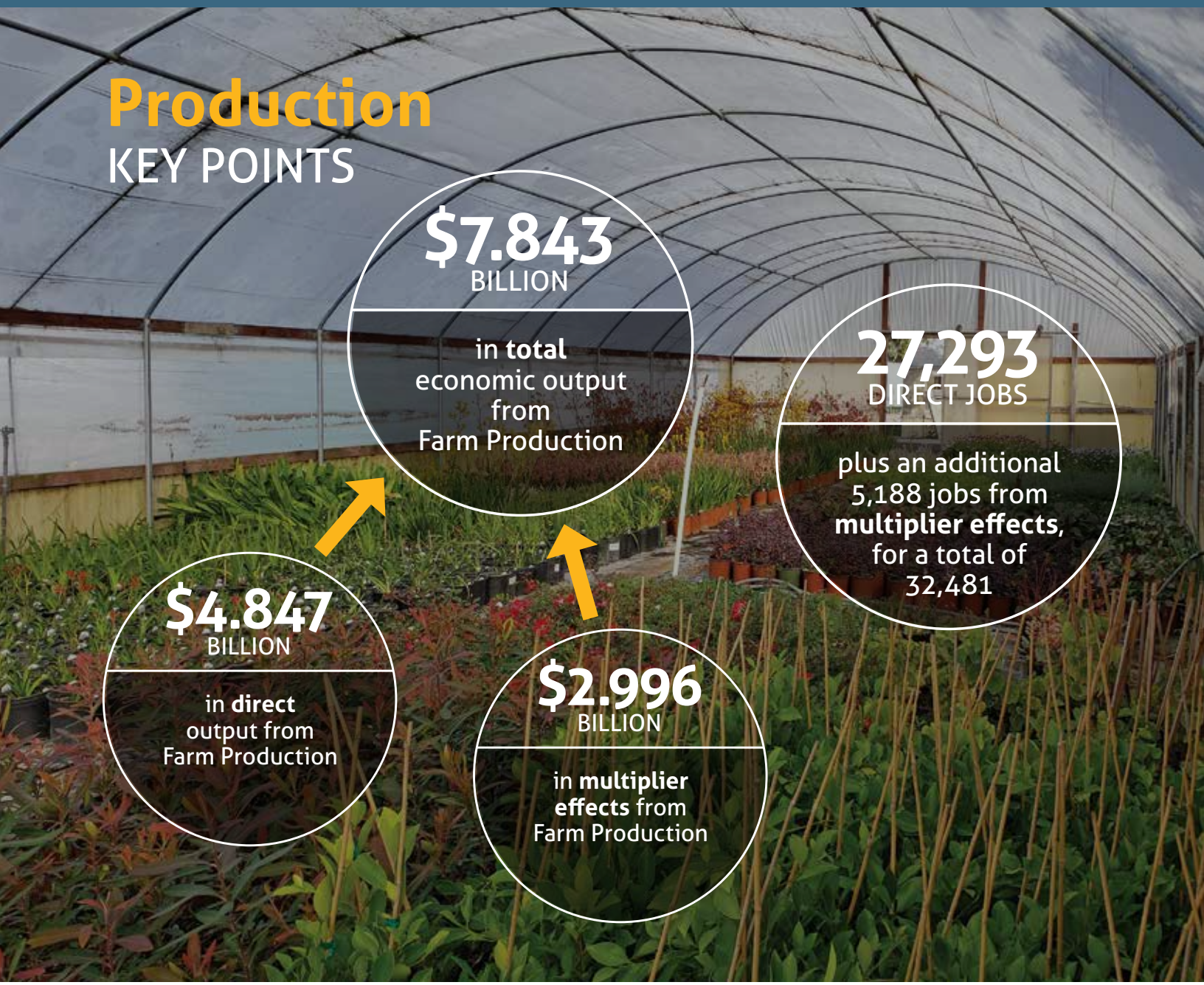
Each sector has distinct multipliers. Monterey County "Vegetable & Melon Farming," for example, had a 2018 *indirect effects* multiplier of 0.3977 and an *induced effects* multiplier of 0.2584. This means that each dollar's worth of direct output generated an extra 40 cents in supplier purchases, plus 26 cents more in consumption spending by owners and employees of agricultural businesses and their suppliers.

Multipliers change every year, for each sector and county, reflecting where companies and employees spend their money. In general, *multipliers for Monterey County agriculture are high compared to other California counties*. This likely reflects the fact that agricultural companies can purchase many of their supplies from vendors located within the county, and, despite many long-distance commuters, most agricultural employees live in Monterey County and spend their money there.

Sectors have unique multipliers not just for economic output, but also for employment. Monterey County "Fruit Farming," for example, supported 6,099 direct jobs plus an additional 523 *indirect effects* jobs and 359 more from *induced effects*. The bottom row of **Figure 2** shows combined employment figures across sectors.

Because IMPLAN's methodology differs from that of the county's annual agriculture survey, the total 2018 direct production value in **Figure 2** ($4.847 billion) differs slightly from the $4.259 billion reported in the 2018 Monterey County Crop Report. The total also differs from the figure reported in our 2015 study. The latter difference stems partly from industry growth, but mostly from reclassification of many "Support Activities for Agriculture" into a new category, "Light Processing of Fruits & Vegetables," which is described in **Figure 3** and its associated text.

Production
KEY POINTS



Locally Sourced, Value-added Food Processing

Farm production tells only part of the story. Monterey County is home to several food processors that play a key role in the local economy. This section estimates the economic value of local food processing. It is neither an exact science nor a full assessment, but rather gives the reader a basic overview of the topic.

Like previous studies, we avoid overstating the numbers by only including food manufacturers and sectors that fit two strict criteria: 1) they use mostly local agricultural inputs; and 2) they are unlikely to exist here without the presence of the associated agricultural sector. Many processing facilities would not operate in Monterey County were it not for the abundant supply of fruits, vegetables and other raw agricultural products.

Based on these strict criteria, we excluded IMPLAN food and beverage sectors that other studies often include.[2] For example, Monterey County produced $516.4 million in spices, bread, tortillas, pastries, ice, soft drinks, tea, coffee, and related food items. Their production directly supported an estimated 1,747 jobs. Adding these sectors could overstate the value of local agriculture, including its employment and multipliers.

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[2] See, for example: 1) Sexton *et al.* 2015, "The Economic Impact of Food and Beverage Processing in California and Its Cities and Counties"; and 2) "The Measure of California Agriculture, Chapter 5" by the U.C. Davis Agricultural Issues Center (2009).

We also took precautions to avoid double-counting. For example, we did not factor wine grape production into this section because the Farm Production section already captures the dollar value of wine grapes. We only calculated the dollar value that wineries add to wine grapes by producing wine. The same applies to leafy greens and other vegetables that undergo light processing into value-added products.

Figure 3 shows the economic effects of locally sourced, value-added food processing. Like the previous section, sector names generally follow the NAICS and IMPLAN classification system with adjustments for Monterey County context.

Figure 3. Economic Effects of Locally Sourced, Value-added Food Processing

Sources: IMPLAN and U.S. Bureau of Economic Analysis data, with input by local industry experts. Columns and rows may not compute exactly due to rounding.

FOOD PROCESSING	Output Effects ($ Millions) Direct	Indirect	Induced	TOTAL
Light Processing of Fresh Fruit & Vegetables	$2,061.5	$219.3	$803.4	$3,084.2
Wineries	$404.9	$139.2	$66.6	$610.7
Frozen Fruits, Juices & Vegetables Manufacturing	$41.2	$17.9	$6.6	$65.7
Meat & Other Animal Products	$28.1	$14.0	$4.9	$46.9
Canned Fruits & Vegetables Manufacturing	$6.7	$2.0	$0.7	$9.3
Miscellaneous Other Food Processing	$3.1	$0.8	$0.3	$4.1
TOTAL ECONOMIC OUTPUT	$2,545.3	$393.1	$882.5	$3,820.8
	Employment Effects (# Jobs) Direct	Indirect	Induced	TOTAL
TOTAL EMPLOYMENT	30,210	613	616	31,439

The largest sector by far, "Light Processing of Fresh Fruits & Vegetables" in **Figure 3**, reflects post-harvest value added to the county's abundant produce, especially leafy greens. New for this report, and as mentioned earlier, this sector captures portions of IMPLAN's "Support Activities for Agriculture" sector that involve the sorting, grading, cleaning, and packing of fresh produce, including when those activities occur in the field during harvest. It also encompasses portions of the NAICS/IMPLAN sector "All Other Food Manufacturing" which contains fruits and vegetables that are cut, peeled, and turned into perishable foods such as salad mixes and other ready-to-eat and ready-to-use refrigerated products. That sector also accounts for the county's small amount of honey production and processing of seeds for propagation.

"Wineries" in **Figure 3** reflects the value added to the county's $247.8 million wine grape crop. A unique combination of climate, soils, and other factors supports over 340 vineyards producing more than 30 different grape varietals across 44,000 acres. An estimated 50% of wine grapes leave the county for value-added work elsewhere.

Of the county's 82 licensed wineries, roughly 72 actively make and sell wine. Viticulturalists (experts who grow grapes) collaborate with winemakers to produce quality wines, paying attention to *terroir*—the combination of soils, topography, and other physical factors that can affect the wine's character. Many wineries add extra value by hosting tastings, weddings, and other events.

Processing
KEY POINTS

$3.821 BILLION
in **total** economic output from Food Processing

$2.545 BILLION
in **direct** output from Food Processing

$1.276 BILLION
in **multiplier effects** from Food Processing

30,210 DIRECT JOBS
plus an additional 1,229 jobs from **multiplier effects**, for a total of 31,439

As the name suggests, "Frozen Fruits, Juices & Vegetables Manufacturing" encompasses the processing of local produce into frozen products, for example, bags of vegetables or berries. Other produce, especially vegetables, goes into cans and jars, as reflected in "Canned Fruits & Vegetables Manufacturing."

"Meat & Other Animal Products" includes the small amount of meat processed locally. The overwhelming majority of the county's cattle go to auction, then leave the county for finishing and processing at Harris Ranch and other locations outside the county. California's only USDA-inspected Mobile Harvest Unit (MHU) is based ten miles outside the county, in Paso Robles, and can serve local ranchers.

The catch-all category "Miscellaneous Other Food Processing" reflects a broad range of niche products. Examples range from dried & packaged fruits and vegetables, to olive oil and roasted nuts, to a local dairy that produces artisanal milk, cheese, and yogurt. The county's many farmers' markets offer a direct outlet for some of these niche products.

This category also incorporates a small portion of the county's $15.9 million in "Breweries" output. Hops production is slowly returning to Central Coast counties, making it possible to brew beers that are truly fresh and local, rather than relying on hops imported from the Pacific Northwest and Germany. A farm in Royal Oaks, for example, grows a dozen different varieties and supplies several local breweries.

Total Economic Contributions of Monterey County Agriculture

The previous sections have provided key pieces to an economic puzzle. This section combines those puzzle pieces into a final picture showing the overall economic effect of Monterey County agriculture.

As **Figure 4** shows, the total 2018 economic contribution of Monterey County agriculture was $11.659 billion. This consisted of $7.389 billion in combined, direct output from production and processing, plus $4.270 billion in multiplier effects.

The $11.659 billion in total 2018 output marks a 43.6% increase from the $8.118 billion figure in our 2015 report, which was based on 2013 data. It also represents a 41.2% increase from the $8.255 billion figure in our 2012 report, based on 2009 data.

For perspective, agriculture pumped *over thirty-one million dollars per day* into the county economy during 2018 ($31,943,580 to be exact). That equated to $1,330,982 per hour and $22,183 per minute. This marks an increase from the 2015 report when the figures were, respectively, $22,242,162 per day, $926,757 per hour, and $15,446 per minute.

The $7.389 billion in direct output represented 19.7% of the county's 2018 total economic output of $37.500 billion, or nearly one out of every five dollars. This represents a slight increase from the 18.5% figure reported in both previous studies.

Total agricultural employment covered in the scope of this study was 63,921. This included 57,503 jobs directly in agriculture and another 6,417 attributable to multiplier effects. The 57,503 direct agricultural jobs represented 22.8% of Monterey County's total employment of 251,699, or about one out of every five jobs.

Compared to the two earlier studies, the 2018 direct employment of 57,503 represented a 27.4% rise over the 2009 level of 45,140 and a 3.2% increase from the 2013 level of 55,702. As we have seen with other California counties, local employment attributable to multiplier effects has declined over time. A combination of factors likely drives this phenomenon, led by century-long trends toward increased globalization and mechanization.

Figure 4. Overall Economic Effects of Monterey County Agriculture

Columns and rows may not compute exactly due to rounding.

Type of Effect	Direct	Indirect	Induced	TOTAL
FARM PRODUCTION				
Output Effects ($ Millions)	$4,846.9	$1,596.7	$1,399.0	$7,842.7
Employment Effects (# Jobs)	27,293	3,164	2,024	32,481
LOCALLY SOURCED, VALUE-ADDED FOOD PROCESSING				
Output Effects ($ Millions)	$2,542.2	$392.3	$882.1	$3,816.7
Employment Effects (# Jobs)	30,210	613	616	31,439
TOTAL VALUE OF AGRICULTURAL INDUSTRY				
Output Effects ($ Millions)	$7,389.2	$1,989.1	$2,281.2	$11,659.4
Employment Effects (# Jobs)	57,503	3,777	2,640	63,921

How Resilient is Agriculture to Economic Shocks?

Like growers and ranchers everywhere, Monterey County agricultural producers face a long list of risks. Prominent examples include droughts, floods, crop pests and diseases, food safety-related outbreaks, new regulations, new competitors, labor availability and cost, price drops, and rising costs for fuel, equipment, and other inputs. Any one of these risks can deal a damaging blow. When combined, they can undermine not just an individual operation, but an entire industry.

What's the best way to lower these risks? Opinions vary, but most emphasize product diversification. From the old adage, "don't keep all your eggs in one basket" to the advice that modern financial planners give, diversity tends to create stability.

A growing body of research supports this conventional wisdom. The more diversified a local economy is, the better it protects economic growth and employment during economic shocks. It's a complex topic, though, with many factors in play and much research yet to be done.

This raises the question: How economically diversified is Monterey County agriculture? Does the county have low agricultural diversity, likely increasing its risk to economic shocks? Or is agriculture highly diversified, implying a stronger economic buffer?

To answer this question, we calculated the Shannon-Weaver Index for Monterey County agriculture. Created in 1949 for military code breaking, the Shannon-Weaver index is widely used by economists, ecologists, and others interested in quantifying diversity. Different versions of the basic Shannon-Weaver formula exist. What they all have in common, though, is that they quantify not just the number of different items—such as characters in a coded message, species in a rainforest, or crops grown in a county—but also their relative evenness or abundance.

Figure 5 portrays this relationship. County "A" and County "B" both grow the same number of crops and have the same total value of that production. But County "A" has a low index, near zero, because 91% of production concentrates in a single crop. Any shock to that crop could devastate the agricultural economy.

County "B" depicts the opposite. Production perfectly balances across all crop categories. Each crop type contributes 10% of the total. This gives County "B" a strong buffer against economic shocks.

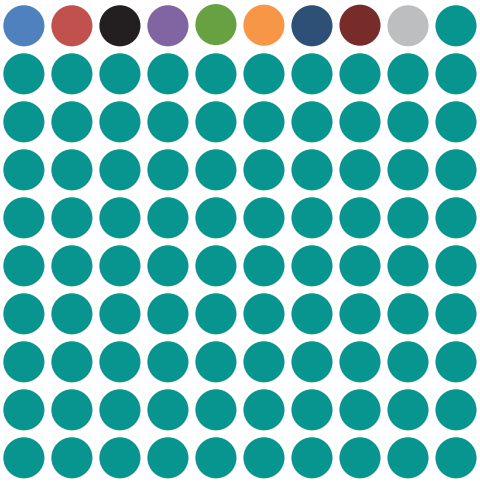
Figure 5. Agricultural Diversification is More Than Just the Number of Products

The two fictitious counties have identical agricultural products and total revenues, but diversification gives County "B" a stronger buffer against economic shocks

County "A"

10 products, $100 million

MINIMUM diversification



County "B"

10 products, $100 million

MAXIMUM diversification

SHANNON-WEAVER INDEX

How exactly does one calculate the Shannon-Weaver Index for agriculture? The main steps were: 1) created a comprehensive list of agricultural products and their production values; 2) removed forty-three minor, outlier products that had production values less than 0.25% of the county total, such as alfalfa, avocados, barley, beans, hogs, honey, lambs, oats, onions, sheep, squash, tomatoes, wheat, and many floricultural products; 3) entered the data into the Shannon-Weaver formula; and 4) converted to a 1.0 scale, which has become popular over recent years. For additional details, please contact the authors.

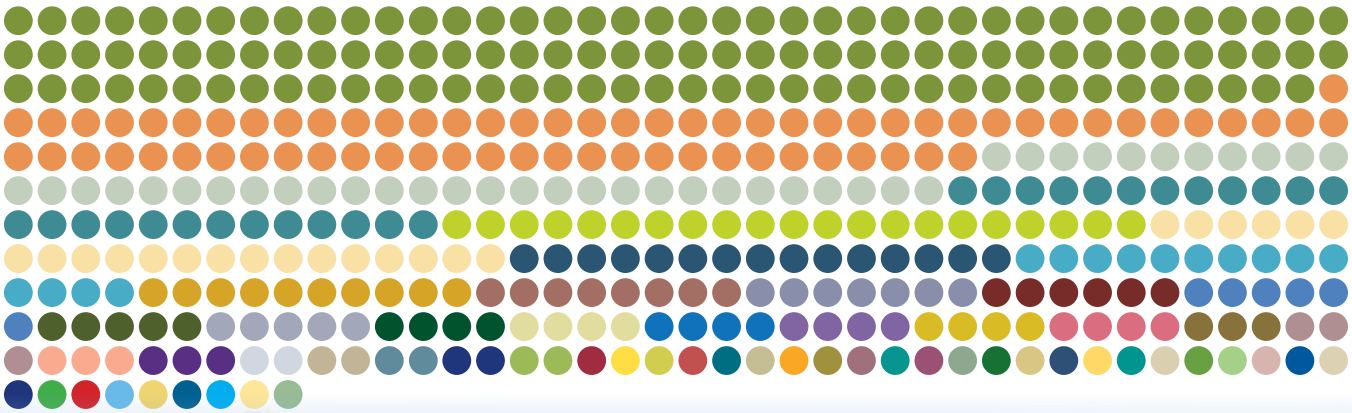
For 2018, the Shannon-Weaver Index for Monterey County's agricultural industry was **0.61**.

What exactly does this number mean? For starters, getting the highest index, a perfect 1.00 on a scale from 0.00 to 1.00, would require the impossible: produce all seventy-two of California's major commodities and have farm gate values equally distributed across them. In such a case, the hypothetical county in **Figure 5** would show seventy-two rows instead of ten, each row a different color and identical length. No single county could accomplish this.

Over the past decade, Monterey County has consistently produced thirty-five major commodities. The relative contribution of individual commodities varied during this period from 0.25% of the county's total farm gate value (the minimum threshold for this analysis) to 35.4% of the county total. **Figure 6** depicts their most recent relative contributions.

Figure 6. Relative Distribution of Monterey County Agricultural Commodities

Colored circles represent approximately $10 million each and depict major agricultural commodities' relative contributions to Monterey County's total 2018 farm gate value. Commodities less than $10 million in value are depicted with a single dot (Source: 2018 Monterey County Crop Report)



At first glance, Monterey County's resulting index of 0.61 seems near the middle of the 0.00 to 1.00 range. But the Shannon-Weaver formula includes a logarithmic function, which complicates interpretation. The logarithm makes the scale exponential, like the Richter Scale that measures earthquakes. Many Californians understand that a 7.4 earthquake releases twice the energy of a 7.2 earthquake even though the numbers are not far apart. The same principle applies here.

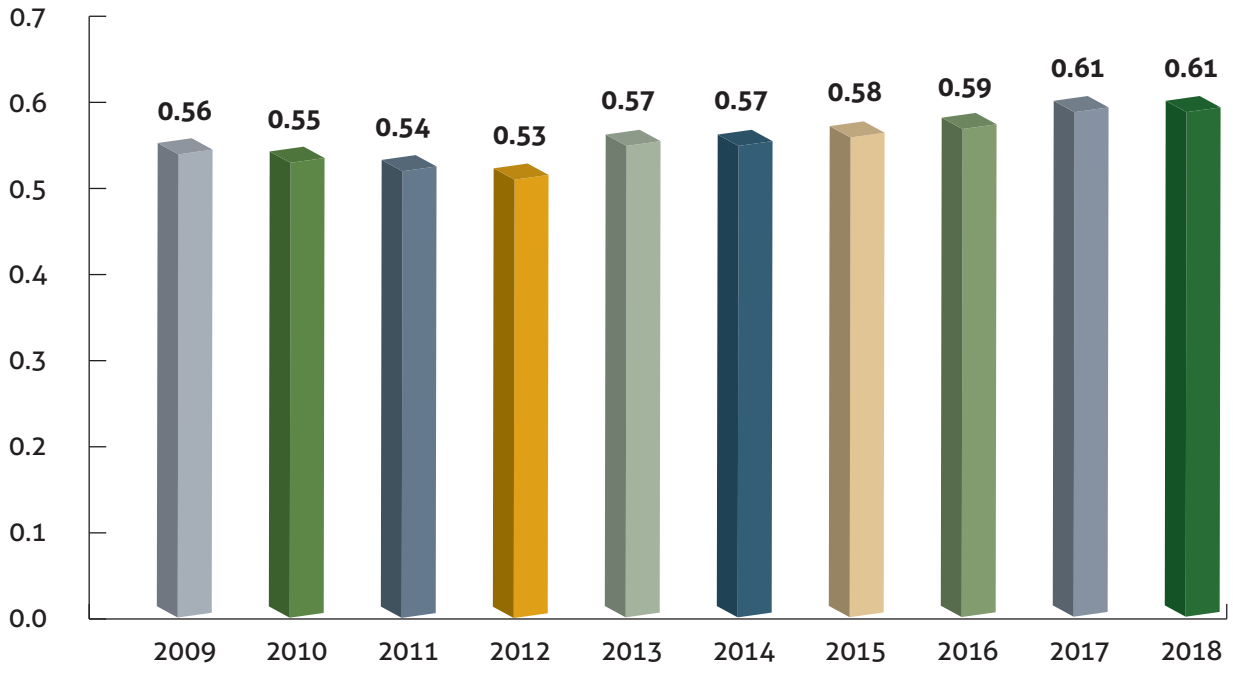
The 0.61 index is quite high compared to the twenty other California counties we have analyzed thus far. It likely suggests exceptional protection from economic shocks. Validating the extent of that protection would require stress testing, i.e. modeling specific shocks to see how they affect the industry. For now, it is clear that Monterey County agricultural production is both diverse and well distributed across types.

How has the Shannon-Weaver Index changed over time? Has agriculture become more diversified in Monterey County, or less so? **Figure 7** shows the Shannon-Weaver Index for the past decade. The main thing to note is consistent, high diversification across years. Despite a dip around 2011 and 2012 for a strawberry boom, agriculture's economic resiliency has held steady for ten years. In fact, the index has risen over time and now stands at an all-time high. This contrasts with the downward trend in many California counties that have become dependent on one or two major products.

Changes over time underscore the importance of a strong, diversified production base. For example, from 2010 to 2011, several of the county's largest product categories experienced notable declines. Examples include spinach (-30.3%), spring mix (-30.0%), wine grapes (-18.5%), and cauliflower (-88.1%). Strawberries and lettuce also dropped. But the county's strong diversification buffered the negative effects. Artichokes, cabbage, carrots, celery, kale, mushrooms, orchids, raspberries, beef cattle, and other commodities increased for 2011. Thus, what could have been a double-digit drop for the county was cushioned to a 3.8% overall decline.

Figure 7. Ten-year Trend in Monterey County Agriculture's Economic Diversification

*An indicator of economic resilience, the **Shannon-Weaver Index** quantifies diversification by combining the number of different commodities produced and their relative economic value.*



Ecosystem Services from Agricultural Lands

Monterey County agricultural lands produce more than the items people can easily buy or sell. Local growers and ranchers also provide open space, wildlife habitat, carbon storage, and many other benefits to society, including protection from wildfires. Often called ecosystem services, these benefits have significant value but are poorly understood and rarely counted.

This section helps raise awareness about the topic. It provides a general overview of ecosystem services, then explores three main questions:

- What types of ecosystem services occur on Monterey County agricultural lands?
- How can we best quantify the dollar value of these ecosystem services?
- What is an initial estimated range of their annual value in Monterey County?

WHY IS THIS IMPORTANT?

In recent decades, thousands of articles and books have described ecosystem services and their importance. The term generally refers to goods and services provided by natural and modified ecosystems that benefit, sustain, and support the well-being of people.

As one might expect, protected natural areas—for example, Point Lobos State Preserve and the Ventana Wilderness—tend to provide the highest value. But even city parks and highly modified agricultural landscapes deliver nature-related benefits to people.

PAYMENTS FOR ECOSYSTEM SERVICES

A key challenge is that most ecosystem services are hard to see and measure. Thus, their contribution to economic and social well-being rarely factors into management decisions. A growing number of efforts are trying to address this, including through economic markets and public policies.

Many Monterey County producers already participate in various state and federal programs that pay for ecosystem services. The Williamson Act, U.S. Farm Bill programs, and the California Department of Food and Agriculture's (CDFA) Healthy Soils Initiative are especially popular. Organizations such as the Natural Resources Conservation Service, Farm Services Agency, CDFA, and the Resource Conservation District of Monterey County play key roles in implementing these programs.

Current trends suggest the number and types of opportunities will increase in coming years. For example, new private sector markets have emerged for water, biodiversity, and greenhouse gases. Others are under development. In fact, some experts believe that market-based ecosystem services could become a major economic driver for rural America.

CALIFORNIA AGRICULTURE: LEADING AGAIN

California agriculture has emerged as a national leader in documenting and valuing ecosystem services. A key early milestone occurred in 2011, when CDFA created the Office of Environmental Farming and Innovation (OEFI), with a mission to: "serve California by supporting agricultural production and incentivizing practices resulting in a net benefit for the environment through innovation, efficient management and science." For details, please see www.cdfa.ca.gov/oefi/.

Among other things, OEFI created a first-ever typology of specific ecosystem services that California's agricultural lands provide (see **Figure 8**). It also launched a project to document, recognize, and incentivize them.

Figure 8. Typical Ecosystem Services Provided by California Agricultural Lands

Source: California Department of Food and Agriculture. See http://www.cdfa.ca.gov/oefi/ecosystemservices/

Wildlife Habitats

Providing food, water, shelter and space to support resident and transient wildlife, especially through riparian areas and perennial vegetation.

Food Production

Nourishing a growing global population with nutrients and energy, the primary product of agricultural production.

Fuel Production

Meeting energy needs by producing plant-based biofuels, and through mechanized production of renewables such as wind, solar, hydro, and geothermal.

Soil Structure, Formation and Fertility

Sustaining healthy soils, the foundation of all life, by managing them in ways that not only support plant growth, but also reduce erosion, prevent landslides, suppress pathogens, sequester carbon, and purify water.

Water Cycling

Maintaining or improving soil moisture and water storage, while minimizing runoff, through cover crops, tillage, residue management, and dozens of related practices.

Pest Control

Controlling pests and weeds through many management practices that support their natural enemies, such as raptors, beneficial insects, and other wildlife.

Pollination Services

Supporting agricultural production and healthy ecosystems by providing nesting habitat and floral resources for wild pollinators such as bees, bats, and birds.

Nutrient Cycling

Managing plant nutrients and soil amendments in ways that help store, transform, and cycle important nutrients in the soil, such as carbon, nitrogen, and phosphorus.

Fiber Production

Clothing people by producing cotton, wool, and other fibers that can be processed into thread, yarn and cloth.

Recreation and Cultural

Improving quality of life by providing places for wildlife viewing, nature walks, outdoor recreation, entertainment, and educational experiences.

Biodiversity Conservation

Promoting ecosystem productivity, beauty, pest control, and other benefits by managing on-farm streams, trees, shrubs, wetlands, and cropped areas in ways that support diverse plants and animals.

Atmospheric Gas & Climate Regulation

Reducing greenhouse gas levels through practices that make farm operations more energy efficient, and by building capacity to store carbon.

Water Quality

Improving and protecting water quality through vegetative buffers, stream bank protection, prescribed grazing, grassed waterways, and dozens of other management practices

Wildfire Protection*

Crops, orchards, grasslands, and other agricultural areas can help protect people and property from wildfires.

**This new category, Wildfire Protection, does not occur on CDFA's original list.*

Providing Open Space and Scenic Beauty

Many wild and cultivated plants depend on pollinators that agricultural lands support.

Supporting Pollinators

Promoting Carbon Sequestration

California's Agricultural Lands Deliver Multiple Benefits

Agricultural areas provide open space, scenic beauty, and an alternative to urban sprawl.

Fostering Community

Farmlands foster a sense of community, as well as physical and emotional benefits.

ASSIGNING DOLLAR VALUES TO ECOSYSTEM SERVICES

Economists have tried with varying success to assign monetary values to ecosystem services. They use several methodologies such as Travel Cost Method, Hedonistic Pricing, Replacement Cost Method, and Contingent Valuation.

This raises an important question: ***what is the annual dollar value of ecosystem services provided by Monterey County agricultural lands?***

Answering this question thoroughly would require primary data collection, likely taking several years and costing over a million dollars. Fortunately, economists have developed a cost-effective approach to estimate such values that takes full advantage of existing research. Called the Benefit Transfer Methodology, the approach estimates economic values by transferring existing benefit estimates from studies already completed for another location.

For example, researchers recently used the Benefit Transfer Methodology to estimate the value of ecosystem services in three California counties. The philanthropic foundations that commissioned these expensive pilot studies hoped the results would prove useful for other counties, too.

Figure 9 summarizes relevant results from those three studies. It shows average dollar value per acre for ecosystem services provided by four specific land use types that are common in agricultural settings, adjusted for compounding inflation through 2018.

Of the three counties listed in **Figure 9**, Santa Cruz is most relevant to this analysis. Monterey and Santa Cruz Counties are by no means identical, but they do share the same Monterey Bay location and many other characteristics, including several common crops.

Figure 9. Annual Average Value of Select Ecosystem Services in Three California Counties

	Santa Cruz County [3]		Santa Clara County [4]		Sonoma County [5]	
LAND COVER TYPE	LOW	HIGH	LOW	HIGH	LOW	HIGH
Grassland	$4,349	$9,267	$3,729	$7,965	$2,535	$11,254
Pasture	$552	$11,846	$1,146	$11,289	$541	$8,744
Cultivated	$137	$2,852	$137	$2,852	$137	$2,852
Evergreen Forest	$3,680	$9,750	$3,743	$9,735	$3,108	$7,466

[3] Inflation-adjusted averages calculated for 2018 from Table 7 (pp. 27-30) in R. Schmidt *et al.*, 2014, Nature's Value in Santa Cruz County. Earth Economics, Tacoma, WA & the Resource Conservation District of Santa Cruz County, Capitola, CA.

[4] Inflation-adjusted averages calculated for 2018 from Table 7 (pp. 30-33) in D. Batker *et al.*, 2014. Nature's Value in Santa Clara County. Earth Economics, Tacoma, WA & the Santa Clara Valley Open Space Authority, San Jose, CA.

[5] Inflation-adjusted averages calculated for 2018 from Table 8 (pp. 33-37) in R. Schmidt *et al.*, 2015, Nature's Value in Sonoma County. Earth Economics, Tacoma, WA & Sonoma County Agricultural Preservation and Open Space District, Santa Rosa, CA.

Figure 10 lists inflation-adjusted Santa Cruz County values in the Value per Acre column, then multiplies them by the number of Monterey County acres of each land cover type, from the county's 2018 Crop Report. As the final column shows, this puts ecosystem services' 2018 estimated Total Value at $4.7 billion to $10.9 billion per year.

Figure 10. Initial Estimated Value of Ecosystem Services Provided by Monterey County Agricultural Lands

Please see text for details and important caveats. "Value per Acre" derived from a detailed Santa Cruz County study. Acreage totals are from the Monterey County 2018 Crop Report. "Crops" includes four categories: Vegetable Crops, Fruit & Nut Crops, Nursery Products, and Seed Production.

Agricultural Land Cover Type	# of Acres	Value per Acre		Total Value	
		LOW	HIGH	LOW	HIGH
Rangeland (Grassland)	1,063,918	$4,349	$9,267	$4,626,883,243	$9,859,338,794
Crops (Cultivated)	334,305	$137	$2,852	$45,957,990	$953,432,165
Pasture	9,583	$552	$11,846	$5,290,124	$113,522,571
TOTALS	**1,407,806**			**$4,678,131,358**	**$10,926,293,530**

We would like to highlight two key points from **Figure 10**. First, the total value, $4.7 billion to $10.9 billion, may be more than some readers expected. It might come as a surprise that for 2018, the agricultural industry likely produced as much economic value in ecosystem services as it did in direct production of commodities ($4.3 billion), and perhaps more than double that amount.

Second, rangelands delivered most of the value. In the county's 2018 Crop Report, rangelands and the livestock that used them, accounted for $101.7 million—less than 3% of the county's total agricultural production. However, because rangelands produce so many invisible benefits for people, their total 2018 economic contribution through ecosystem services alone was likely $4.6 billion to $9.9 billion.

LIMITATIONS

We want to underscore the limitations of this analysis and the many caveats that are in order. The most important caveat is that estimates in this report are for illustrative purposes only. They provide some indication of magnitude but are by no means definitive. Any mention of specific dollar values from this section should make clear they are initial, imprecise estimates, not verified with actual data collection.

Getting robust numbers would require a full, county-specific study. Compared to other counties, Monterey County agricultural lands have noteworthy characteristics that reduce the value of ecosystem services they provide, and other features that increase them. A full study could reflect these using the Benefit Transfer Methodology, or even better, through primary data collection.

For an excellent discussion of methods and limitations, please consult the original 97-page Santa Cruz County report on which this analysis depends. That full report is available for PDF download from various websites, including the Resource Conservation District of Santa Cruz: http://www.rcdsantacruz.org/healthy-lands-healthy-economies.

Agricultural Lands Reduce Wildfire Risk[6]

Ample scientific evidence shows that crops, orchards, grasslands, and other agricultural areas can help protect people and property from wildfires. Agricultural belts around urban areas are especially helpful, where they reduce the fuel load, disrupt advancing fires, and facilitate firefighting efforts. Economists have not yet quantified the value of this protection in Monterey County or elsewhere.

[6] See, for example, Moreira, F., and G. Pe'er, "Agricultural policy can reduce wildfires," *Science*, 359:6379, p. 1001 (March 2018).

Toward the Future

This report has documented the role that Monterey County agriculture plays in the county economy. The key points for 2018 are:

- Including local food production, processing, and multiplier effects, agriculture contributed $11.659 billion to the county economy, over $31 million dollars per day.
- Agriculture directly supported 57,503 employees, one out of every five jobs in the county.
- With a Shannon Weaver Index of 0.61, agricultural production had exceptional diversification, providing important economic resilience to the industry and to the larger county economy.
- Initial analysis suggests that agricultural lands contributed an estimated $4.7 billion to $10.9 billion in ecosystem services, mostly from rangelands.

Agriculture is an important pillar of the Monterey County economy and represents a vital link to both the county's cultural past and competitive future. Although this report has presented many facts and figures, it has barely begun to fill key information gaps about agriculture's role. Several additional questions that lie beyond the scope of this report may warrant future research (see below). In the meantime, the findings herein provide the clearest picture yet of Monterey County agriculture's powerful economic role.

ADDITIONAL QUESTIONS

- LOCAL PROCESSING. What new policies, programs, and other initiatives, if implemented, could expand locally sourced, value-added food processing within Monterey County?
- TECHNOLOGY INNOVATION. Our 2015 report detailed an ambitious, multi-stakeholder initiative to solidify Salinas Valley as the world leader in fresh agriculture technology. The report also proposed indicators for measuring progress. What specific results has that initiative produced?
- ECONOMIC SHOCKS. How has the COVID-19 pandemic affected agriculture's economic contributions? What effects could other shocks have in the future, for example, significant new regulations, pest outbreaks, labor policies, water issues, technology breakthroughs, or changes in the price of key inputs?
- TAX IMPLICATIONS. What contribution do agricultural businesses make to county tax revenues? Including production and local processing, and after subtracting significant subsidies, our initial estimate puts agriculture's net 2018 tax contribution at $61.9 million to $122.7 million. This included excise, sales and property taxes, as well as fees, licenses and permits (but not income taxes). Further research could firm up this number and also tailor it to specific locations.
- ECOSYSTEM SERVICES. This report has included an initial estimated value of ecosystem services provided by agricultural lands based on a detailed study in neighboring Santa Cruz County. What is a viable path toward developing rigorous, defensible estimates for Monterey County?
- CANNABIS AND HEMP. Commercial cannabis and industrial hemp production continue to gain traction across California, including in Monterey County. What economic opportunities and risks do they pose for the agricultural industry? For the county economy?

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Monterey County Agricultural Commissioner's Office

https://www.co.monterey.ca.us/government/departments-a-h/agricultural-commissioner#ag

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