

"Crop Report PLUS" Series

December 2017



Agricultural Impact Associates 
"Quantifying the value of California agriculture"

Economic Contributions of Imperial County Agriculture



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I am pleased to share the "Crop Report Plus" Series that shows the **Economic Contributions of Imperial County Agriculture**. This report takes an important step beyond the annual *Imperial County Agricultural Crop & Livestock Report* that we publish every year. Instead of stopping at crop production values and acreage, it quantifies agriculture's total economic contribution through food production, local food processing, employment, and economic "multiplier effects." In short, the report documents agriculture's broader role in sustaining a thriving local economy.

Section 2279 of the California Food and Agricultural Code requires all county agricultural commissioners to report the annual "value" of agriculture. This typically occurs via our yearly *Agricultural Crop & Livestock Report*. Using twenty-first century economic tools, we can now fulfill this mandate better than ever. We can also explore additional topics that clarify agriculture's role in sustaining a healthy local economy.

For 2016, agriculture contributed a total of \$4.50 billion to the county economy. This far exceeds the \$2.06 billion figure from our 2016 *Agricultural Crop & Livestock Report*. Agriculture also supported 12,916 direct employees, or about one out of every six jobs in the county. When we add multiplier effects, total employment rises to 24,429 jobs.

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

Sincerely,

Carlos Ortiz
Agricultural Commissioner
Sealer of Weights and Measures



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Agriculture is the backbone of Imperial County's rich history and bright future. Agricultural production, innovations to improve on-farm efficiencies and supportive businesses contribute billions of dollars into our local economy each year. Farm dollars provide tax revenue used to improve our roads, build parks and create jobs. Our farmers and ranchers produce fruits, vegetables, forage and beef for the nation and world's population consistently ranking Imperial in the top ten agricultural producing counties in California. With an abundance of open space and reliable water supply agriculture in Imperial County will remain strong for generations to come.

Michael W. Kelley

Michael W. Kelley
Chairman, Supervisor District 3



Economic Contributions of Imperial County Agriculture

For 2016, Imperial County Agriculture:

...contributed a total of \$4.50 billion to the local economy, including:

- \$2.94 billion in direct economic output, representing 25.9% of the county's total economic output
- \$1.56 billion in additional economic output in the form of expenditures by agriculture companies and their employees.
- This equates to over half a million dollars per hour and \$12.3 million per day.

...provided 24,429 jobs, including:

- 12,916 direct employees, or about one out of every six jobs in the county.
- 11,513 additional jobs attributable to expenditures by agriculture companies and their employees.

...maintained exceptional diversity of agricultural commodities, providing stability within the agricultural and broader county economy.

- The Shannon-Weaver Diversity Index measures economic diversity. Imperial County agriculture's score for 2016 is 3.23

Introduction

Residents and visitors alike know and value the contributions agriculture makes to Imperial County. Well-tended fields stretch for miles. Onions, carrots, broccoli, lettuce, and dozens of other crops grow in deep, fertile soils and help feed the world. Alfalfa colors the landscape while cattle, sheep, and other livestock thrive in local fields and feedlots.

Clearly, agriculture plays a vital role in sustaining a healthy local economy. What is not so clear; however, is the true size of that role. How much money does agriculture pump into the local economy? How many jobs does agriculture support? In other words, just how important is agriculture as a driver of Imperial County's economic health?

This report sheds light on these and related questions. Using multiple data sources and advanced economic modeling techniques, it analyzes agriculture's total contribution to the Imperial County economy. The report also examines agricultural diversity and its role in supporting economic resiliency, including a first-ever quantitative measure. On the whole, the findings offer important information for policy makers, the public, and anyone who values a thriving local economy.



Our Approach

When it comes to economic analysis, it is important to examine the fullest possible range of economic contributions. This report does that by focusing not just on *direct* economic effect such as farm production and employment, but also on *multiplier effects*. *Multiplier effects* are ripples through the economy. These ripples include inter-industry "business to business" supplier purchases as well as "consumption spending" by employees. The **Multiplier Effects** section on page 5 explains this further.

It is appropriate to calculate *multiplier effects* when analyzing what economists call a *basic industry*. 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 Imperial County. Therefore, this report includes *multiplier effects* when describing agriculture's total economic contribution.

Our analysis only examines agriculture's economic contributions. To understand agriculture's full economic impact, one would also need to assess agricultural-related costs to society, for example 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 *Agricultural Crop & Livestock Report* produced by the office of the Agricultural Commissioner Sealer of Weights and Measures. The main national data source is IMPLAN®, a widely used economic modeling program (see www.implan.com). 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 536 industry sectors. Except where otherwise noted, all figures are from the year 2016, the most recent IMPLAN® dataset available. Please contact the authors for additional details on the methods used.

"Direct Effects" of Imperial 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 agriculture jobs.

Figure 1 shows the various categories that made up Imperial County farm production value. Vegetable & Melon Crops were the single largest production category by dollar value (\$1.01 billion), comprising 48.8% of the county total. Three products dominated this category: leaf lettuce (\$133.2 million), broccoli (\$120.6 million), and head lettuce (\$119.3 million).

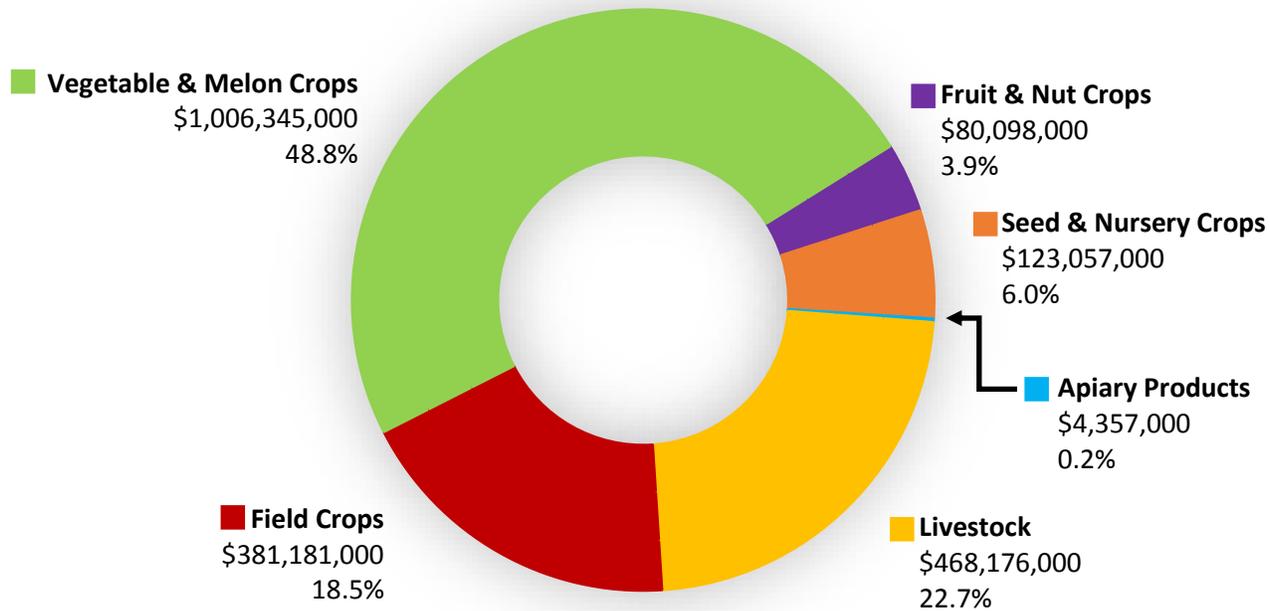
At 22.7%, Livestock represented the second largest category (\$468.2 million) and consisted mostly of feedlot cattle (\$400.6 million). Field Crops ranked third with \$381.2 million and 18.5%. Together, these three super categories accounted for 89.9% of the county's direct farm production values.

The combined, total dollar value for all products rose 50.7% over the past decade, from \$1.37 billion in 2007 to \$2.06 billion in 2016. Inflation totaled 19.5% during this period, averaging just under 2% per year. Thus, agricultural production grew an impressive 31.2% even after adjusting for inflation. 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 annual *Agricultural Crop & Livestock Report* for additional details on specific products and their value.

Figure 1: Distribution of Imperial County Farm Production

Source: 2016 Imperial County Agricultural Crop & Livestock Report



Employment. How many people work in agricultural production? For 2016, agricultural production directly employed 12,186 people in Imperial County. The figure encompasses a wide range of production-related jobs, including not just growing and harvesting, but also sales, marketing and many other roles. It does not include food processing jobs, which we discuss below.

"Multiplier Effects" of Imperial 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 consist of "business to business" supplier purchases. For example, when a grower buys farm equipment, fertilizer, seed, insurance, banking services, and other inputs, the grower creates *indirect effects*.

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

Although agricultural companies and their employees certainly spend money in Yuma, AZ, Mexicali, Mexico and many other locations outside Imperial County, this study only reflects those expenditures that occur within the county. Quantifying expenditures outside the county would be an expensive, complex effort that lies well beyond our scope here.

Figure 2 shows agriculture's *direct*, *indirect*, and *induced* economic effects within the county, for major production categories. The numbers use IMPLAN multipliers for each

sector, which are rooted in U.S. Bureau of Economic Analysis production data and other sources.

For example, “Beef cattle ranching & farming” in Imperial County has an *indirect effects* multiplier of 0.7219 and an *induced effects* multiplier of 0.1256. This means that for 2016, each dollar’s worth of direct output generated an extra 72 cents in supplier purchases, plus approximately 12 cents extra in consumption spending by agriculture owners and employees. Every sector has its own, unique multipliers reflecting where companies and employees spent their money.

Each sector also has its own unique multipliers for employment. For example, “Vegetable & Melon farming” supported 3,097 direct jobs, plus an additional 2,494 jobs from *indirect effects* and 1,134 jobs from *induced effects*. The bottom row of **Figure 3** shows combined employment figures across sectors.

Figure 2: Economic Effect of Imperial County Farm Production

FARM PRODUCTION SECTOR	DIRECT	INDIRECT	INDUCED	TOTAL
	Output Effect (\$ Millions)			
Vegetable and Melon Farming	\$874.7	\$211.5	\$141.9	\$1,228.1
Livestock and Animal Products	\$479.9	\$323.9	\$62.1	\$866.0
All Other Crop Farming	\$513.3	\$165.4	\$89.8	\$768.5
Support Activities for Agriculture and Forestry	\$385.4	\$20.5	\$111.2	\$517.1
Sugarcane and Sugar Beet Farming	\$49.2	\$15.9	\$10.3	\$75.4
Fruit Farming	\$42.5	\$11.9	\$7.9	\$62.3
Grain Farming	\$22.8	\$9.5	\$2.5	\$34.8
Forestry, Forest Products, and Timber Production	\$4.3	\$2.1	\$1.3	\$7.8
Greenhouse, Nursery, and Floriculture Production	\$5.0	\$0.9	\$0.8	\$6.6
Cotton Farming	\$2.8	\$0.7	\$0.5	\$4.0
Tree Nut Farming	\$1.5	\$0.4	\$0.3	\$2.2
TOTAL ECONOMIC OUTPUT:	\$2,381.4	\$762.9	\$428.5	\$3,572.8
Employment Effect (# Jobs)				
TOTAL EMPLOYMENT:	12,186	6,549	3,421	22,156

Dollar values are in \$ millions. Figures are for 2016 and come from IMPLAN® and U.S. Bureau of Economic Analysis. Not all columns and rows add due to rounding.

Note that category names and production data in **Figure 3** differ from the Imperial County’s annual *Agricultural Crop & Livestock Report*. They follow a standard classification system used nationwide called the North American Industrial Classification System (NAICS). Each NAICS category has an explicit definition. For example, “**Support activities for agricultural production**” refers to soil preparation, planting, cultivating, harvesting, labor contracting, post-harvest crop activities and other farm management services.

Agricultural production created \$3.57 billion in total economic output within Imperial County, of which \$1.19 billion were multiplier effects. Agricultural production also supported 12,186 direct jobs, plus another 9,970 through multiplier effects, for a total of 22,156 jobs.

Because the data reflect production activities that the county's *Agricultural Crop & Livestock Report* is not designed to capture, the 2016 direct production value (\$2.38 billion) is higher than the \$2.06 billion reported in the *Agricultural Crop & Livestock Report*.

Locally Sourced, Value Added Food Processing

Farm production tells only part of the story. Imperial County is home to several food processors that play a key role in the local economy. This section captures 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.

To avoid overstating the numbers, we only include 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 exist in Imperial County were it not for the abundant supply of vegetables, livestock, and other raw agricultural products.

Based on our strict criteria, we did not include the county's \$14.9 million bread and bakery products sector because most raw ingredients such as flour and yeast come from outside the county. The county produced \$31.0 million in wheat for 2016, but it went to Texas, Missouri and Illinois for processing into wheat flour. The county's nascent beer brewing sector (\$2.3 million) sometimes flavors beer with local lemons, melons, honey, and carrots, but depends on outside grains such as hops grown in the Pacific Northwest or Germany.

Figure 3 shows the economic effects of locally sourced, value added food processing. Like the previous section, category names follow a standard classification system used nationwide called the North American Industrial Classification System (NAICS). Each NAICS category has an explicit definition. For example, the NAICS category "All other food manufacturing" includes processed leafy greens, peeled or cut vegetables, and other perishable prepared foods. We selected and validated the categories and numbers in consultation with local experts, and slightly adjusted two sector names for clarity.

The "Beef & other animal processing" sector consists mostly of one facility that handles about 30% of the county's cattle production. Most cattle go to other counties for processing (Los Angeles, Fresno), or to other states (Arizona, Utah). Sheep only spend the winter in Imperial County, going elsewhere for processing. Boutique-scale processing of goats, rabbits, poultry, swine, and lambs occurs in conjunction with the California Mid-Winter Fair & Fiesta, with show animals sold by auction or barn sales. With respect to dairy products, Imperial County has a few remaining dairies, and was home to California's last remaining producer of Swiss and Muenster cheeses, until it closed in late 2013.

"Compressed hay & other animal food manufacturing" in **Figure 3** captures the estimated 25% to 30% of the county's \$148 million alfalfa hay production that growers compress into small, dense squares, rather than sell for direct consumption in feedlots. Several alfalfa compressing facilities operate within the county. These facilities export most of their product to Asian markets such as China, Japan, Saudi Arabia, Korea, and the United Arab Emirates. A similar percentage of county's \$154 million Bermuda Grass production (20%) also goes to Asia in compressed form.

“Beet sugar manufacturing” is especially interesting given the ongoing decline of beet processing in California. Imperial County is home to California’s last remaining beet processing facility. The operation produces beet sugar as well as co-products such as dried beet pulp and beet molasses. The sugar plant only uses beets grown in Imperial County.



The “All other food manufacturing” category reflects light processing of leafy greens and other vegetables into bagged and other ready to eat products. Estimates of local processing range from 50% for Romaine lettuce, head lettuce, and cabbage, to 60% for leaf lettuce, to 100% for Romaine hearts.

Vegetables go mostly to the fresh market or to other counties for processing. For example, an estimated 50% of the county’s \$61.4 million onion crop was processed, but it occurred outside the county. Similarly, \$51.3 million of the county’s carrot production went to processors, but nearly all of it in Kern County.

Most citrus is for the fresh market. Depending on the quality of the fruit, an estimated 20% to 40% of tangerines, tangelos, oranges, lemons, and grapefruit are processed into juices and related products. Based on consultations with several growers, all of this processing occurs outside the county.

Imperial County’s \$12.3 million Aquatic Products sector plays an interesting and important role nationally and internationally. The county is a major fish supplier to California and Asia, but only sells live fish. Algae is a different story: the county has become the world’s largest manufacturer of spirulina and spirulina-based products, with exports to more than 20 countries.

Consultations with local experts revealed other, small-scale processing. For example, a portion of the county’s \$19.1 million date crop was processed into date nut bread, date butter, and related products. A portion of the olive crop was processed into olive oil. At least one producer used local figs to make jams.

Figure 3: Economic Effect of Locally Sourced, Value-added Food Processing

FOOD PROCESSING SECTOR	DIRECT	INDIRECT	INDUCED	TOTAL
	Output Effect (\$ Millions)			
Beef & Other Animal Processing	\$307.4	\$252.2	\$28.0	\$587.6
Compressed Hay and Other Animal Feed	\$205.5	\$52.2	\$8.7	\$266.3
Beet Sugar Manufacturing	\$27.4	\$19.8	\$3.9	\$51.1
All Other Food Manufacturing	\$15.5	\$4.1	\$0.8	\$20.4
TOTAL ECONOMIC OUTPUT:				
	\$555.7	\$328.3	\$41.4	\$925.4
Employment Effect (# Jobs)				
TOTAL EMPLOYMENT:	730	1,213	330	2,273

Sources: IMPLAN® and U.S. Bureau of Economic Analysis data, with input by local industry experts. Not all columns and rows add due to rounding.

Total Economic Contribution of Imperial 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 Imperial County agriculture.

As **Figure 4** shows, the total 2016 economic contribution of Imperial County agriculture was \$4.50 billion. This consisted of \$2.94 billion in combined, direct output from production and processing, plus \$1.56 billion in multiplier effects.

For perspective, agriculture pumped over half a million dollars per hour into the county economy during 2016 (\$513,494, to be exact). The \$2.94 billion in direct output represented 25.9% of the county's total economic output of \$11.36 billion, about one out of every four dollars. This made agriculture the largest economic sector in Imperial County, followed by government, at \$2.68 billion. Among other things, government includes public safety, public education, military, social services, and even agricultural agencies. Real Estate ranked third, at \$849.7 million

Total employment was 24,429. This included 12,916 jobs directly in agriculture and another 11,513 attributable to multiplier effects. For perspective, the 12,916 direct agriculture jobs represented 16.5% of Imperial County's total employment of 78,395, or about one out of every six jobs. Only government created greater direct employment (18,505 jobs). Health & Social Services ranked third with 9,879 jobs and includes things such as doctors, dentists, hospitals, and day care services.



Figure 4. Overall Economic Effect of Imperial County Agriculture

TYPE OF EFFECT	DIRECT	INDIRECT	INDUCED	TOTAL
FARM PRODUCTION SECTOR				
Output Effect (\$ Millions)	\$2,381.4	\$762.9	\$428.5	\$3,572.8
Employment Effect (# Jobs)	12,186	6,549	3,421	22,156
LOCALLY SOURCED, VALUE-ADDED PROCESSING SECTOR				
Output Effect (\$ Millions)	\$555.7	\$328.3	\$41.4	\$925.4
Employment Effect (# Jobs)	730	1,213	330	2,273
TOTAL VALUE OF AGRICULTURAL SECTOR				
Output Effect (\$ Millions)	\$2,937.2	\$1,091.1	\$469.9	\$4,498.2
Employment Effect (# Jobs)	12,916	7,762	3,751	24,429

The Value of Agricultural Diversity

Economists may disagree on some things but there's one thing they all can agree on: a diverse economy is a resilient economy. Any region that depends on a large number of economic sectors reduces risk of catastrophic shocks.

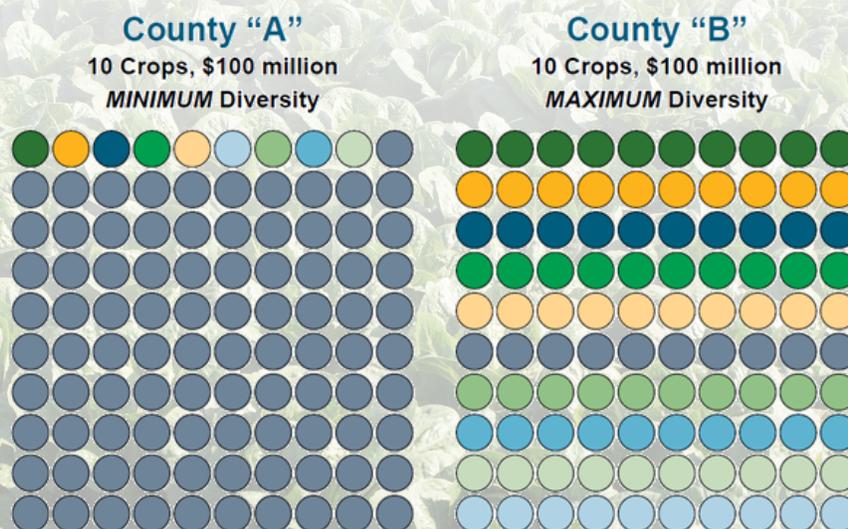
This important economic principle applies to agricultural diversity, too. For example, a county with just one or two main crops faces higher vulnerability to shocks in the form of price drops, disease outbreaks, new regulations, new competitors, spikes in the cost of key inputs, and other unpleasant surprises. Meanwhile, a county with a diverse agricultural industry can withstand shocks to certain crops without unraveling the entire agricultural economy.

Unfortunately, robust measures of Imperial County agricultural diversity do not exist, let alone the total economic value of such diversity. People see assorted crops growing in well-tended fields. They see lambs grazing and feedlots full of cattle. But no one has attempted to quantify that diversity or its economic value.

Part of the reason is that measuring diversity is a complex job. It requires more than just counting the different things for sale at a farmers' market or listed in the *Agricultural Crop & Livestock Report*. Measuring diversity entails combining the number of different crops grown and their economic *abundance* or *evenness*.

For example, imagine two California counties where the annual farm production value is \$100 million each. Both counties grow ten different kinds of crops. In County "A," a single crop contributes 91% of the revenue and the nine other crops make up 1% each (see **Figure 5** below). In County "B" the ten crop types all contribute equally, at 10% each. *Both counties have the same number of crops and total revenues, but County "B" has much higher economic diversity.* Thus, we could expect County "B" to be much more resilient to economic shocks than County "A".

Figure 5. Agricultural Economic Diversity is More Than Just the Number of Crops



Because economic diversity is so important, economists have developed sophisticated tools for measuring it. The most popular one is a summary statistic called the Shannon-Weaver Index. The index stems from the Shannon-Weaver entropy function, which was created in 1949 and is widely used in both ecology and economics. Economists and ecologists alike use the formula to calculate the Shannon-Weaver Index, which we share here and can explain further to interested readers:

$$SW_t^k = - \sum_{n=1}^k p_n * \ln (p_n)$$

The lowest possible index score is 0.00. Zero represents an extreme case where all economic output occurs in only one sector. In ecology, this would be a rain forest with only one species. In agriculture, it would be a county with just one commercial crop. The other extreme, an open system where potential diversity is unlimited, would have a much higher score. The higher the score, the greater the diversity.

To measure agricultural diversity in Imperial County, we started by creating a list of specific crops mentioned in the *Agricultural Crop & Livestock Report* over the past decade. We only used crops for which production values were provided for all ten years, even though the total number of commercial crops grown is certainly much larger. For example, we tracked onions from their 2016 total (\$128.5 million) all the way back to 2007 (\$39.6 million).

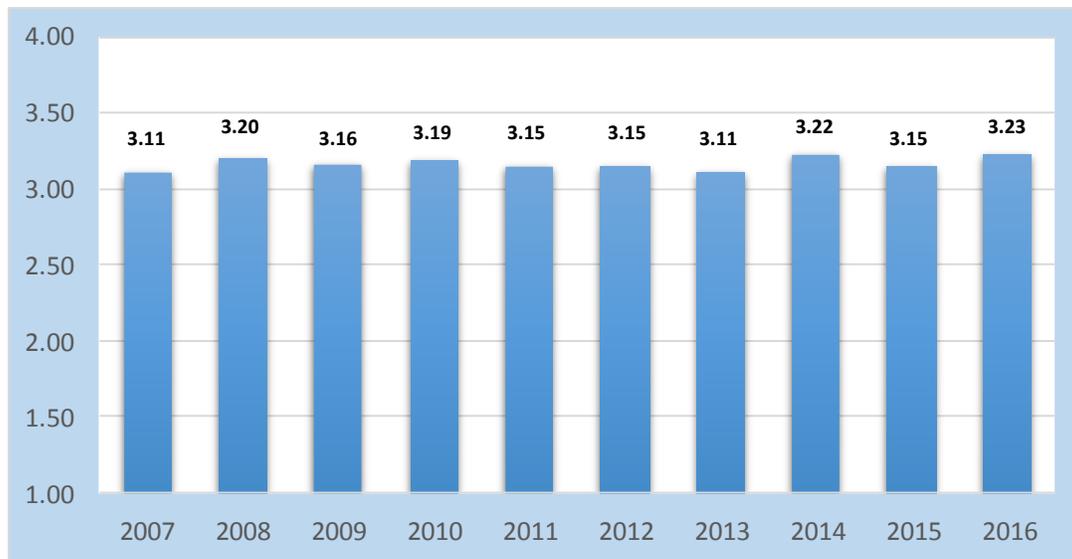
Careful lumping and splitting resulted in 57 different crop categories consistently reported over the past decade. Next, we applied the list of crops and production values to the formula above. This resulted in a 2016 Shannon-Weaver Diversity Index score of **3.23**.

By itself, the index score says little. Where it comes in handy is making internal and external comparisons over time. Internally, the agricultural community can track the score across years to ensure that overall agricultural economic diversity remains high. Maintaining high economic diversity in agriculture will minimize the risk of significant economic shocks. It's an insurance policy against economic earthquakes.

Speaking of earthquakes, note that equation above includes a logarithmic function ("ln"), similar to the Richter Scale for measuring 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 to Shannon-Weaver Diversity Index scores: a tiny numeric difference represents a big change.

Figure 6 shows how the Shannon-Weaver Diversity Index score has fluctuated over time. The 2016 score of **3.23** marks a new high. Scores have changed little over time, in contrast to the downward trend we have seen in other California counties. When slight dips did occur, for example the 2013 drop to 3.11, the decrease was small. The dip did not mean that fewer crop types were grown in the county during that year, but rather than a small number of crops represented larger pieces of the economic pie.

Figure 6. How Economically Diverse is Imperial County Agriculture?



The *Shannon-Weaver Diversity Index* score combines the number of different crops grown and their relative economic value.

Externally, the index score can allow useful comparisons to other industries within Imperial County, for example real estate, tourism, and mineral development. It also allows comparisons between Imperial County agriculture and agriculture in other California counties and beyond. Although the number of external comparisons remains limited at this time, we have produced diversity index scores for agricultural commissioners in several other California counties. Examples include: Monterey (3.09), Solano (3.00), San Luis Obispo (2.92), Santa Barbara (2.49), San Diego (2.43), Santa Cruz (2.01), and Inyo/Mono (1.73).

Potential comparisons will no doubt grow over time as more counties adopt this innovative and important measurement. In the meantime, Imperial County residents can take pride in having one of the most economically diverse agricultural industries anywhere, with numbers to prove it.

Toward the Future

This report has documented the role that Imperial County agriculture plays as a local economic driver. Including local food processing and multiplier effects, agriculture contributed \$4.50 billion to the county economy. Agriculture also played an important role in county employment, directly or indirectly supporting 24,429 jobs. Finally, agriculture's impressive diversity continues to provide critical economic stability to the county. The economic value of this stability is certainly high, albeit hard to quantify.

Agriculture is an important pillar of the Imperial 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. The process of developing this report has raised several additional questions that lie beyond the scope of this report but may warrant future research (**Box 1**). In the meantime, the findings herein provide the clearest picture yet of Imperial County agriculture's important economic role.

Box 1: Additional Questions to Answer

Processing. As this report has shown, processing of Imperial County's raw agricultural products occurs mostly outside the county. What new policies, programs, and other initiatives could expand locally sourced, value-added food processing within Imperial County?

Water. Imperial County's abundant food production depends on Colorado River water delivered via the All-American Canal. What risks does this water supply face? What measures, if implemented, could best safeguard this vital resource well into the future?

Ecosystem services. What is the annual dollar value of wildlife habitat, scenic beauty, carbon sequestration, pollination, and more than 20 other "ecosystem services" that Imperial County's agricultural lands provide to society?

Diversity. How diverse is Imperial County agriculture not just in terms of economic production across crop types, but also across farm sizes, geographical markets, and organic/conventional?

Economic shocks. How would potential "shocks" affect agriculture's economic results, for example significant new regulations, labor policies, water issues, or changes in the price of key inputs?

Cannabis. Experts predict an explosion of cannabis cultivation in response to California's legalization of recreational marijuana use. What economic opportunities and risks does this change present for Imperial County growers?

Acknowledgments

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