FINAL REPORT

Food System Multipliers for Specialty Crops in the Sacramento Region

Prepared for the Sacramento Area Council of Governments (SACOG) under Contract Nos. 15160002 and 15160029 with

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1. Executive Summary

The Sacramento Area Council of Governments (SACOG) received funding through a competitive Specialty Crop Block Grant from the California Department of Food and Agriculture (CDFA) to develop a suite of tools that can be used to analyze the economic value of specialty crop producers, processors, and distributors in the greater Sacramento region. According to the U.S. Department of Agriculture, specialty crops include "fruits and vegetables, tree nuts, dried fruits, horticulture, and nursery crops including floriculture."[1] The geographic scope of the project is the six counties that comprise the Sacramento Area Council of Governments. These counties include El Dorado, Placer, Sacramento, Sutter, Yolo, and Yuba and are collectively referred to as the Sacramento region. SACOG contracted with ERA Economics LLC (ERA) and technical subcontractor BAE Urban Economics (the "ERA team") to develop the economic modeling framework for evaluating the economic contribution of specialty crop agriculture. The economic modeling framework for specialty crops developed under this project relies on two separate, but linked, approaches: an economic model of primary farm production in the Sacramento region and a regional model based on the Impact Analysis for Planning (IMPLAN) platform. Prior to this study, this suite of tools did not exist for Sacramento region specialty crop agriculture. Together the integrated framework is used to analyze the economic value of specialty crop agriculture from the field to the table.

The specialty crop cluster starts with producers, the primary farming activity in the region. From rows of fresh vegetables to blooming orchards and rolling hills of wine grapes, this sector is the heart of specialty crop agriculture in the Sacramento region. The linked processing sector thrives on local specialty crop production. Processing businesses include post-harvest handling, canning, large scale processing, and a range of new boutique processors creating new products for localized markets. Closely linked to specialty crop agriculture processing and production is the distribution sector, which includes businesses such as produce distributors, fruit stands, and farmer's markets who work seamlessly with the production and processing sectors to meet consumer demand. The specialty crop agriculture cluster of producers, processors, and distributors includes many businesses that are vertically integrated. For example, grower-packer-shippers farm, process, and distribute fresh vegetables, and many farming operations rent equipment and offer custom farming services to other growers. It is important to consider the total economic activity generated by the entire specialty crop agriculture cluster in order to quantify the current value in the Sacramento region, and how it will grow in the future.

SACOG initiated this study to determine the economic value that specialty crop agriculture brings to the Sacramento region. In particular, the annual economic value that specialty crop agriculture provides to the six counties and twenty-two cities in the SACOG region is significantly greater than the $1.47 billion in gross farm-gate revenues. Growers purchase

[1] U.S. Department of Agriculture. *What is a Specialty Crop?* Available at: http://www.ams.usda.gov/services/grants/scbgp/specialty-crop

materials and machinery from local suppliers, farm workers purchase goods and services in the community, restaurants purchase local produce, and businesses in all of these related industries pay local, state, and federal taxes. In other words, each dollar of economic value generated by a specialty crop business (the direct effect) generates multiplier effects in other industries. Multiplier effects are decomposed into indirect effects, economic activity generated through purchases from other businesses, and induced effects, economic activity generated by employee expenditures in the local economy. The total economic effect is the sum of the direct, indirect, and induced components.

While the direct farm-gate value of specialty crop agriculture is often understood and accurately quantified, the multiplier benefits are rarely quantified or cited in public policy discussion. This web of economic activity, alternatively referred to as an economic cluster, generated by specialty crop agriculture is the central focus of this study. Economic activity is expressed in terms of jobs, which is full time equivalent employment, output value, which is the gross sales value of an industry, and value added, which is the net contribution to the local economy after netting out double-counting of purchases between businesses.

The specialty crop agriculture cluster in the Sacramento region contributes significant jobs and value added to the regional economy. There are over 17,000 jobs in specialty crop agriculture production, processing, and distribution. Every jobs in specialty crop agriculture generates another 0.82 jobs in other areas of the regional economy. The total output value of the specialty crop cluster is approximately $3.9 billion annually, with each $1 of output generating an additional $0.49 of output in other sectors of the regional economy. Specialty crop industries directly contribute over $1.2 billion in total value added to the regional economy. For every dollar in value added, $0.90 in additional value added is generated across other industries.

1.1 Analysis Approach

The economic modeling framework developed under this project relies on an economic model of primary farm production in the Sacramento region and a regional economic model based on IMPLAN. Together the integrated framework is used to analyze the total economic value of specialty crop agriculture. The analysis approach is decomposed into five central tasks: (i) preliminary analysis, (ii) data gathering and outreach, (iii) primary agricultural production model development, (iv) Input-Output model development, and (v) economic cluster analysis.

A preliminary analysis using the default IMPLAN 2013 R3 data finds that the specialty crop agriculture production cluster includes four sectors: vegetable and melon farming, fruit farming, tree nut farming, and nurseries and greenhouses. The coarse grouping of production sectors in the default IMPLAN data means that important differences in regional economic activity between crops cannot be accurately represented. For example, processing tomato farming and melon farming require different inputs, serve different markets, have different domestic and international sales, and have different links for post-harvest handling (processing and/or distribution). This aggregation bias is an important limitation to completing an economic cluster analysis. In addition, a preliminary analysis revealed that the default IMPLAN data for the specialty crop sectors does not accurately represent expenditures and economic activity associated with specialty crop agriculture in the SACOG region. Key measures of economic activity and expenditure patterns in the IMPLAN data are derived from national benchmark data provided by the Bureau of Economic Analysis (BEA), which the ERA team determined is not representative of specialty crop production in the Sacramento region. In particular, the proportion of expenditures on inputs (intermediate expenditures) is significantly higher than in the default IMPLAN trade flow data. This was a consistent finding in all surveys and alternative sources of data used in the analysis. In short, the default IMPLAN model reflects the best information that is available on a national basis, but this study finds that its application for agriculture – specialty crops in particular – must be improved using supplemental data in order to generate meaningful estimates of the economic value of specialty crop agriculture in the Sacramento region. This project develops a primary economic model of specialty crop production linked to a custom IMPLAN model representing regional purchases in the specialty crop agriculture cluster to address this deficiency.

Recognizing that the modeling framework is only as good as the underlying data, the ERA team undertook a comprehensive data gathering effort with surveys and supplemental research to characterize Sacramento region specialty crop agriculture. Over one hundred specialty crop farmers, processors, and distributors were contacted through phone, email, and in-person interviews over an eight month period. The surveys elicited information on expenditures, use of inputs, employees, and sales. In addition, the surveys quantified the regulatory cost facing specialty crop agriculture in the region. These data were compiled, combined with supplemental information gathered by the ERA team and from a study by UC Davis[2], and aggregated in a confidential database so that no one entity can be identified. The information was then used to develop a primary model of agricultural production and a customized version of the IMPLAN model.

A primary production model of Sacramento region primary agriculture was developed using the comprehensive data compiled under this project. The model covers all irrigated agriculture in the six-county SACOG area. It is used to estimate cropping patterns, use of inputs, outputs, and farm-gate returns across the diverse specialty crop production sectors in the Sacramento region. The modeling framework is designed to simulate the response of agriculture to changes in policy (e.g. new regulations), market conditions (e.g. prices and costs), resource conditions (e.g. drought), and a range of other factors. For this study, the model is used to quantify the farm-gate value of crop production in the Sacramento region, and simulate the economic response of the industry to changes in policy or other market conditions.

[2] http://sfp.ucdavis.edu/pubs/Economic_Impact_Reports/

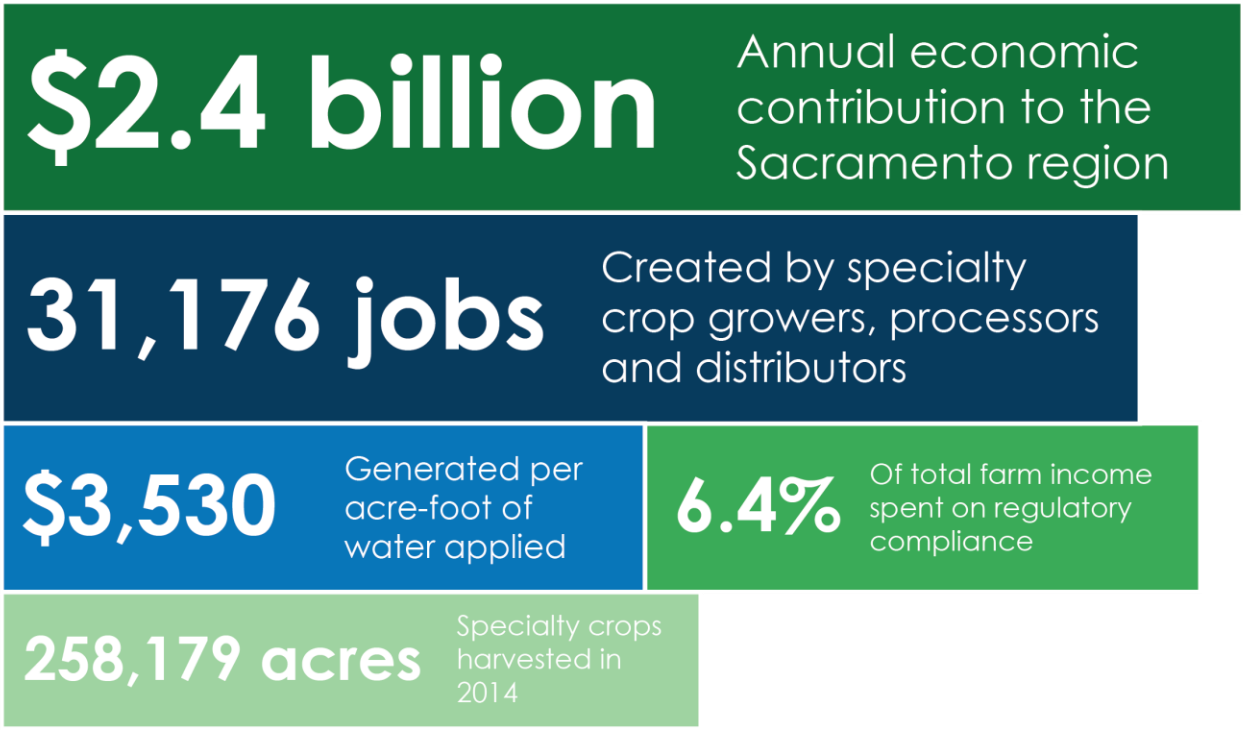
A custom IMPLAN model of Sacramento region primary agriculture was developed using the comprehensive data compiled under this project. This study developed a series of detailed IMPLAN model industry accounts which reflect the expenditures observed in the survey of specialty crop businesses. The primary production model simulates the responsiveness of agriculture to changes in market conditions or shifts in technology, and the regional IMPLAN model traces these changes from the farm to all related sectors of the economy. The model is used to estimate the linkages to the regional economy and quantify the total economic value of specialty crop agriculture.

The final phase of the analysis uses the data, the primary model, and the custom IMPLAN model to analyze the economic contribution of specialty crop agriculture to the Sacramento region, and analyze an industry cluster growth scenario. The economic contribution analysis evaluates the additional economic activity generated for each dollar of economic activity generated by specialty crop agriculture. To demonstrate how the models can be used to estimate future growth in the industry, the ERA team evaluated the economic impacts of increased peach production, and a new frozen peach processor moving into the region in response to an increase in the demand for frozen peaches. In both analyses, the economic activity is linked from the field to all related industries in the specialty crop agriculture cluster.

1.2 The Value of Specialty Crop Agriculture in the Sacramento Region

The farm-gate value of specialty crop production in the Sacramento region exceeds $1.47 billion annually. In spite of regulatory compliance costs that exceed 6 percent of total farm income, this production value is generated on just over a quarter-million acres in the Sacramento region. The primary farming sector supports businesses in the processing sector, and in turn, the distribution sector. Taken together the specialty crop cluster in the Sacramento region generates $3.9 billion in direct output value annually. Including indirect and induced multiplier effects, representing expenditures in ancillary businesses and by employees, respectively, the total output value exceeds $5.8 billion annually. The total value added contribution to the Sacramento region economy from the specialty crop agriculture cluster equals $2.4 billion dollars annually. The total cluster supports over 31,000 full time equivalent jobs in the Sacramento region. Figure ES-1 illustrates the economic contribution of the Sacramento region specialty crop agriculture economic cluster.

Figure ES-1. Total Economic Contribution of the Specialty Crop Agriculture Cluster



A diverse mix of specialty crops produced in the Sacramento region generates the economic activity of the specialty crop agriculture cluster. Foothill vineyards produce excellent wines for a growing market, Yolo County is the workhorse for processing tomato production to feed local canneries, and Sutter and Yuba counties are California's premier peach region for direct-to-consumer and processing demand. Each region has comparative advantages in growing a specific set of cops resulting from microclimate, soil conditions, and access to water, markets, and generations of farmer knowledge. These important regional differences are represented in the economic primary model and have important implications for the total value of the specialty crop cluster.

The recent robust growth in specialty crop agriculture in the Sacramento region is driven by comparative advantages in farming in the Sacramento region, market shifts in consumer tastes and preferences, and increasing domestic and international market demand for local crops. The Sacramento region is endowed with the three key natural resources required for successful agriculture: soil, climate, and water resources. Given the severe water shortages experienced by the San Joaquin and Tulare regions, and the potential for further costs or restrictions on through-Delta transfers, it is likely that the comparative advantage of the Sacramento Valley for primary irrigated production will be increasing in the future. For example, in the 2014 – 2015 drought there was a shift in processing tomato contracts to the Sacramento Valley region from the San Joaquin Valley region due to relative abundance of water supplies under drought conditions. With the recently enacted Sustainable Groundwater Management Act of 2014 (SGMA), the importance of groundwater as a drought reserve will be accentuated and this relative advantage of the Sacramento region over the San Joaquin and Tulare regions will continue to grow.

1.3 Frozen Fruit Processing Market Growth in the Sacramento Region

The ERA team applied the primary production model and IMPLAN model to evaluate an expansion in the frozen fruit processing sector in the Sacramento region. Currently, the Sacramento region has no large-scale frozen fruit processors. The potential to process fruit that is grown locally to meet a growing consumer demand for frozen fruit represents a significant opportunity for the regional economy. Jobs, value added, and taxes that are currently flowing out of the Sacramento region could stay in the area if a processor is attracted to the region by business-friendly policies.

An example application is developed for the frozen peach processing industry. Currently, the Sacramento region produces around 240,000 tons of peaches on 12,000 acres, generating approximately $92 million in gross farm-gate revenues. Most of these are clingstone peaches grown in Sutter and Yuba counties for consumer and processing demand. Peaches represent a potential growth industry in response to increasing consumer demand for frozen fruit. The share of peaches in the U.S. that are frozen tripled from 3 percent of available peaches in 1970 to 9 percent in 2013. Individual quick freezing (IQF) transforms fresh raw produce into a frozen product in a matter of minutes. The speed of the transformation better maintains the texture, flavor, and color compared to traditional freezing methods. In addition, because the produce is individually frozen it is less likely to clump during storage, resulting in a more consistent product for a variety of uses.

The presence of a peach processor in the region will incentivize additional peach production by reducing production costs (e.g. transportation) or risks (e.g. long-term contracts) to growers. This can be modeled as an increase in the gross margin of peaches produced in the Sacramento region. The primary production model simulates a 10 percent increase in the gross margin for peaches. In response, total peach production increases by just over 35,000 tons, representing an increase of $14 million in gross farm-gate revenues. The new IQF processor is assumed to process all of the additional peach production. The increase in peach acreage pushes out some competing crops, including lower value field crops grown on more marginal lands and a mix of older orchards, primarily in Yuba and Sutter counties. The total farm-gate revenues for these other crops fall by just over $1 million dollars, thus the net increase in farm-gate production value in the Sacramento region equals $13 million dollars.

The expansion of the peach market and the addition of a new IQF processor in the region generate additional economic activity in the regional economy. The IMPLAN model is linked to the change in direct output value estimated using the primary model to evaluate this change. Table ES-1 summarizes the results of the impact analysis. The direct effect of the location of the IQF processor equals $88 million, or equivalently, the approximate sales value for 35,000 tons of IQF peach production equals $88 million. This direct output value generates an additional change in indirect expenditures with other businesses and induced expenditures by employees of all businesses, equal to $59.5 million. The total output value is equal to the sum of the direct plus indirect and induced ("multiplier"), which equals $147.9 million. In addition, the IQF processor generates $43.8 million in total value added in the Sacramento regional economy and 620 total jobs. Balanced against this increase in IQF production is a decrease in the value of production for other crops pushed out by the modest expansion in peaches. The direct output value decrease of $1.049 million results in an additional decrease of $710 million dollars from indirect and induced (multiplier) effects. Total value added losses equal $614,260 and total employment losses equal 12 full-time equivalent jobs. Taking the increase in IQF processing and the decrease in farm production of other crops together, the total net effect of an expansion in peach production and IQF processing is an increase of 608 jobs, $43 million in value added, and $146 million in total output value in the Sacramento region.

Table ES-1. Economic Impact of Peach IQF Processing Expansion

	Employment	Value Added	Output
New Processing Facility			
Direct Effect	190	$12,250,000	$88,353,000
Multiplier Effect	430	$31,625,000	$59,562,000
Total	**620**	**$43,875,000**	**$147,915,000**
Change in Farm Output			
Direct Effect	-7	($190,720)	($1,049,000)
Multiplier Effect	-5	($423,540)	($710,000)
Total	**-12**	**($614,260)**	**($1,759,000)**
Combined Impact			
Direct Effect	183	$12,059,000	$87,304,000
Multiplier Effect	425	$31,202,000	$58,853,000
Total	**608**	**$43,261,000**	**$146,157,000**

1.4 Summary

The ERA team developed a suite of tools that can be used to evaluate the economic contribution of the specialty crop agriculture cluster, and evaluate the impact of new policies or changes in market conditions that may affect this sector. The standard IMPLAN model includes a limited number of specialty crop sectors and the data used to populate the expenditure patterns describing the key financial linkages in the model are based on national averages which are not representative of Sacramento region agriculture. The ERA team developed a linked economic and regional modeling framework by developing an economic model of primary crop production and a custom IMPLAN model. These models were developed using primary data from a comprehensive, and confidential, survey of over one hundred specialty crop businesses in the Sacramento region.

Using the primary production model and the IMPLAN model to evaluate the economic contribution of the specialty crop agriculture cluster, this analysis finds that the total value added contribution equals $2.4 billion annually. The value added is generated on over $5.8 billion in total output value, and supports over 31,000 jobs. Put another way, through the lens of economic multipliers, there are over 17,000 direct jobs in the specialty crop cluster and every job in specialty crops generates another 0.82 jobs in other areas of the economy. Specialty crop industries directly contribute over $1.2 billion in total value added to the regional economy. For every dollar in value added, $0.90 in additional value added is generated across other industries. Total output value of the specialty crop sector is approximately $3.9 billion, with each $1 of output generating an additional $0.49 of output in all other sectors of the specialty crop cluster.

Looking forward, robust growth in the specialty crop agriculture cluster is likely because the Sacramento region has comparative advantages in water and climate, and more importantly, produces a set of healthy, safe, and reliable crops that are in high demand in domestic and international markets. In particular, the on-going shift toward high-value locally consumed fresh fruit and vegetables, and growth in the export market for high-value nut crops will drive growth in the specialty crop agriculture cluster. Specialty crop agriculture generates higher value per unit land (and water) than most non-specialty crops, and has the potential to generate additional employment in secondary processing and distribution. While many regions of California's premier agricultural economy are reeling from drought and water restrictions, the Sacramento region specialty crop agriculture cluster is well suited for years of robust growth.

2. Introduction

The Sacramento Area Council of Governments (SACOG) received funding through a competitive Specialty Crop Block Grant from the California Department of Food and Agriculture (CDFA) to develop a suite of tools that can be used to analyze the economic value of specialty crop producers, processors, and distributors in the greater Sacramento region. The geographic scope of the project is the six counties that comprise the Sacramento Area Council of Governments. These counties include El Dorado, Placer, Sacramento, Sutter, Yolo, and Yuba and are collectively referred to as the Sacramento region. SACOG contracted with ERA Economics LLC (ERA) and technical subcontractor BAE Urban Economics (the "ERA team") to develop the economic modeling framework for evaluating the economic contribution of specialty crop agriculture. The economic modeling framework for specialty crops developed under this project relies on two separate, but linked, approaches: a model of primary farm production in the Sacramento region and a regional economic model based on the Impact Analysis for Planning (IMPLAN) platform. Prior to this study, this suite of tools did not exist for Sacramento region specialty crop agriculture. Together the integrated framework is used to analyze the economic value of specialty crop agriculture from the field to the table.

The specialty crop cluster starts with producers, the primary farming activity in the region. From rows of fresh vegetables to blooming orchards and rolling hills of wine grapes, this sector is the heart of specialty crop agriculture in the Sacramento region. The linked processing sector thrives on local specialty crop production. Processing businesses include post-harvest handling, canning, large scale processing, and a range of new boutique processors creating new products for localized markets. Closely linked to specialty crop agriculture processing and production is the distribution sector, which includes businesses such as produce distributors, fruit stands, and farmer's markets who work seamlessly with the production and processing sectors to meet consumer demand. The specialty crop agriculture cluster of producers, processors, and distributors includes many businesses that are vertically integrated. For example, grower-packer-shippers farm, process, and distribute fresh vegetables, and many farming operations rent equipment and offer custom farming services to other growers. It is important to consider the total economic activity generated by the entire specialty crop agriculture cluster in order to quantify the current value in the Sacramento region, and how it will grow in the future.

The economic modeling framework developed under this project relies on an economic model of primary farm production in the Sacramento region and a regional input-output model based on IMPLAN. Together the integrated framework is used to analyze the total economic value of specialty crop agriculture. The analysis approach is decomposed into five central tasks: (i) preliminary analysis, (ii) data gathering and outreach, (iii) primary agricultural production model development, (iv) Input-Output model development, and (v) economic cluster analysis.

2.1 Terminology

Given the technical nature of the analyses described in this report, it is necessary to use some economic jargon so that measures of economic activity can be presented consistently. Changes in economic activity are commonly expressed in terms of the following.

1. **Output value**. The gross sales value of an industry. In crop production, for example, this measure is equal to the price of the crop multiplied by the total production.
2. **Value added**. The net contribution of an industry to the Sacramento region economy. It is equivalent to the commonly-cited national measure of economic activity known as Gross Domestic Product (or GDP).
3. **Employment**: The number of full time equivalent jobs in a sector.

Each measure of economic activity can be decomposed into direct, indirect, and induced components. This is sometimes referred to as the multiplier effect. The components are defined as follows.

1. **Direct.** The economic effects of direct sales activity by an individual agricultural sector. For example, the farm-gate revenues from crop production.
2. **Indirect.** The economic effects of intermediate input purchases by the sector. For example, irrigation supply purchases for crop production.
3. **Induced.** The economic effects of spending by employees in all other industries. For example, farm workers purchase housing and food in the Sacramento region.

The multiplier effect can be expressed in terms of indirect and induced, together or individually, and may include or exclude direct effects. An intuitive way to understand the multiplier effect for this report is to think about the additional jobs (or output value/value added) created for each direct job (or output value/value added) in the sector of interest.

2.2 Organization of the Report

The first section of the report provides an overview of specialty crop agriculture in the Sacramento region. This section includes a description of current and historical trends in acreage and the value of production for major specialty crops to illustrate the significant growth in this industry. The following section describes the data collection effort including the surveys and supplemental data used to populate the economic models developed under this project. Two subsequent sections describe the development of the primary production model and IMPLAN model, respectively. The final section of the report summarizes the economic cluster analysis of specialty crop agriculture using the two models, and presents the market growth scenario for the peach processing sector. The main body of the report is written at a moderate level of technical detail, a series of nine appendices provide the interested reader with additional technical information.

3. Overview of Specialty Crop Agriculture in the Sacramento Region

Specialty crop agriculture is a valuable and growing industry in the six-county Sacramento region. Over the past decade, the farm-gate value of specialty crop production in the Sacramento area has nearly doubled, from $748 million in 2004 to $1.47 billion in 2014. In 2013, the top specialty crops in the Sacramento region based on value of production were walnuts, wine grapes, processing tomatoes, dried plums, and almonds. Across the region, cropland (including specialty crops and non-specialty crop agriculture) accounted for 37 percent of total land use.

Although several specialty crops are grown across the six county region of SACOG, there is a few that drive the production values within the region. Walnuts, wine grapes, and processing tomatoes are the three most valuable crops. Table 1 shows the twelve most valuable specialty crops produced in each of the Sacramento region counties.

Table 1: 2013 Top Specialty Crops (Millions 2016 dollars)

	El Dorado	Placer	Sacramento	Sutter	Yolo	Yuba
Walnuts	0.17	5.46	2.69	**146.54**	64.00	**75.69**
Wine Grapes	8.18	0.94	**144.20**		70.97	
Processing Tomatoes			5.97	24.94	**110.19**	
Almonds				17.77	70.83	3.30
Plums	0.60	0.28		51.48	4.31	24.15
Peaches	1.24	0.54		42.58		19.14
Misc. Vegetables		1.53	24.61	1.14	34.19	
Misc. Nursery	1.75	**9.04**	25.44	0.42	11.16	
Pears	1.62	0.29	43.53			
Misc. Fruits and Nuts	1.32	0.75	3.41	2.93	14.58	11.14
Nursery Stock				25.80	4.26	
Apples	**28.08**	0.37				
Total Specialty Crop Value	46.38	21.85	259.68	340.72	402.97	138.53

Source: California Agricultural Statistics

As shown in bold in Table 1, walnuts were the top value specialty crop in two of the Sacramento region counties, Sutter and Yuba. Wine grapes and processing tomatoes were the highest value crops in Sacramento and Yolo County, respectively. El Dorado's top specialty crop was apples and Placer County generated the most value from miscellaneous nursery products, including Christmas trees.

Farm size also varies across counties in the Sacramento region, reflecting differences in climate, crop mix, and cultural practices. Table 2 summarizes the average farm size in each county using data from the 2012 Census of Agriculture. The Census of Agriculture does not differentiate by specialty crop so these figures represent both specialty crop and non-specialty crop agriculture. Placer and El Dorado counties have a smaller average farm size, reflecting smaller-scale vegetable farming and boutique wineries. The largest average farm size is in Yolo County where processing tomatoes and non-specialty crops such as rice are typically farmed on much larger acreage. Across the Sacramento region the average farm size is just over 200 acres.

Table 2: Average Farm Size (in acres) in Sacramento Region Counties, 2012

El Dorado	Placer	Sacramento	Sutter	Yolo	Yuba	Sacramento Region
95	67	183	276	456	236	206

Source: USDA, 2012 Census of Agriculture

Like most areas in California, the intensity of farming is increasing in the Sacramento region at the same time as the total irrigated footprint is decreasing. Total harvested acreage across the region declined by 31 percent from 1980 to 2014 for all crops. It is noteworthy that harvested acreage in specialty crops increased by 13 percent over the same time period, primarily due to increased plantings of fruits and nuts. The increase in nut production is driven by favorable terms of trade and increasing demand in Asian export markets, as well as increasing domestic demand. Nut prices have stabilized in 2016 in response to a stronger dollar and weakening global demand, declining by as much as 50 percent for some nuts. Figure 1 illustrates this trend.

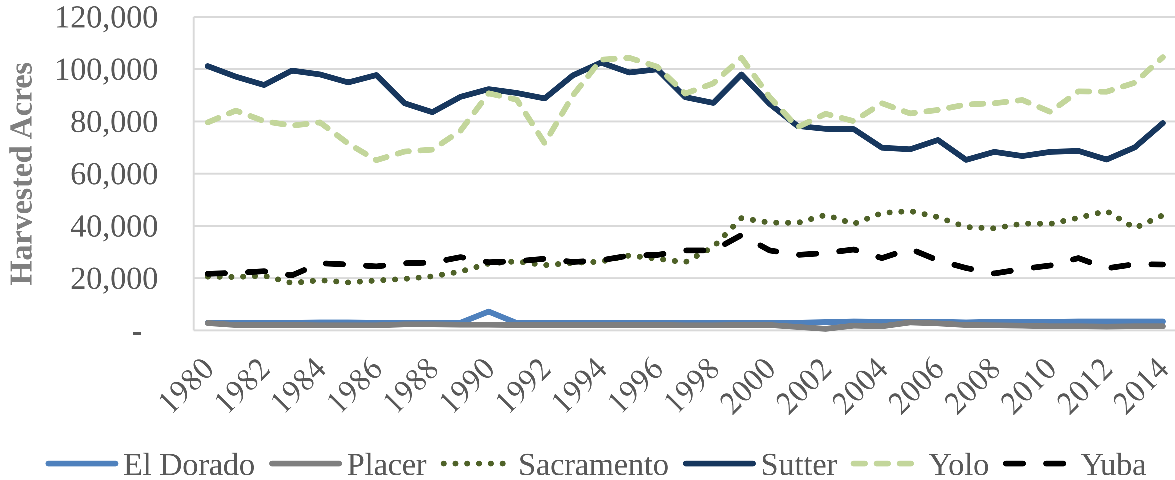
Figure 1: 1980-2013 Total Annual Harvested Acres for All Crops and Specialty Crops in the Sacramento Region

Source: California Agricultural Statistics

Acreage planted to specialty crops across the Sacramento region varies in response to market conditions across the six counties. Figure 2 illustrates the trends in specialty crop acreage in each of the six counties between 1980 and 2014. Sutter and Yolo County experienced an increase in acres, influenced predominately by the demand for nuts. However, other counties including El

Dorado and Placer maintain a fairly stable level of production. Acreage in El Dorado and Placer is primarily planted to orchards and vineyards with stable market conditions.

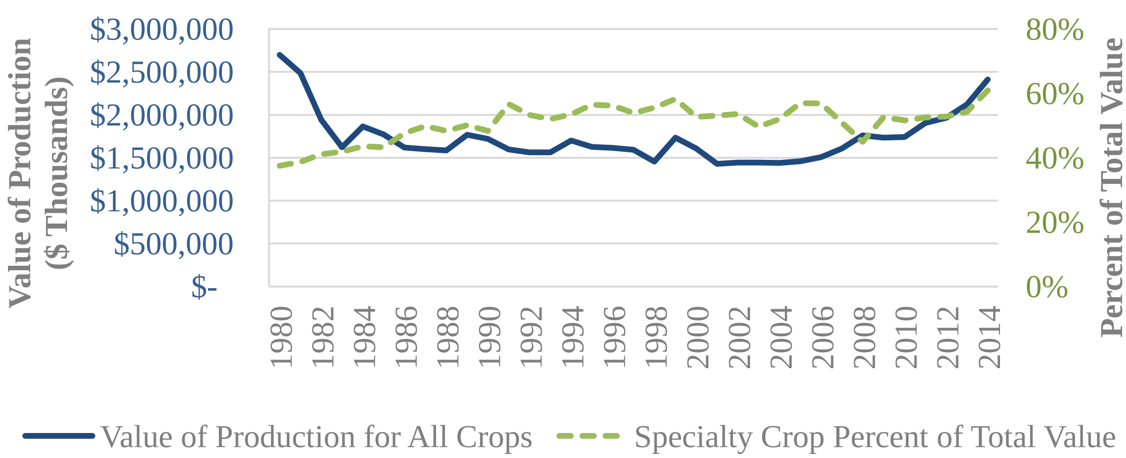
Figure 2: 1980-2014 Specialty Crop Harvested Acreage in the Sacramento Region



Source: USDA NASS, California Agricultural Statistics, 1980-2014

As harvested acreage increased, so did the value of production. In 2014, the total farm-gate value of production for specialty crops was $1.47 billion. Between 1980 and 1984, specialty crops accounted for 41 percent of total crop value. Between 2010 and 2014 this share was equal to 54 percent. As shown in Figure 3, the total value of production for all crops, including livestock and grain, in 2014 was $2.4 billion. From 1980 to 2014, specialty crops have contributed roughly half of the Sacramento region's annual agricultural production value.

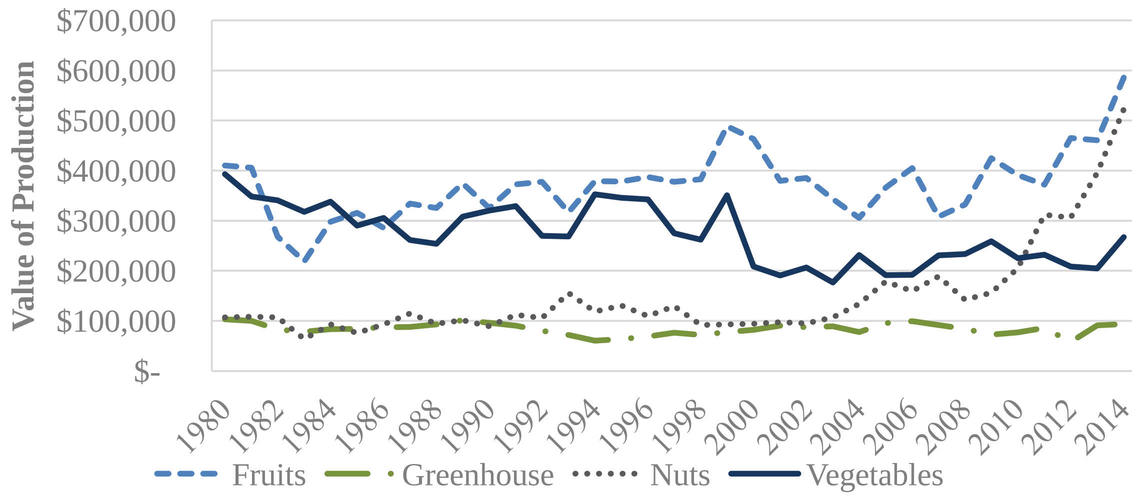
Figure 3: 1980-2014 Value of Production for All Crops and Percent of Value Attributed to Specialty Crops (2016 Dollars)



Source: California Agricultural Statistics

This increase in the share of total agricultural value contributed by specialty crops in the region is driven by a shift in acreage and the farm-gate price received for the crops produced. Fruit production in the Sacramento region area saw an increase in production value of 57 percent from 2011 to 2014. The value of nuts produced in the Sacramento region increased by 268 percent between 2008 and 2014. This has been driven primarily by rising prices as a result of favorable trading conditions and increased demand both domestically and internationally. In 2016, a strong U.S. dollar and weak export economies have dampened this trend and prices have settled back toward long-term averages. Figure 4 illustrates the trend in production value for major specialty crop categories.

Figure 4: 1980-2014 Production Value by Specialty Crop Category (2016 Dollars)



Source: California Agricultural Statistics

Gross farm output values have been increasing at the same time as the price of farm inputs have been increasing, with a net effect on farm income which varies by specialty crop and region. Table 3 summarizes number of farms by gross sales and average net farm income by county using the 2012 Census of Agriculture for all crops, including specialty and non-specialty. The average annual net farm income in the Sacramento region is $54,666 per year. However, the county average ranges from a $3,479 dollar loss in El Dorado County to a $174,606 average net profit in Yolo County. This figures represent a snapshot in time for 2012 market conditions, in the long-run farms are operating with a positive margin in these regions.

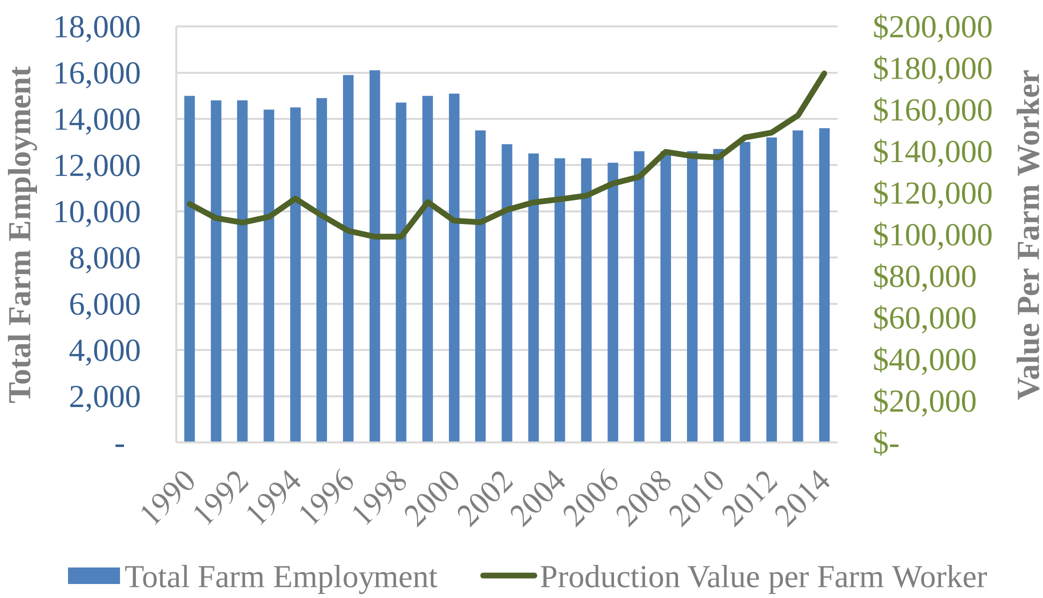
Table 3: Farms by Value of Sales in 2012

	El Dorado	Placer	Sacramento	Sutter	Yolo	Yuba
Less than $1,000	472	428	376	122	213	187
$1,000 to $19,999	589	688	501	272	243	320
$20,000 to $99,999	220	171	224	410	209	86
$100,000 to $249,999	55	28	83	209	105	58
$250,000 to $499,999	15	19	44	122	71	62
$500,000 or more	7	21	124	223	170	82
Total Farms	1,358	1,355	1,352	1,358	1,011	795
Average net cash farm income of operation	-$3,479	-$3,383	$28,073	$106,550	$174,606	$57,000

Source: USDA, 2012 Census of Agriculture

A critical input to specialty crop agriculture is on-farm labor. Figure 5 illustrates the on-farm labor in the Sacramento region using California Employment Development Department (EDD) data. EDD data do not differentiate between specialty crop and non-specialty crop farm labor, so these figures represent the sum of both. From 1990 to 2015, the number of on-farm employees ranged from 12,000 to 16,000 in the Sacramento region. Most counties have seen an increase in on-farm labor from 2005 to 2015 with Yolo County realizing the greatest increase in employees, expanding by 55 percent during that period. Placer and Yuba counties experienced a noticeable decrease in on-farm labor of 50 percent. Overall, the number of workers has been relatively stable in recent years while the value per worker continues to increase significantly. Since 1990, the production value per farm worker has increased by over 54%. The production value per farm worker increased 21 percent between 2011 and 2014, reflecting the recent growth in the value of agriculture in the region.

Figure 5: 1990-2014 On-Farm Employment and Production Value Per Worker



Source: EDD and California Agricultural Statistics

The production of crops, both specialty and non-specialty, in the Sacramento region supports the processing and distribution sectors. Specialty crop food processing across the region had a direct output value of $1.69 billion in 2013. Specialty crop food processors are primarily located in Yolo, Sacramento, and Sutter counties. El Dorado County boasts a robust industry of small and mid-sized wineries, and Placer and Yuba County have fewer specialty crop food processors. Specialty crop distribution includes small shares of large and diverse industries such as wholesale trade, retail food stores, and restaurants. The total output value for specialty crop distribution in 2013 equals $725 million, comprised primarily of fresh produce merchant wholesaling. The majority of the region's specialty crop distribution is located in Sacramento County with twenty-five of the region's thirty-seven fresh produce distributors.

In summary, the Sacramento region boasts a robust and growing sector of specialty crop agriculture. This sector has evolved in response to market conditions, and will continue to do so into the foreseeable future. The following sections of this report describe the primary production model and the IMPLAN model developed by the ERA team to characterize the total specialty crop cluster.

4. Outreach, Surveys, and Industry Data

The ERA team engaged local specialty crop businesses and stakeholders in an outreach and data gathering effort. Industry representatives were contacted early in the project so that key individuals were aware of, and generally supportive of, the project. Following this initial contact, the ERA team surveyed over one hundred specialty crop businesses.

4.1 Outreach

Initial outreach for this project was directed to agricultural organizations in the region. Local county Farm Bureaus, UC Cooperative Extension farm advisors, and Agricultural Commissioners were all provided with a project overview so they could inform their constituencies of the project. In addition, input was sought from umbrella organizations such as the California League of Food Processors.

4.2 Surveys

Growers, processors, and distributors of specialty crops in the Sacramento Region were surveyed to gather the information necessary to quantify specialty crop business expenditure patterns in the Sacramento region. The primary survey reached over 100 specialty crop businesses including growers, processors, and distributors in the Sacramento region. Surveys included a questionnaire used to construct the spending pattern of each of the major industries in the specialty crop cluster.

Based on the default IMPLAN model data, four preliminary crop categories were identified for grower interviews. These include Vegetable and Melon Farming, Fruit Farming, Tree Nut Farming, and Greenhouse and Nursery Farming. Survey priorities for processing and distribution were shaped by a preliminary cluster analysis that used the IMPLAN model to identify key industries linked to specialty crops. In addition, new and emerging markets with high potential for growth were surveyed in order to anticipate industry developments and provide forward-looking results that will remain meaningful as industries change.

The following factors further guided efforts to survey specialty crop growers, processors, and distributors:

1. **Value of production**. Priority was given to industries and sub-sectors with the highest values of production, since expenditures by these producers drive the economic multiplier effects.
2. **Entity size**. Surveys capture a range of entity sizes as expenditure patterns are likely to differ by entity size. For example, small farms are more likely to use custom services and to lease machinery whereas larger farms, with economies of scale, are more likely to keep these operations in-house.

Surveying efforts were challenged by the complexity and detail of the financial information requested, which is necessary to complete the analyses. Nonetheless, the quantity and diversity of surveys received are sufficient to inform the modeling and analysis. Table 4 summarizes survey activities by type of entity. One hundred and sixteen specialty crop growers, processors, and distributors were contacted to participate in the survey and 36 provided complete survey responses. To obtain these survey responses, potential survey respondents were called, emailed, and interviewed in-person through 307 unique communications.

Table 4: Sacramento Region Survey Results

Type of Entity	Entities Contacted	Communications	Returned Surveys
Growers	31	76	14
Processors	60	171	13
Distributors	25	60	9
General Ag Organizations	19	33	N/A
Total	116	307	36

Grower surveys were received from all major specialty crop sectors. All major processing industries were also surveyed. Surveys of potential industries that are currently absent in the Sacramento region, such as frozen fruit processing, were obtained from processors in other Northern California counties. Distributor surveys targeted produce distributors, grower-packer shippers, and produce stands in the SACOG region. In addition, surveys were obtained from farm product trucking companies, cold storage facilities, and broadline distributors. The survey instruments used in the analysis can be found in Appendix C.

5. Primary Agricultural Production Model for the Sacramento Region

The specialty crop cluster starts with producers, the primary farming activity in the region. From rows of fresh vegetables to blooming orchards and rolling hills of wine grapes, this sector is the heart of specialty crop agriculture in the Sacramento region. Production decisions at the field filter through all of the related sectors of the economy. Field-level production decisions are driven by a range of factors including experience, soil conditions, microclimate, access to markets, and in some cases, regional policy changes may also affect farming decisions.

The ERA team developed a primary model of field production which explicitly links to the regional IMPLAN model sectors developed in this study. The primary model is an economic optimization model that estimates field-level production decisions and the responsiveness of the farming industry to changes in market conditions, technology, and other factors. These changes, in turn, feed directly into the IMPLAN model which simulates the effect in all related industries. Combined, the linked models show the total economic effect of a change in the agricultural sector. The technical details of the primary agriculture model are provided in Appendix B, this section provides an overview of the model and application for this study.

5.1 Model Overview

The primary model is an economic model of irrigated agricultural production that simulates the decisions of agricultural producers (farmers) in the Sacramento region. The model assumes that farmers maximize profit subject to resource, technical, and market constraints. Farmers sell and buy in competitive markets, and no one farmer can affect or control the price of any commodity. The model selects those crops, water supplies, and other inputs that maximize profit subject to constraints on water and land, and subject to economic conditions regarding prices, yields, and costs. A central feature of this modeling approach is that the model calibrates to, meaning it exactly reproduces, the observed farmer planting decisions in a set of base years. As such, it represents a robust framework for simulating the response to changes in policy and resource conditions.

The primary model is calibrated using the method of Positive Mathematical Programming (PMP), a widely-accepted economic modeling approach which has been used and subject to peer review[3,4] for the last several decades. The essence of the PMP economic modeling approach underlying the primary model can be described as follows. The decision by profit-maximizing producers to plant certain crops, given the market for those crops and the market for inputs, tells us about the physical and economic ability to produce crops in certain areas. These observed grower decisions are combined with additional information about market conditions, variability

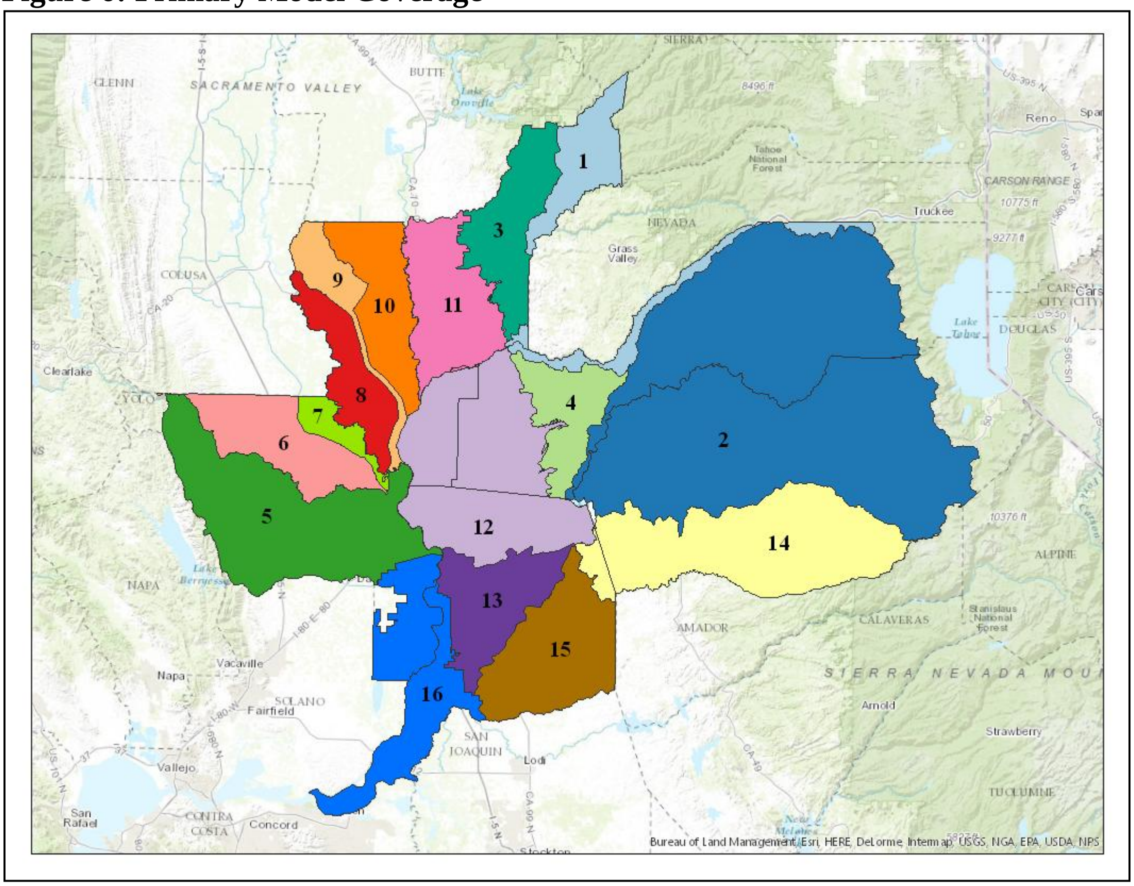
[3] Howitt. R.E. (1995). "Positive Mathematical Programming." American Journal of Agricultural Economics. 77(2): 329-342.
[4] Howitt. R.E, Medellín-Azuara. J, MacEwan. D, and Jay R. Lund. (2012) "Calibrating Disaggregate Economic Models of Agricultural Production and Water Management" Environmental Modeling and Software. 38: 244-258.

over time, and well-established economic principles to calibrate an economic model. For example, peaches are primarily produced in Yuba County because of soil and climate conditions (physical criteria) and a critical mass of growers with the detailed knowledge required to manage various risks and produce a profitable crop (economic criteria), as well as other considerations. In addition, Yuba County peach growers, like all peach growers, are subject to market fluctuations that affect aggregate demand and supply for their crop, ultimately determining the market-clearing price, and in turn, farm-gate profitability. The PMP approach is a method that combines all of this information to calibrate a model that exactly reproduces what growers actually do. The model is then used to simulate changes in production in response to changes in conditions (sometimes referred to as "policy simulations").

5.2 Model Coverage

The primary model covers all irrigated agriculture in the Sacramento region, represented by 16 different model regions. The subregions are based on water budget areas, called Detailed Analysis Units, which are commonly used for water planning in California. The model scope is shown in Figure 6.

Figure 6: Primary Model Coverage



The primary model regions are specified on the basis of 16 DAUs in the Sacramento region, which can be decomposed into 24 regions if county boundaries are included.

Figure 6 illustrates the 16 regions in the primary model. The figure also shows the county lines to illustrate model region DAUs which span multiple counties. For example, region 16, "Sacramento Delta" includes portions of Sacramento and Yolo Counties. Delta agriculture is relatively homogenous, with high-value vegetable and fruit production and corn, grain, and fodder field crops being produced in both Yolo and Sacramento Counties.

Crops are aggregated into 17 crop groups which are the same across all regions, although not all crops are produced in all regions. Each crop group represents a number of individual crops, but many are dominated by a single crop. Total acreage within any one crop group represents all of the crops within the group, production costs and returns are represented by a single proxy crop for each group. For each group, the representative (proxy) crop is chosen based on four criteria: (i) a detailed production budget is available from the University of California Cooperative Extension (UCCE) or from primary surveys completed under this project, (ii) it is the largest or one of the largest acreages within a group, (iii) its water use (applied water) is representative of water use of all crops in the group, (iv) its gross and net returns per acre are representative of the crops in the group.

5.3 Policy Simulation with the Primary Model

The fully specified base model is written and solved using a well-known but commercially-based program called GAMS (Generalized Algebraic Modeling System). The GAMS Development Corporation provides a free version of the program that can be downloaded and will run standard nonlinear algorithms. This free version GAMS restricts the maximum dimensions of constraints and variables possible in the model to be less than 300. Accordingly, the fully specified base model has been simplified, as described in Appendix B, enabling it to be solved with the free GAMS software in the initial stages of analysis. The principle applied was to simplify the model in terms of the complexity of the production function specification and price formation, but retain the full 16 regions and 17 potential crops that show the essential trade-offs in agricultural production within the Sacramento region.

For consistency with the IMPLAN model, the base year in the primary model is defined to be 2013. All prices, costs, land use, and market conditions, used to calibrate the model are for 2013. Having calibrated the model using the 2013 data, the model is then used for policy simulations under future conditions, and dollar values are deflated to current (2016) values.

The primary production model is a robust framework that can be used to simulate a range of policy responses. For example, changes in prices, yields, climate, water availability, and other changes in resource availability, as well as policy changes that affect production input costs. The ERA team has applied the model to evaluate the total contribution of specialty crop agriculture in the Sacramento region, and the impact of growth in the frozen fruit processing sector. Both of these analyses link to the IMPLAN model, described in the following section, and the results of the analyses are summarized in a subsequent section of this report.

6. Custom IMPLAN Model for the Sacramento Region

The ERA team analyzed specialty crop economic linkages using the social accounts available in the IMPLAN software, other underlying IMPLAN data, data collected through the primary survey of specialty crop businesses, and supplemental information compiled from other publically available sources and industry reports. This section of the report provides a summary of the refined structure of the specialty crop agriculture industry cluster within the greater Sacramento region for the custom IMPLAN model. The specialty crop industry cluster is defined by the magnitude of input purchases and output sales by and between the businesses that grow, process, and distribute specialty crops in the Sacramento region. This primarily takes the form of purchaser and supplier relationships, but also includes payments to governmental agencies, proprietor's income, and other monetary transfers.

6.1 IMPLAN

This study utilizes the IMPLAN Version 3.1 software package, in conjunction with the 2013 R3 IMPLAN economic data file for El Dorado, Placer, Sacramento, Sutter, Yolo, and Yuba counties in California. The IMPLAN software functions as an input-output economic model, which estimates the effects of assumed exogenous changes in final demand within the specified geographic region. The model leverages a robust data set of national and regional economic accounts that document purchasing relationships between industries through multiple rounds of spending. The software also incorporates institutional demand and inter-institutional transfers, which reflect purchases made by households and government agencies. An overview of the IMPLAN modeling effort is provided here and a more detailed discussion is available in Appendix D.

6.1.1 Model development

The output values typically generated through IMPLAN input-output analysis include the direct, indirect, and induced economic impacts. These are most commonly expressed in terms of output, but may also be expressed in terms of employment, labor income, or one of the four components of value added (employee compensation, proprietor income, other property type income, or tax on production and imports). By definition, the direct impacts are associated with the initial dollars spent within the study area. Amounts paid to entities located outside of the study area are excluded from the analysis and considered economic "leakage" because these dollars do not circulate within the local economy and thus cannot be counted among the local economic impacts. As a result, the direct impact estimates reported in the model outputs may differ somewhat from the gross dollar values that are initially reported, since the direct impact estimates account for economic leakage. The indirect impacts are estimated as industries that receive direct spending for the purchase of materials and services necessary for production. Induced impacts result from household consumption made possible by wages paid to workers and by income generated to proprietors and institutions. When combined, this cycle of spending represents an economic multiplier effect, by which a direct increase in exogenous demand, as input from the economic primary production model, results in a total economic effect that is greater than the initial direct impact.

6.1.2 Customizing the IMPLAN Model

An evaluation of the data underlying the IMPLAN model identified that at least some of the default data for the four crop sectors may not be fully representative of economic activity associated with specialty crop farming in the Sacramento region. For example, data on the ratio of value added to output is based on national benchmark data provided by the U.S. Bureau of Economic Analysis (BEA). While IMPLAN utilizes detailed county-level data to define the output values associated with agricultural commodities, the model estimates total value added based on national benchmark data provided by the BEA. The breakdown of value added is similarly derived, since the BEA reports things like proprietor income only at the farm level with no detail provided that would help to distinguish between commodities. While the IMPLAN model offers a detailed spending profile for intermediate expenditures, the list of commodities purchased is held constant across commodities. Likewise, purchasing coefficients are held constant in proportion to the intermediate expenditure coefficient. Though this model reflects the best information that is available on a national basis, modifying the model using alternative data sources that better reflect the characteristics of the local specialty crop agricultural producers and related industries makes it possible to leverage the robust systematic methods associated the IMPLAN input-output software while also improving the accuracy of the resulting multipliers.

In order to develop a customized IMPLAN model that more accurately reflects the expenditures by specialty crop growers, processors, and distributors within the SACOG region, the ERA team supplemented primary survey data with assorted secondary data. When developing unique subsectors of industries, survey data is insufficient to establish the output value of the subsector and additional data is needed. For instance, to model processing tomato farming as an activity separate from vegetable and melon farming, the total output value for processing tomato farming must be known. USDA statistics provide the basis for determining the output value for crops and other data sources are used for subsectors in the processing and distribution industries.

Complicating efforts to determine the value of sectors and subsectors in the Sacramento region specialty crop food system is IMPLAN's use of North American Industry Classification System (NAICS). Businesses are assigned a single NAICS codes based on their "primary business activity". For this reason, revenues for businesses producing more than one product are imperfectly translated using NAICS. A farm growing processing tomatoes, wheat, and almonds produces three diverse products but is only classified by its primary business activity.

The ERA team developed custom IMPLAN model sectors reflecting 19 specialty crop production in the Sacramento region. However, the IMPLAN National Trade Flows Model data limit the ability of an analyst to customize a range of sectors simultaneously. As such, the ERA team developed two custom IMPLAN models, one with modified industry sectors for the default IMPLAN groupings, and one with all 19 custom industry sectors. The result is a flexible modeling framework that can be used to evaluate policy changes and industry-specific multiplier effects, and corresponding economic contribution.

The two custom models developed for this research include one that is aggregated to correspond to the default IMPLAN sectoring scheme and one that is disaggregated using re-purposed IMPLAN sectors that represent custom industry sectors that were broken out from the default industries. Both the aggregated and disaggregated models include custom industry data based on the ERA team's research into specialty crop businesses.

In the aggregated model, the custom industry profiles for each break-out sector were combined using a weighted average method. The aggregated custom model will provide the most reliable and internally consistent economic impact results because the IMPLAN National Trade Flows Model is preserved. The disaggregated model can be used to evaluate the economic multiplier effects of individual specialty crop agriculture sectors. This difference is because the trade flow data associated with re-purposed IMPLAN sectors (those used to represent custom industry sectors, such as the tobacco farming sector which was re-purposed to represent the processing tomato farming sector) may not be fully representative of the custom industry trade flows. This affects dollars flowing into the custom sector, and therefore, analyses focused on dollars flowing out of custom sectors can be reliably modeled using the disaggregated model.

6.2 Custom IMPLAN Model Sectors

Based on survey responses, industry research, and preliminary IMPLAN analysis, custom subsectors were created from existing sectors to be added to the specialty crop cluster using a two-step process. A list of subsectors was generated including subsectors that were either (i) industries that comprise a large share of an IMPLAN specialty crop sector, (ii) an industry with strong connections to other specialty crop sectors in the region such as input suppliers or processors, (iii) a specialty crop industry with high leakage to other geographical areas, or (iv) emerging specialty crop industries in the Sacramento region. This list was evaluated using survey data to exclude industries for which the default IMPLAN sector is representative of the identified industry. The result is a set of specialty crop agriculture industries that are significant in the Sacramento region, but are not currently represented in the default IMPLAN model. The custom IMPLAN model includes a total of 19 sectors representing the specialty crop agriculture cluster. Table 5 summarizes the list of sectors.

Table 5: Custom Sectors in the IMPLAN Model

SACOG IMPLAN Model	Default IMPLAN Model Sector
Producers	
Processing tomato farming	Vegetable and melon farming
Misc. vegetable farming	Vegetable and melon farming
Misc. fruit farming	Fruit farming
Olive farming	Fruit farming
Peach farming	Fruit farming
Wine grape farming	Fruit farming
Walnut farming	Tree nut farming
Misc. tree nut farming	Tree nut farming
Greenhouse, nursery, and floriculture prod.	Greenhouse and nursery production
Processors	
Nut hulling	Support activities for agriculture and forestry
Support activities for ag. and forestry	Support activities for agriculture and forestry
Olive oil mills	Soybean and other oilseed processing
Frozen peach processing	N/A
Processing tomato canning	Canned specialties
Canned specialties	Canned specialties
Canned fruits and vegetables mfg	Canned fruits and vegetables mfg
Dehydrated food products mfg	Dehydrated food products mfg
Boutique nut processing	Roasted nuts and peanut butter manufacturing
Roasted nuts and peanut butter mfg	Roasted nuts and peanut butter manufacturing
Wineries	Wineries and distilleries
Distributors	
Packer-shippers	Wholesale trade
Produce distributors	Wholesale trade

6.3 IMPLAN – Primary Production Model Crosswalk

The primary model links directly to the IMPLAN model developed for the project. Table 6 shows the crosswalk between IMPLAN sectors and the primary model. All crops, not just specialty crops, are included in the primary model because the joint production of some crops is an important factor in planting decisions. For example, as a nitrogen-fixer alfalfa is sometimes included as a break crop to improve fertility in a multi-year rotation system. The primary model crop groups are linked to the IMPLAN model sectors by using the crosswalk. Changes in gross revenues (output value) can be input into the IMPLAN model to simulate the effect of that change in primary production on the related processing and distribution sectors. The integrated framework can be used to simulate the specialty crop agriculture cluster.

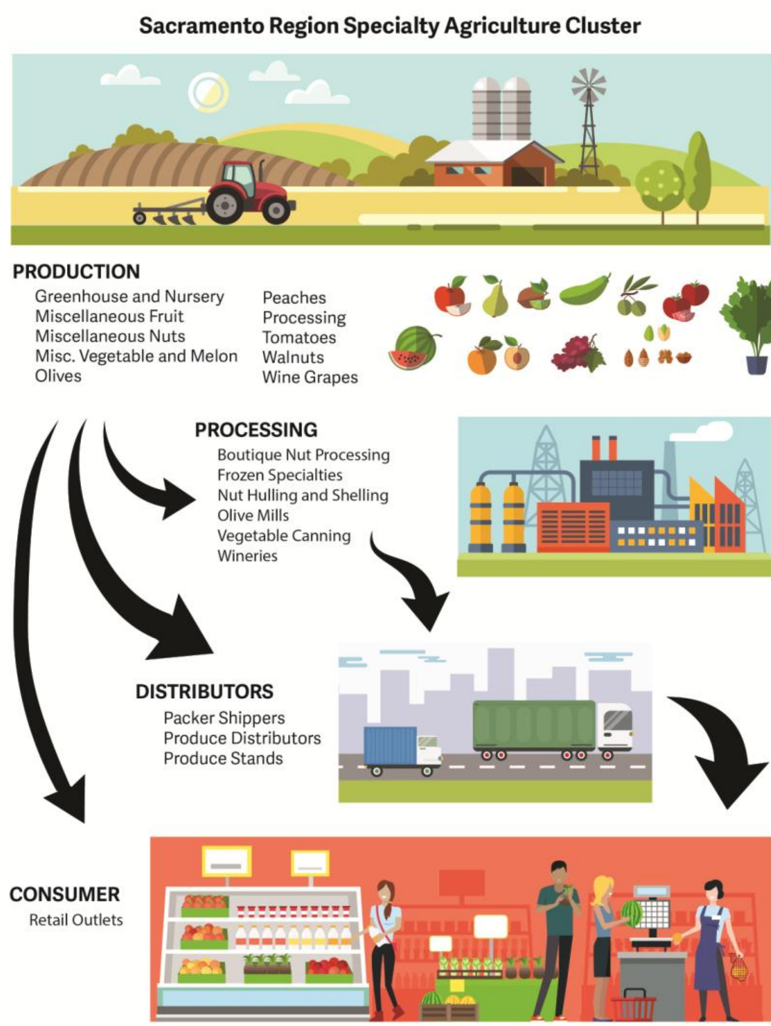
Table 6: Primary Model – Custom IMPLAN Model Crosswalk

Number	Crop Group	IMPLAN Sector Number	IMPLAN Sector Name
1	Alfalfa	10	All other crop farming
2	Almonds	5	Misc. tree nut farming (revised)
3	Corn	2	Grain farming
4	Cucurbits	3	Misc. vegetable farming (revised)
5	Dry Beans	10	All other crop farming
6	Grain	2	Grain farming
7	Olives	9	Olive farming
8	Other Deciduous	4	Misc. fruit farming (revised)
9	Other Field	1	Oilseed farming
10	Other Truck	3	Misc. vegetable farming (revised)
11	Pasture	11	Ranching and grazing farming
12	Peach	23	Peach farming (custom)
13	Processing Tomatoes	7	Processing tomato farming (custom)
14	Rice	2	Grain farming
15	Safflower	1	Oilseed farming
16	Vines	25	Wine grape farming (custom)
17	Walnuts	26	Walnut farming (custom)

7. The Value of Specialty Crop Agriculture in the Sacramento Region

The specialty crop cluster starts with producers, the primary farming activity in the Sacramento region. From rows of fresh vegetables to blooming orchards and rolling hills of wine grapes, this sector is the heart of specialty crop agriculture in the Sacramento region. The linked processing sector thrives on local specialty crop production. Processing businesses include post-harvest handling, canning, large scale processing, and a range of boutique processors creating new products for localized markets. Closely linked to specialty crop processing and production is the distribution sector, which includes businesses such as produce distributors, fruit stands, and farmer's markets who work seamlessly with the production and processing sectors to meet consumer demand. Figure 7 illustrates the specialty crop agriculture cluster in the Sacramento region.

Figure 7: Specialty Crop Agriculture Cluster Graphical Representation

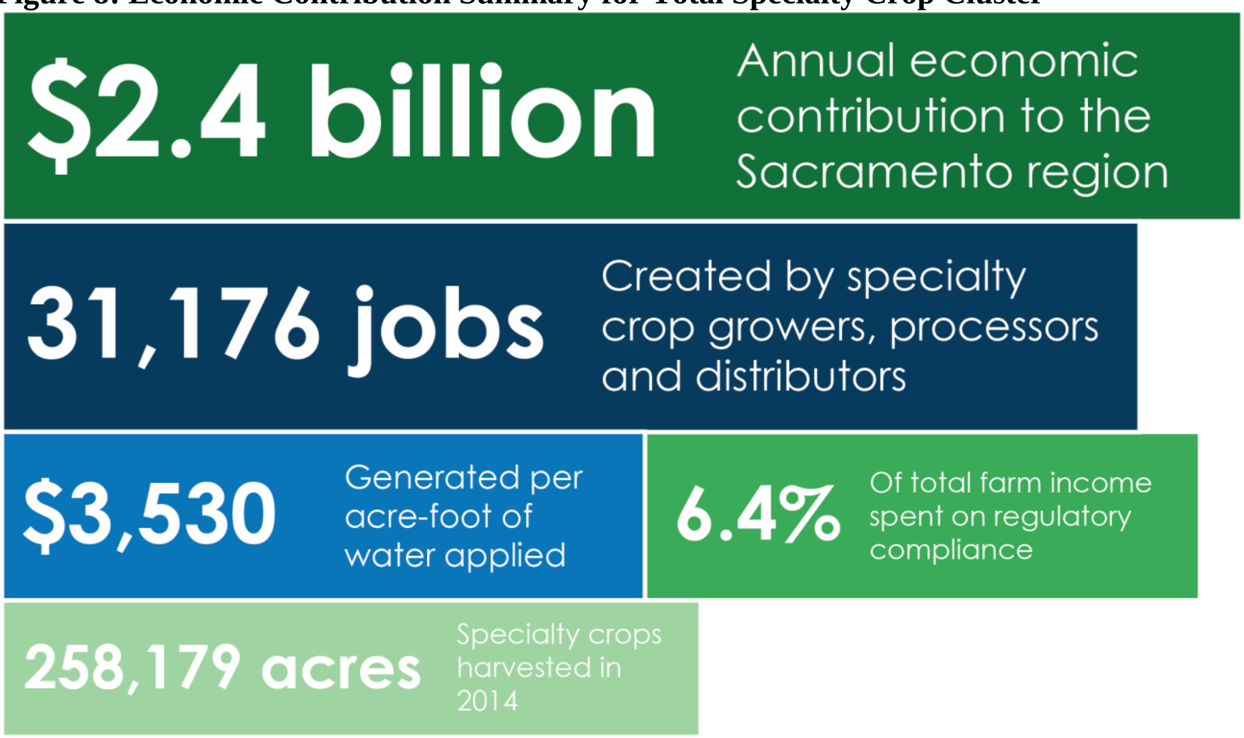


7.1 The Economic Contribution of Specialty Crop Agriculture

The economic contribution of an industry is a measure of the total jobs, output (sales) value, and value added created by the industry, considering the expenditures in all related industries. It is a true measure of the importance of an industry to the local economy. The contribution is expressed in terms of direct effects and indirect and induced effects (together "secondary" effects) for key measures of jobs, output value, and value added. Value added is the key measure of economic contribution because it excludes double counting the gross sales value between industries in the same cluster. The custom IMPLAN model is used to evaluate the total economic contribution of all specialty crop agriculture businesses included in the cluster, and for each of the specialty crop clusters – producers, processors, and distributors – individually.

Taken together the specialty crop cluster in the Sacramento region generates $3.9 billion in direct output value annually. Including indirect and induced multiplier effects, representing expenditures in ancillary businesses and by employees, respectively, the total output value exceeds $5.8 billion annually. The total value added contribution to the Sacramento region economy from the specialty crop agriculture cluster equals $2.4 billion dollars annually and supports over 31,000 full time equivalent jobs. Figure 8 illustrates the economic contribution of the Sacramento region specialty crop agriculture economic cluster.

Figure 8: Economic Contribution Summary for Total Specialty Crop Cluster

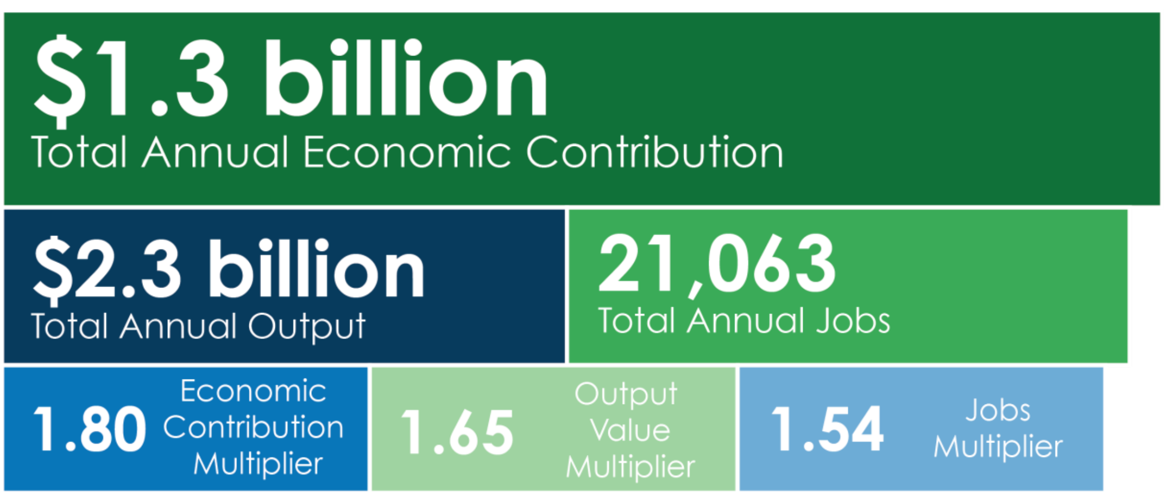


7.1.1 Specialty Crop Producers Economic Contribution

The specialty crop production sector is comprised of 10 IMPLAN model categories: nine farming activities and one sector for support services. The sector includes growth markets such as olives for olive oil — a crop well suited for the region’s Mediterranean climate. Americans consumed 317,000 metric tons of olives in 2015 compared to just 55,000 metric tons in 1985 and California olive oil producers have responded to the trend by doubling olive oil output every year for the last ten years. The peach sector is another growth sector which includes production of freestone and clingstone peaches for fresh market and processing. The share of peaches in the U.S. that are frozen tripled from 3 percent of available peaches in 1970 to 9 percent in 2013. A unique specialty crop sector is greenhouse, nursery, and floriculture production. Most of the value in this sector is generated by nurseries that raise immature tree fruits, tree nuts, and vines. These are typically transplanted for commercial agriculture, so this sector represents a strong connection as an input to fruit farming and nut farming as well as to other greenhouse and nursery firms.

The specialty crop production sector, including primary crop farming and support services, contributes a total (including all multiplier effects) annual economic value added of $1.3 billion to the Sacramento region. This value added is generated on total annual output value of $2.3 billion and creates 21,063 jobs in the Sacramento region. Figure 9 illustrates the contribution of the primary production sector. The value added, output value, and jobs multipliers show the additional economic activity generated for each dollar of direct value added, output, and jobs created by the producer sector.

Figure 9: Economic Contribution Summary for Producers

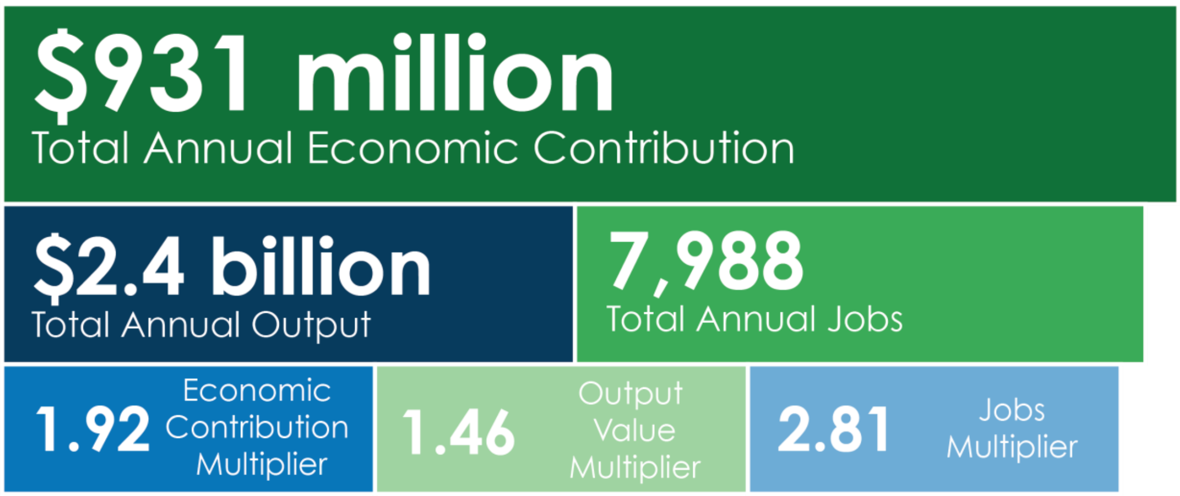


7.1.2 Specialty Crop Processors Economic Contribution

The processing sector includes a range of supporting business related to primary crop production, typically for post-harvest handling. This first-stage of post-harvest processing typically takes place relatively near the farm, therefore economic activity is likely to remain in the region with relatively little leakage. Some of these processing sectors include nut hulling and other processing, olive milling, and vegetable canning. This cluster also includes potential growth industries such as frozen fruit processing, and current growth industries such as wineries.

The specialty crop processing sector contributes a total (including all multiplier effects) annual economic value added of $931 million to the Sacramento region. This value added is generated on total annual output value of $2.4 billion and creates 7,998 jobs in the Sacramento region. Figure 10 illustrates the contribution of the processing sector. The value added, output value, and jobs multipliers show the additional economic activity generated for each dollar of direct value added, output, and jobs created by the processing sector.

Figure 10: Economic Contribution Summary for Processors

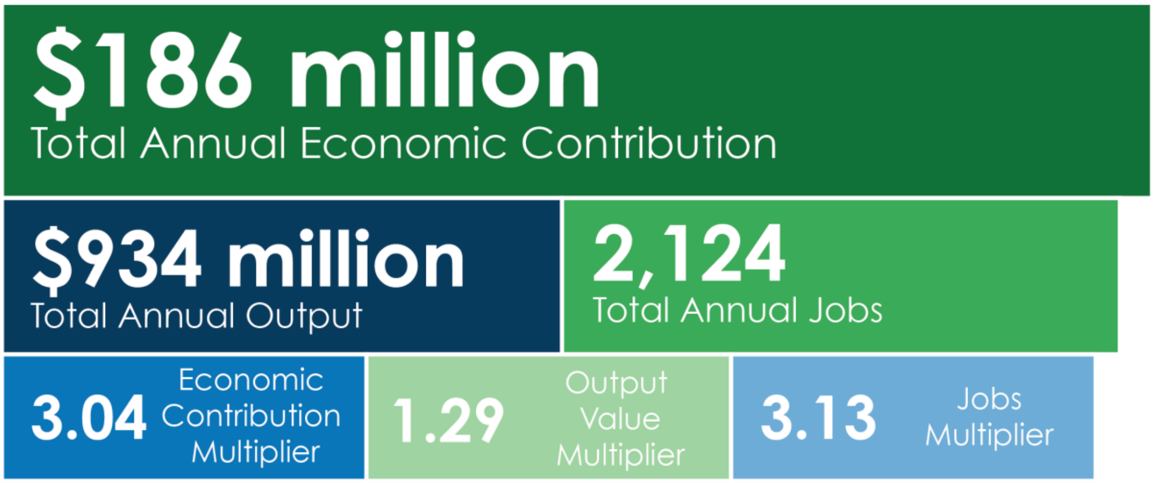


7.1.3 Specialty Crop Distributors Economic Contribution

Consumers, particularly domestic markets, increasingly demand fresh produce. The farming industry has met this demand by growing more produce for the fresh market and by improving shelf-life through increased prevalence of on-farm refrigeration and breeding improvements. As more produce is marketed through fresh market distribution channels, fresh produce distributors and packer-shippers have become increasingly important in the specialty crop agriculture economic value chain. The produce distribution sector includes the primary packing and shipping of specialty crop production. Grower-packer-shippers fill an important niche in creating a market for specialty crop growers. This sector includes first-handlers that market crops for growers, many of which are in fact grower-shippers that market production for themselves as well as others. Marketing is typically confined to one or a few crops, but these businesses are, by definition, vertically integrated (grower-packer-shippers), and create strong connections to the specialty crop production sectors. Produce distributors offer primarily perishable items or possibly just fresh produce, delivering to food service and retail outlets.

The specialty crop distribution sector contributes a total (including all multiplier effects) annual economic value added of $186 million to the Sacramento region. This value added is generated on total annual output value of $934 million and creates 2,124 jobs in the Sacramento region. Figure 11 illustrates the contribution of the distribution sector. The value added, output value, and jobs multipliers show the additional economic activity generated for each dollar of direct value added, output, and jobs created by the distribution sector.

Figure 11: Economic Contribution Summary for Distributors



7.2 Specialty Crop Agriculture Economic Multipliers

Another way to conceptualize the economic contribution of specialty crop agriculture is by calculating a multiplier. An economic multiplier is a parameter that describes the ripple effects of changes in final demand in one industry on all related industries. Multipliers are expressed in terms of direct, indirect, induced, and total effect for jobs, value added, and output value contribution of each sector. By definition, the direct effect multiplier is equal to one.

Table 7 summarizes the output value multiplier for each of the default sectors in the IMPLAN model and each of the custom IMPLAN sectors created by the ERA team. The output value multiplier shows the additional dollars generated for each dollar in output (sales) by the primary industry. For example, for every dollar in direct sales by the vegetable and melon farming sector (farm-gate revenue), there is an additional 43 cents of output value (sales) created in other linked industries. This includes input purchases, and spending by employees in the local economy. The custom IMPLAN model has been defined with a miscellaneous vegetable farming sector and a processing tomato farming sector using the data compiled by the ERA team. The output multiplier increases for both indirect and induced effects over the default sector. Table 7 additionally illustrates the percent change in the multiplier relative to the default IMPLAN data, the industry output value, and the effect of the revised multiplier on the total economic value of activity generated in the Sacramento region.

Table 7: IMPLAN Output Multipliers for Specialty Crops

Industry	Default Model Output Multiplier	Custom Model Output Multiplier	Percent Change	Industry Output Value ('000)	Effect of Multiplier Revision ('000)
Miscellaneous vegetable farming	1.43	1.74	22%	$78,528	$17,043
Processing tomato farming		1.87	31%	$135,002	$41,571
Miscellaneous fruit farming	1.50	1.82	21%	$113,402	$24,373
Olive farming		1.70	13%	$5,998	$795
Peach farming		1.63	9%	$34,931	$3,142
Wine grape farming		1.78	19%	$123,342	$22,928
Miscellaneous tree nut farming	1.45	1.85	28%	$107,778	$30,112
Walnut farming		1.65	14%	$335,572	$45,763
Greenhouse, nursery, and floriculture prod.	1.51	1.59	5%	$171,787	$9,275
Support activities for ag. and forestry	1.51	1.54	2%	$344,611	$6,668
Nut hulling		1.48	-2%	$16,511	($337)
Olive oil mills	1.34	1.57	18%	$6,841	$1,217
Frozen peach processing	0.00	0.00	0%	$0	$0
Canned fruits and vegetables mfg	1.50	1.51	0%	$181,090	$574
Canned specialties	1.56	1.53	-2%	$46,969	($783)
Processing tomato canning		1.64	5%	$300,000	$14,833
Dehydrated food products manufacturing	1.45	1.46	0%	$285,398	$773
Roasted nut and peanut butter mfg	1.50	1.49	-1%	$661,937	($6,379)
Boutique nut processing		1.24	-17%	$5,000	($866)
Wineries	1.63	1.63	0%	$185,082	$284
Wholesale trade	1.55	1.63	5%	$8,207,725	$430,281
Produce distributors and shippers		1.61	4%	$725,220	$26,804
Change (relative to default IMPLAN data)	-	-	5.5%		$668,071

The custom IMPLAN model, based on surveys and supplemental data, confirms that the default IMPLAN model multipliers are not representative of specialty crop agriculture in the Sacramento region. Intermediate expenditures (input purchases) by specialty crop businesses represent a higher proportion of total expenditures than shown in the default IMPLAN model based on national trade flow averages. As such, the output value contribution is actually higher than shown in the default IMPLAN data, but the value added contribution is lower. This is because a larger proportion of purchases are going to other specialty crop businesses. However, it is also true that more of these expenditures stay within the Sacramento region. As shown in Table 7, the net effect is an increase in the total output value generated by the specialty crop agriculture cluster equal to $668 million, representing a 5.5 percent increase. Small changes in the multipliers generate a significant change in total economic contribution of the specialty crop cluster. The custom IMPLAN model multipliers represent a significant improvement in accuracy over the default IMPLAN model data.

8. Conclusion

This report summarizes the outcomes of a comprehensive 11 month study of the specialty crop agriculture cluster in the Sacramento region. The ERA team developed a suite of tools that can be used to evaluate the economic contribution of the specialty crop agriculture cluster, and evaluate the impact of new policies or changes in market conditions that may affect this sector. The standard IMPLAN model includes a limited number of specialty crop sectors and the data used to populate the expenditure patterns describing the key financial linkages in the model are based on national averages which are not representative of Sacramento region agriculture. The ERA team developed a linked economic and regional modeling framework by developing an economic model of primary crop production and a custom IMPLAN model. These models were developed using primary data from a comprehensive, and confidential, survey of over one hundred specialty crop businesses in the Sacramento region.

Using the primary production model and the IMPLAN model to evaluate the economic contribution of the specialty crop agriculture cluster, this analysis finds that the total value added contribution equals $2.4 billion annually. The value added is generated on over $5.8 billion in total output value, and supports over 31,000 jobs. Put another way, through the lens of economic multipliers, there are over 17,000 direct jobs in the specialty crop cluster and every job in specialty crops generates another 0.82 jobs in other areas of the economy. Specialty crop industries directly contribute over $1.2 billion in total value added to the regional economy. For every dollar in value added, $0.90 in additional value added is generated across other industries. Total output value of the specialty crop sector is approximately $3.9 billion, with each $1 of output generating an additional $0.49 of output in all other sectors of the specialty crop cluster.

Looking forward, robust growth in the specialty crop agriculture cluster is likely because the Sacramento region has comparative advantages in water and climate, and more importantly, produces a set of healthy, safe, and reliable crops that are in high demand in domestic and international markets. In particular, the on-going shift toward high-value locally consumed fresh fruit and vegetables, and growth in the export market for high-value nut crops will drive growth in the specialty crop agriculture cluster. Sacramento region specialty crop agriculture also benefits from “boutique” industries that pop-up to capture a specialized market. For example, in the foothill regions the winery industry has grown both in volume, but more importantly, in prestige of the wineries. Along with this increase in prestige and value has come a burgeoning tourist industry, which contributes to the regional economy. Olive oil is another success story where the traditional low-productivity olive oil production in the Sacramento region with high volume commercial production using mechanized harvesting and pruning systems, has partially shifted to traditional tree production and harvesting specializing in boutique olive oil sales.

Specialty crop agriculture generates higher value per unit land (and water) than most non-specialty crops, and has the potential to generate additional employment in secondary processing and distribution. While many regions of California’s premier agricultural economy are reeling from drought and water restrictions, the Sacramento region specialty crop agriculture cluster is well suited for years of robust growth.

8.1 Lessons Learned and Future Considerations

The most important lesson learned from this project is that the default IMPLAN data does not accurately characterize the expenditure patterns of specialty crop agriculture businesses. In fact, the default IMPLAN data does not accurately characterize expenditure patterns for most agriculture-related industries. An in-depth evaluation of the data underlying the IMPLAN model identified that key parameters of the default data for the 14 agricultural crop and livestock sectors is based on national benchmark data provided by the BEA. While IMPLAN utilizes detailed county-level data to define the output values associated with agricultural commodities, the model estimates total value added based on national benchmark data provided by the Bureau of Economic Analysis (BEA). These trade flows are imposed on specialty crop agriculture in the Sacramento region, and the survey of specialty crop agriculture businesses found that these national averages are significantly different than actual practices. In particular, the proportion of expenditures on inputs (intermediate expenditures) is significantly higher than in the default IMPLAN trade flow data. The ERA team has created custom specialty crop sectors which better reflect actual expenditures, but future analysis should consider other farming sectors and ancillary businesses.

Surveying specialty crop businesses is a time-intensive process. The ERA team spent significant time calling, emailing, and following up with survey respondents. The ability to capture this survey information is critically important for the success of the project, as is the ability to leverage additional data to integrate with the survey results. Ideally, the survey process would start in the late summer and continue through the fall, leading up to the holidays. This preliminary data would be analyzed over the following 8 months, and follow-up surveys would take place in the following late summer and fall. This would allow time to gather data, analyze the data, and formulate follow-up questions while respecting the standard work schedules of specialty crop farmers.

There are several limitations to the modeling framework developed and SACOG should be cautious developing the models and applying the results. In particular, trade flows in the newly-created custom sectors default to the existing sector categories. This has several implications for policy analysis, most importantly the measures of household demand, institutional demand, and export values are unreliable. To circumvent this problem, the ERA team developed an aggregated version of the IMPLAN model which includes all of the data gathered under this project combined into the existing IMPLAN model sectors. The aggregated and disaggregated models are powerful analysis tools that should be used and interpreted carefully. This report and the appendices carefully document these limitations.

Appendix A. Supplemental Sources

The following is a list of the supplemental sources used by the ERA team to fill in gaps in the data collected in the primary specialty crop surveys. Other private sources the ERA team used, such as The Packer, which require a subscription and log-in, are omitted from this list. Thus, this represents a partial list of the supplemental sources used.

Beaman, J.A and A.J. Johnson. (2006), A Guide for New Manufacturers: Food Distribution Channel Overview, Oregon State University Extension Service, EM 8921.

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Cook, R. L. (2011), Fundamental Forces Affecting U.S. Fresh Produce Growers and Marketers, Choices, Quarter 4.

Dimitri, C., A. Tegene, and P.R. Kaufman, (2003), U.S. Fresh Produce Markets: Marketing Channels, Trade Practices, and Retail Pricing/AER-825, United States Department of Agriculture, Economic Research Service.

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United States Census Bureau, (USCB). (2016), EC1242A1 - Wholesale Trade: Geographic Area Series: Summary Statistics for the U.S., States, Metro Areas, Counties, and Places: 2012, 2012 Economic Census.

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United States Department of Agriculture, (USDA). (2016), Fruit and Tree Nuts Yearbook 2015.

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University of California Cooperative Extension Cost and Return Studies. (2013), Sample Costs to Establish a Vineyard and Produce Wine Grapes: Chardonnay Variety, Sacramento Valley, Available online at http://coststudies.ucdavis.edu/current/.

University of California Cooperative Extension Cost and Return Studies. (2011), Sample Costs to Establish a Medium-Density Olive Orchard and Produce Bottled Olive Oil: North and Central Coasts, Available online at http://coststudies.ucdavis.edu/current/.

University of California Cooperative Extension Cost and Return Studies. (2014), Sample Costs to Produce Processing Tomatoes: Sub-Surface, Drip Irrigated (SDI) in the Sacramento Valley & Northern Delta. Available online at http://coststudies.ucdavis.edu/current/.

University of California Cooperative Extension Cost and Return Studies. (2011), Sample Costs to Establish and Produce Processing Peaches: Cling and Freestone Late Harvest Varieties, Sacramento Valley and San Joaquin Valley. Available online at http://coststudies.ucdavis.edu/current/.

Appendix B. Sacramento Region Primary Agricultural Production Model

1. Introduction

The primary model of agricultural production developed by ERA Economics for SACOG encompasses the geographic area defined by the Sacramento region.[1] The primary agricultural production model is used to simulate production decisions by growers in the Sacramento region, and the statewide market for those crops. This model links directly to the IMPLAN model. The primary model evaluates changes in farm production and the IMPLAN model simulates the corresponding effect on related industries within the broader specialty agriculture cluster.

2. Overview

The primary agricultural production model (hereafter "primary model" or simply "model") is a regional agricultural production and economic optimization model that simulates the decisions of growers across the Sacramento region. The model simulates the input and output markets for major specialty crops produced in the Sacramento region under current conditions, and in response to changes in policy, prices, or resource (e.g., water) availability. The primary model inputs include user-defined policies or other changes in market conditions. Outputs include the change in gross farm-gate production value, acreage, yield, prices, and input use. Farm-gate production value (or output value) is a direct input into the IMPLAN model. The sixteen production regions in the Sacramento area differ with respect to soil type, microclimate, and crop suitability. These regional differences result in widely varying measures of agricultural productivity, which are the returns to land and management per acre. The values vary widely—from $427 to $1073 per acre. This range of returns to agricultural production reflects the large differences in the value of production in the Sacramento region, with premium winegrowing regions being the highest valued, and field crops such as wheat and safflower being the lowest.

The primary model is calibrated using the method of Positive Mathematical Programming (PMP), a widely-accepted economic modeling approach which has been used and subject to peer review[2][3] for the last two decades. The essence of the PMP economic modeling approach underlying the primary model can be described as follows. The decision by profit-maximizing producers to plant certain crops, given the market for those crops and the market for inputs, reflects the physical and

[1] The Sacramento region is defined to include the six counties that are within the SACOG region. These include the counties of El Dorado, Placer, Sacramento, Sutter, Yolo, and Yuba.
[2] Howitt. R.E. 1995. "Positive Mathematical Programming." American Journal of Agricultural Economics. 77(2): 329-342.
[3] Howitt. R.E, Medellín-Azuara. J, MacEwan. D, and Jay R. Lund. (2012) "Calibrating Disaggregate Economic Models of Agricultural Production and Water Management" Environmental Modeling and Software. 38: 244-258.

economic ability to produce crops in certain areas. These observed grower decisions are combined with additional information about market conditions, variability over time, and well-established economic principles to calibrate an economic model. For example, peaches are primarily produced in Yuba County because of soil and climate conditions (physical criteria) and a critical mass of growers with the detailed knowledge required to manage various risks and produce a profitable crop (economic criteria), as well as other considerations. In addition, Yuba County peach growers, like all peach growers, are subject to market fluctuations that affect aggregate demand and supply for their crop, ultimately determining the market-clearing price, and in turn, farm-gate profitability. The PMP approach incorporates all of this information to calibrate a model that exactly reproduces what growers actually do. The model is then used to simulate changes in production in response to changes in conditions (sometimes referred to as “policy simulations”).

2.1 Primary Model Technical Overview

The primary model assumes that growers select the crops, water supplies, and other production inputs to maximize profit subject to resource constraints, technical production relationships, and market conditions. Growers face competitive markets for inputs and outputs, where no one grower can influence the market price. The competitive market is simulated by maximizing the sum of consumer and producer surplus subject to the following characteristics of production, market conditions, and available resources:

1. Constant Elasticity of Substitution (CES) production functions for every crop in every region. A production function is a mathematical relationship that shows how inputs (land, water, chemicals, etc) are combined to produce a crop. The CES has 4 fundamental inputs: land, labor, water, and other supplies. CES production functions allow for limited substitution between inputs which allows the model to estimate both total input use and input use intensity. The parameters of the CES production technology are calibrated to *observed* grower decisions using the method of PMP.
2. Decreasing Returns to Scale (RTS). Production exhibits decreasing returns to scale in land. Additional land into production for a particular crop is generally less productive than the primary land allocated to that crop, resulting in decreasing returns.
3. Crop production input costs, including water costs, are representative of cultural practices within the regions included in the model. The prices paid for inputs, and the quantity of inputs used, are partially based on primary grower surveys.
4. Downward sloping, linear, statewide crop demand functions. A demand function is a mathematical relationship that describes willingness to pay for a particular crop. Growers in the Sacramento region participate in the statewide (or international, for some crops) agricultural market.
5. Resource constraints on land, water, and other input availability by region. These are limits to the amount of resources available for use by agriculture. For example, water supplies were curtailed under the current drought.

6. Other agronomic and economic constraints. These are technical relationships that describe various aspects of farming in the Sacramento region. For example, the standard productive life of an orchard is 25 – 30 years and some crops are commonly grown as part of a multi-year rotation.

The model maximizes profits by choosing the optimal values of land, water, labor, and other input use in addition to input use intensity, as described by the CES production surface, subject to these constraints and definitions. Downward-sloping crop demand curves guarantee, all else constant, that as production increases crop price decreases (and vice-versa). Over time, crop demands may shift in response to real income growth and increases in population.

The calibrated model is used for policy simulation. As conditions change within a region (e.g., SACOG incentivizes frozen fruit processing which decreases transportation costs for peach growers) the model optimizes production by adjusting the crop mix, water sources and quantities, and other inputs. It also fallows land when that appears to be the most cost-effective land-use response to resource conditions.

3. Primary Model Coverage

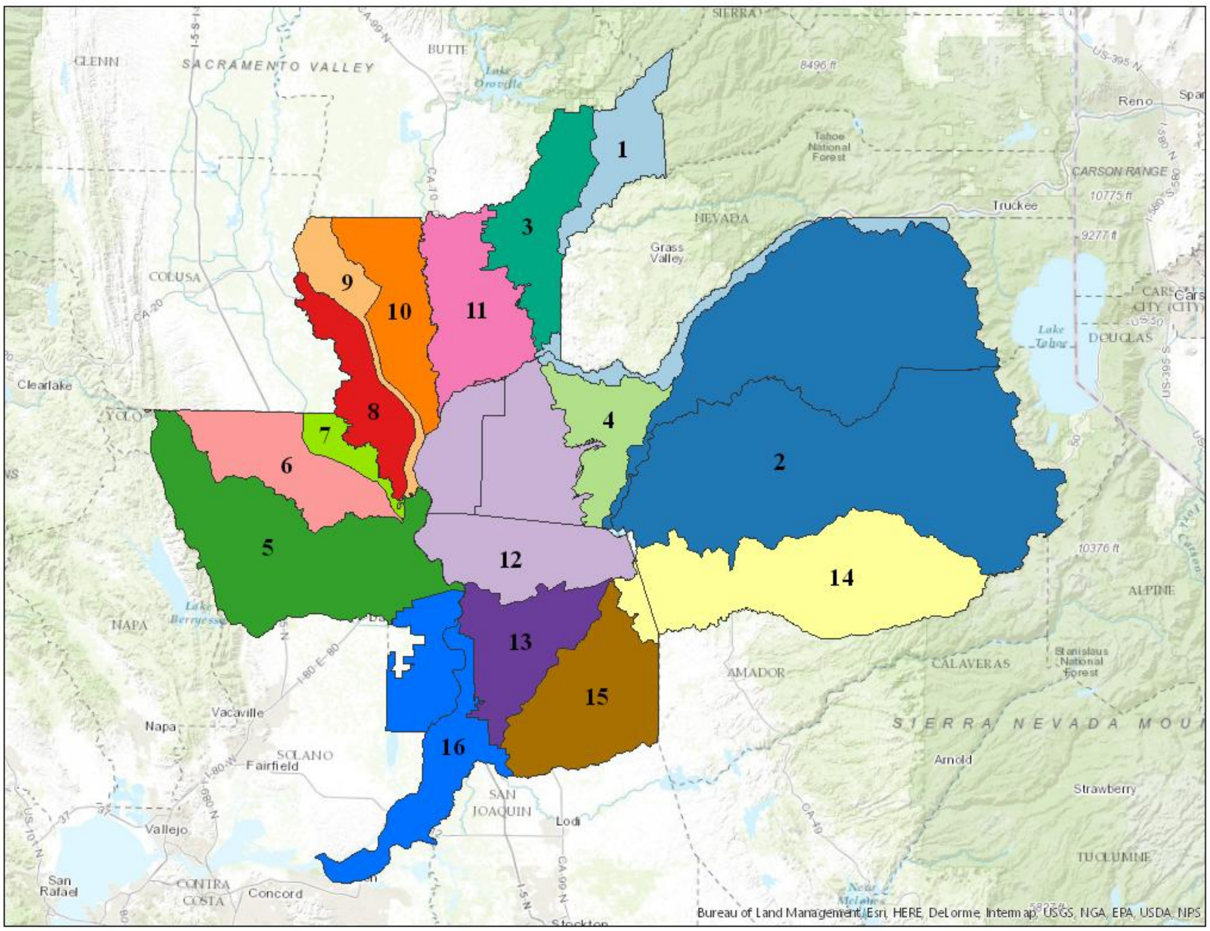
The primary model coverage includes all irrigated acreage in the Sacramento region. The model regions are defined on the basis of political boundaries (counties) and production regions. The production regions are based on water and land use planning areas known as Detailed Analysis Units (DAUs), as developed by the California Department of Water Resources. Table B.1 summarizes the 16 regions included in the primary model.

Table B.1: Primary Model Regions

Region Number	Model Region Name (DAU)	Counties
1	Yuba-Bear Rivers	Placer, Yuba
2	American River	El Dorado, Placer
3	Yuba Foothill	Yuba
4	Placer Foothill	Placer
5	Lower Cache Creek	Yolo
6	Willows-Arbuckle	Yolo
7	Glenn-Knights Landing	Sutter, Yolo
8	Meridian-Robbins	Sutter
9	Durham-Sutter	Sutter
10	Yuba City-Gridley	Sutter
11	Yuba	Sutter, Yuba
12	Placer	Placer, Sacramento, Sutter
13	Sacramento	Sacramento
14	Consumnes-Mokelumne-Calaveras	El Dorado
15	Elk Grove	Sacramento
16	Sacramento Delta	Sacramento, Yolo

The primary model regions are specified in the basis of 16 DAUs in the Sacramento region, which can be decomposed into 24 regions if county boundaries are included. Figure 1 illustrates the 16 regions in the primary model. The figure also shows the county lines to illustrate model region DAUs which span multiple counties. For example, region 16, "Sacramento Delta" includes portions of Sacramento and Yolo Counties. Delta agriculture is relatively homogenous, with high-value vegetable and fruit production, as well as corn, grain, and fodder field crops being produced in both Yolo and Sacramento Counties. The model definitions follow the convention used in the DAU regions.

Figure B.1: Primary Model Coverage



Crops are aggregated into 17 crop groups which are the same across all regions, although not all crops are produced in all regions. Each crop group represents a number of individual crops, but many are dominated by a single crop. Total acreage within any one crop group represents all of the crops within the group, production costs and returns are represented by a single proxy crop for each group. For each group, the representative (proxy) crop is chosen based on four criteria: (i) a detailed production budget is available from the University of California Cooperative Extension (UCCE) or from primary surveys completed under this project, (ii) it is the largest or one of the largest acreages within a group, (iii) its water use (applied water) is representative of water use of all crops in the group, (iv) its gross and net returns per acre are representative of the crops in the group. The relative importance of these criteria varies. Crop group definitions and the corresponding proxy crop are shown in Table B.2.

Table B.2: Crop Group Definitions in the Primary Model

Number	Crop Group	Proxy Crop	Example Other Crops
1	Alfalfa	Alfalfa	
2	Almonds	Almonds	
3	Corn	Grain corn	
4	Cucurbits	Honeydew melons	Squash, other melons
5	Dry Beans	Dry beans	
6	Grain	Wheat	Other miscellaneous grains
7	Olives	Olives	
8	Other Deciduous	Prunes	Apples, cherries, kiwi, pears
9	Other Field	Sunflower	Miscellaneous irrigated hay
10	Other Truck	Fresh tomatoes	Berries, misc small vegetables
11	Pasture	Irrigated pasture	
12	Peach	Clingstone peaches	Freestone peaches
13	Processing Tomatoes	Processing tomatoes	
14	Rice	Rice	Wild rice
15	Safflower	Safflower	
16	Vines	Wine grapes	
17	Walnuts	Walnuts	

All crops, not just specialty crops, are included in the primary model because the joint production of some crops is an important factor in planting decisions. For example, as a nitrogen-fixer alfalfa is sometimes included as a break crop to improve fertility in a multi-year rotation system. The primary model crop groups are linked to the IMPLAN model sectors by using the crosswalk shown in Table B.3. Changes in gross revenues (output value) can be input into the IMPLAN model to simulate the effect of that change in primary production on the related processing and distribution sectors. The integrated framework can be used to simulate the specialty agriculture cluster.

Table B.3: Primary Model – Custom IMPLAN Model Crosswalk

Number	Crop Group	IMPLAN Sector Number	IMPLAN Sector Name
1	Alfalfa	10	All other crop farming
2	Almonds	5	Misc. tree nut farming (revised)
3	Corn	2	Grain farming
4	Cucurbits	3	Misc. vegetable farming (revised)
5	Dry Beans	10	All other crop farming
6	Grain	2	Grain farming
7	Olives	9	Olive farming
8	Other Deciduous	4	Misc. fruit farming (revised)
9	Other Field	1	Oilseed farming
10	Other Truck	3	Misc. vegetable farming (revised)
11	Pasture	11	Ranching and grazing farming
12	Peach	23	Peach farming (custom)
13	Processing Tomatoes	7	Processing tomato farming (custom)
14	Rice	2	Grain farming
15	Safflower	1	Oilseed farming
16	Vines	25	Wine grape farming (custom)
17	Walnuts	26	Walnut farming (custom)

3.1 Primary Model Inputs and Outputs

As discussed previously, the primary model characterizes crop production with a CES production function for each region and crop. This production function captures the relationship between the inputs used to produce a crop and the realized output (yield) of that crop. Constant Elasticity of Substitution production functions in the primary model are region-specific, thus regional input use is combined to determine regional production for each crop.

For consistency with the IMPLAN model, the base year in the primary model is defined to be 2013. All prices, costs, land use, and market conditions, used to calibrate the model are for 2013. Having calibrated the model using the 2013 data, the model is then used for policy simulations under future conditions, as described in a subsequent section. Table B.4 summarizes the components of the model calibration data.

Table B.4: Primary Model Inputs

Input	Description
Land Use	Cropping patterns for the 2013 base year, by region and crop group.
Crop Prices	Farm-gate price received for the crops produced using an average of 2011 and 2012 prices to reflect grower expectations for the crops planted in 2013.
Crop Yields	Average yield realized in 2013 for the crops produced.
Interest Rates	All interest rates for short-term production loans, and long-term capital recovery are normalized to 2013 levels, equal to 4.75% and 5.75%, respectively.
Land Costs	The land rental rate or capital recovery cost of the land, per acre.
Other Supply Costs	Other supply costs include variable material and chemical inputs to crop production, such as fertilizers and pesticides. All input costs are in 2013 dollars.
Labor Costs	Labor costs include on-farm, contractor, and custom operator labor inputs into to crop production. All input costs are in 2013 dollars.
Surface Water Costs	Surface water costs per acre-foot for each region are a weighted average of the rates paid by growers in major water districts in the Sacramento region.
Groundwater Costs	Groundwater pumping costs are calculate per acre-foot and include the amortized fixed cost of the well and pump, an annual maintenance cost, and variable energy pumping cost per foot of dynamic head.
Irrigation Water	Crop applied water requirements, in acre-feet per acre, are used to establish the average applied irrigation water for each crop and region.
Elasticities	Demand and supply elasticities are estimated from a 30 year time-series of cropping data and used to establish the statewide market for crops produced in the Sacramento region.

3.2 Gross Returns and Market Conditions

Farm-gate gross revenues are calculated by multiplying the farm-gate price received by the realized crop yield. Crop yields and prices vary over time, both jointly and individually. Average crop yields by crop and region are established using a time-series of historical yields within each of the model regions. Farm-gate prices received are established over the same time series. The economic theory underlying the model calibration requires that the base year (2013) is representative of production conditions, and resulting grower planting decisions, in that year. As such, prices reflect a lagged two-year average to approximate grower price expectations when making 2013 planting decisions. Crop yields reflect the county average yield, which is also assumed to be representative of grower expectations when making planting decisions.

Having calibrated the economic model, it is then used for policy simulations. In these simulations the realized price and yield for each crop, in a given region, are estimated by (meaning, are an output from) the economic model. Total crop production and the market for that crop determine the market-clearing price any given year. Additionally, crop yields (and therefore total output) are estimated by the model and vary in response to market conditions. The model is specific to the Sacramento region, but the market for crops produced in the region follow the supply and demand conditions for the statewide agricultural market. For example, the farm-gate price for wheat in the Sacramento region is determined by demand and supply conditions elsewhere in California and internationally. The market outside of the Sacramento region is accounted for in the primary model and implicitly held constant so that the response to changes in Sacramento region production causes a small (if any) change in the market for a given crop.

3.3 Production Costs

The primary model includes four aggregate inputs to the CES for production of each crop and region: land, labor, water, and supplies. All units are converted into monetary terms, e.g., dollars of labor per acre instead of worker hours. Land is simply the number of acres of a crop in any region. Land costs represent basic land investment, cash overhead, and (when applicable) land rent. Labor costs represent both machinery labor and manual labor from on-farm sources, farm labor contractors, and custom operators. The “other supplies” category captures a range of inputs including fertilizer, pesticides, chemicals, custom, capital recovery, and interest on operating capital. Water costs and use per acre vary by crop and region. All costs are representative of prices paid by growers in 2013.

4. Policy Simulations with the Primary Model

The fully specified base model is written and solved using a well-known but commercially-based program called GAMS (Generalized Algebraic Modeling System). The GAMS Development Corporation provides a free version of the program that can be downloaded and will run any of the standard nonlinear algorithms. For this free version that SACOG will initially use to test the model, the vendor restricts the maximum dimensions of constraints and variables possible in the model to no more than 300. Accordingly, the ERA team has simplified the fully specified base model in the following ways to enable it to be solved with the free GAMS software in the initial stages of analysis. The principle that the ERA team applied was to simplify the model in terms of the complexity of the production function specification and price formation, but retain the full 16 regions and 17 potential crops that show the essential trade-offs in agricultural production within the SACOG region. The simplifications required to reduce the dimensionality of the model were: (i) Replacing the full regional crop CES production functions with a simpler function that has decreasing returns to scale in the acreage of crop grown for any region, but leaves the quantities of variable input per acre, namely land and labor and water, constant for any given region; (ii) simplifying the specification of water resources over multiple different supplies for each region to a single aggregated water supply and priced at the average cost observed in the base years; and (iii) replacing the formation of output prices—which are responsive and endogenous in the fully specified model—with prices that were fixed at the market clearing values in the base year data in the simplified model.

While it is obviously preferable to have more flexible specifications for input use per acre, prices that adjustment in response to changes in supplies, and potential changes in the mix of water sources used, the simplified model calibrates exactly and retains the essential economic trade-offs between the 16 regions and 17 crops which will show changes in gross agricultural output by location and type for a given policy scenario. The output of the simplified model is both presented and interacts with the IMPLAN model in exactly the same way as the full specification model since it calibrates exactly and generates the same change in gross agricultural returns for each region, and very similar responses to most policy scenarios.

ERA estimates that the initial stages of analysis the savings in software costs of approximately $6,000 is worth the simplifications in the model specification. At a later stage or for more complex price-based policy analysis, the fully specified endogenous prices and input use model can be swiftly combined with the simpler model.

For policy analysis (using the model to estimate the response by agriculture to changes in any condition) using the primary model the user needs three things:

1. Microsoft (MS) Excel workbook data input file;
2. GAMS data include file; and
3. GAMS program file; and

Simple changes for a policy scenario, such as changing the value of a single input or parameterizing a change in some resource (e.g., water supply) over a range, can be changed from the MS Excel input file. The input file is well documented so that the user can understand which inputs to change.

The model generally runs in under 2 minutes. The output from the model is exported using a GAMS data-exchange (GDX) routine which translates GAMS output into Excel. The output is populated in a MS Excel file and the user can easily visualize and manipulate the output from the model. For example, changes in gross farm revenues can be output and linked to the IMPLAN model using the primary model to IMPLAN model crosswalk shown above in Table B.3.

4.1 Data Input File

The MS Excel workbook data input file contains all of the user-defined data tables required for the model. Other data and calibration parameters are included in the GAMS include file. Some scalar parameters are incorporated into the model file itself rather than the data input file. Features of the data input file include the following:

- The input data file is automatically imported into the program file using the built-in GAMS program “xls2gms.” This program reads the tables and parameters from each tab in the data file and generates the “.INC” file which GAMS can read. Thus the user can edit data within the MS Excel file and it will be automatically updated in the model.

- The data input file must be saved as ".xls," GAMS does not recognize the default extension for Excel 2007, ".xlsx".

4.2 GAMS data include File

The data include file (.inc) contains additional data used to populate the model. This includes the calibrated parameters. The user can modify these data, but it is generally not necessary, thus they are left in the include file.

4.3 Program File

The program file (.gms) contains all of the model code. This includes a routine to automatically update input data and the policy simulation models. Simple or parameterized data input changes can also be made within the program file, if the user is feeling adventurous. The program file contains numerous comments and references. Sub-routines are all clearly detailed within the model and all set definitions follow the convention: region, input, and crop.

4.4 Output File

The program file will automatically export summary tables to a MS Excel workbook. The user can create different output tables within the program file, or can export results with two other methods. It is up to the user to decide how output should be organized; ERA Economics has created a series of default, standard summary metrics.

4.5 Post-Processing Workbook

It is good practice to create a post-processing MS Excel workbook. It typically includes a series of tables, charts, and figures used to summarize relevant output statistics. The post-processing workbook allows the user to quickly summarize model output and thus facilitates sequential model simulations. ERA Economics has prepared a standard post-processing MS Excel workbook for SACOG with default summary statistics.

5. Summary

The primary model is an optimization model that calibrates to observed grower decisions and the market for crops produced in the Sacramento region. It is a flexible, robust framework that can be, and has been, used to simulate a wide range of response by primary agriculture to changes in policy or market conditions. The model is being refined so that SACOG staff can make basic changes to the inputs and outputs and simulate the resulting effect on production in the Sacramento region. The model links directly to the IMPLAN model to simulate the total effect of changes in the economic cluster.

Appendix C. Producer, Processor, and Distributor Survey Responses

1. Introduction

Growers, processors, and distributors of specialty crops in the Sacramento Region were surveyed to: (i) gather the information necessary to establish economic multipliers for industry sub-sectors; and (ii) determine the key regulatory areas that affect the specialty crop value chain. Survey responses provide the foundational data necessary to establish economic multipliers and to model scenarios. Survey responses also inform the summary of regulatory costs provided in Appendix E. Surveys priorities were informed by a preliminary cluster analysis.

2. Sampling Universe

Using the United States Department of Agriculture (USDA) definition of specialty crops, four IMPLAN categories were identified for grower interviews. These include farming of vegetables and melons, fruit, nuts, and greenhouse and nursery farming. A preliminary cluster analysis identified key industries linked to specialty crops using the IMPLAN model, focusing on processing and distribution. That information and the following factors guided efforts to survey specialty crop growers, processors, and distributors:

1. **Value of production**. Priority was given to industries and sub-sectors with the highest values of production, since expenditures by these producers drive the economic multiplier effects. Special focus was given to the region's major specialty crops and to the associated industries that process and distribute these crops.
2. **Entity size**. Surveys capture a range of entity sizes as expenditure patterns are likely to differ by entity size. For example, small farms are more likely to use custom services and to lease machinery whereas larger farms, with greater economies of scale, are more likely to keep these operations in-house.

In addition, new and emerging markets/industries with high potential for growth were surveyed in order to anticipate industry developments and provide progressive results that will remain meaningful as industries change.

3. Outreach

Survey tools and sampling criteria were finalized with SACOG in August 2015 and survey outreach began in September 2015. Initial outreach was directed to agricultural organizations in the region so they could inform their constituencies about the project. Local county Farm Bureaus, UC Cooperative Extension farm advisors, and Agricultural Commissioners were all provided with a project overview and some disseminated the overview to their constituencies. In addition, input was sought from umbrella organizations such as the California League of Food Processors.

Table C.1 summarizes survey outreach by type of entity. Total values do not include outreach to agricultural organizations and agencies. One hundred and sixteen specialty crop growers, processors, and distributors were contacted to participate in the survey and thirty-six provided a survey response. To obtain these survey responses, potential survey respondents were called, emailed, and interviewed in-person in 307 unique communications.

Table C.1: Survey responses through June 15, 2016, by type of entity

Type of Entity	Entities Contacted	Communications	Returned Surveys
Growers	31	76	14
Processors	60	171	13
Distributors	25	60	9
General Ag Organizations	19	33	N/A
Total	116	307	36

4. Responses

Crop production surveys were primarily obtained from growers in Sutter and Yuba counties. El Dorado, Placer, Sacramento, and Yolo county specialty crop farmers were surveyed under a separate analysis led by Dr. Shermain Hardesty and her team at UC Davis. Dr. Hardesty provided aggregate survey data for this project, and the ERA team is grateful for her contribution. When Sutter and Yuba county producers were unavailable, supplemental surveys were obtained from specialty crop producers in the other four SACOG counties or in neighboring counties. Grower surveys received represent all four specialty crop sectors in IMPLAN.

Processors of vegetables and melons, fruit, and nuts were surveyed. As noted above, processor surveys focused on industries with strong links to the four IMPLAN specialty crop categories as reported in the preliminary cluster analysis. In addition, surveys were conducted in emerging industries in the SACOG region. Surveys of potential industries that are currently absent in the SACOG region were obtained from processors in other Northern California counties.

Specialty crop distribution is associated with several large industries in the six-county Sacramento area. Distributor surveys targeted produce distributors, grower-packer shippers, and produce stands in the SACOG region. In addition, surveys were obtained from farm product trucking companies, cold storage facilities, and broadline distributors. Table C.2 summarizes survey results for growers, processors, and distributors by farm or facility location.

Table C.2: Survey responses through June 15, 2016, by location

County	Entities Contacted	Communications	Returned Surveys
El Dorado	11	16	1
Placer	9	14	3
Sacramento	17	46	5
Sutter	34	105	14
Yolo	26	75	7
Yuba	19	51	6
Total	116	307	36

Note: Values do not include outreach to agricultural organizations and agencies.

Appendix C.1. Producer Questionnaire

As a primary business in the Sacramento area specialty crop food system we are requesting your input in an important study of the economic value and regulatory costs in the specialty crop food sector. We hope that you will take some time to review the study and fill out the survey questions. The information generated in this study will directly benefit your business and will be shared with you upon completion of the project.

Purpose of this Study

Specialty crop agriculture is a valuable and growing industry in the Sacramento area. Our region has enjoyed robust growth in specialty crop value over the past several years, establishing itself as a growing food hub. In the last 10 years the value of specialty crop production in the Sacramento area has more than doubled, from $400 million to over $900 million annually. The specialty crop food system value chain, including producers, processors, and distributors, generates significant economic activity and jobs in the region. The Sacramento Area Council of Governments (SACOG) wants to better understand this economic web, and the current regulations which may be stifling growth, to encourage continued growth in the sector and ancillary industries.

The purpose of this study is three-fold: (i) to quantify the economic linkages in the specialty crop food system in the Sacramento area, (ii) to understand key regulatory costs affecting each industry, and (iii) to develop an economic framework that SACOG and its partners can use to evaluate policies that will encourage growth in the regional agricultural and food system economy.

Structure of the Study

This study of the Sacramento area specialty crop food system is initiated by SACOG and funded through a California Department of Food and Agriculture (CDFA) Specialty Crop Block Grant. The project is being conducted by a team of researchers at the agricultural and resource economics consultancy ERA Economics, based in Davis, California. The regulatory cost component of the survey is led by Dr. Jay Noel of ERA Economics and professor in the Agribusiness Department at Cal Poly, San Luis Obispo. The agricultural value chain linkages component of the survey is led by Dr. Richard Howitt of ERA Economics and professor emeritus in the Agricultural and Resource Economics Department at UC Davis. The project is managed by Dr. Duncan MacEwan of ERA Economics and Mr. Garett Ballard-Rosa of SACOG.

Benefits for your business and compensation for your participation

This study will generate the information required to quantify the economic linkages between the different sectors in the specialty crop food system and other sectors in the broader Sacramento area economy. Our research team will use this information to calculate the direct economic value

and jobs created by the specialty crop food system in the Sacramento area and the “ripple” (or sometimes called “multiplier”) effects in all related industries. For example, specialty crop businesses purchase inputs from local suppliers and employ workers, and these workers spend money in the local economy. The suppliers from which specialty crop businesses purchase inputs also employ workers who spend money in the local economy. SACOG wants to understand these linkages so that they can better showcase the full contribution of specialty agriculture and help support strategies and policies that encourage continued growth in the specialty crop food system.

We anticipate the study will be complete by late summer 2016. **In exchange for your participation in this study you will be provided with the following**:

1. Periodic updates on the progress of the research and you will be invited to attend any meetings where SACOG presents results of the study.

2. Key “multipliers” for the sector in which your business operates. A multiplier is a number that tells you the total economic value for each dollar generated by your business. In particular, we will provide you with multipliers for total jobs and total output value generated by your business in the Sacramento area. We will provide this information to you as an appropriately referenced memorandum so that you can cite and use it for internal planning or marketing.

Thank you for taking the time to participate in this important study.

Survey Participant Information and Confidentiality Statement

INFORMED CONSENT TO PARTICIPATE IN A RESEARCH PROJECT, "Sacramento Area Food System Multipliers and Regulatory Costs Study"

A research project to quantify the economic linkages in the Sacramento area specialty crop food system and understand key regulatory costs affecting each industry is being conducted by the research team at ERA Economics at the request of SACOG, and funded by a grant from CDFA.

You are being asked to take part in this study by *answering a series of questions regarding your regulatory costs and business expenditure profile.* Your participation will take approximately *1 hour*. Please be aware that you are not required to participate in this research and you may discontinue your participation at any time without penalty. You also do not have to answer any questions, or parts of questions, you choose not to.

There are no risks anticipated with your participation in this research. Your confidentiality will be protected; no personal identifying information will be used in reports of this research. The information gathered will be placed in a database and used for aggregate statistical analysis. This database will be maintained by ERA Economics and only the aggregate statistical analysis may be shared with SACOG or its partners. The results of the statistical analysis will be used to create the economic model of the specialty crop food system web in the Sacramento area. Potential benefits from this research include encouraging future growth in the Sacramento area specialty crop food system.

If you have questions regarding this study, please feel free to contact Dr. Duncan MacEwan (530-341-3374), Mr. Garett Ballard-Rosa (916-319-5183), Dr. Jay Noel (805-756-5014), or Dr. Richard Howitt (530-304-4123).

If you agree to voluntarily participate in this research project as described please indicate your agreement by completing the questionnaire. Please retain a copy of this consent form for your reference and thank you for participating in this research.

Definitions

Study scope

Specialty crop: The U.S. Department of Agriculture defines specialty crops as "fruits and vegetables, tree nuts, dried fruits, and horticulture and nursery crops, including floriculture." Examples include beans, citrus, grapes, herbs, melons, processing tomatoes, propagative materials, sweet corn, walnuts, and raising any specialty crop for seed. Fiber crops, forage crops, grain crops, livestock, and oil seed crops are NOT considered specialty crops. Examples of local crops that are NOT specialty crops include sorghum, sugar beets, sunflowers, and wild rice.

Within 6-county region: This study focuses on the economic value of specialty crop production, processing, and distribution in the 6-county Sacramento Region, which is limited to the following counties: El Dorado, Placer, Sacramento, Sutter, Yolo, and Yuba. Transactions with entities physically located in these counties (though they may be headquartered elsewhere) fall into this category.

Outside 6-county region: Transactions with entities that are not physically located in El Dorado, Placer, Sacramento, Sutter, Yolo, and Yuba counties fall into this category. Examples include foodservice companies in the Bay Area, farmers' markets in southern California, grocery stores in other U.S. states, and processors overseas.

NAICS code: The North American Industry Classification System (NAICS) is the standard code used by federal agencies to classify business establishments. It can be found in box B on your Schedule F.

Sales

Sales: This category includes all sales of specialty crops from your farming operation. In addition to sales of raw products such as garlic, peaches, and squash, this includes sales of specialty crops that are minimally processed before sale such as honey, hulled walnuts, olive oil, and wine.

Direct sales: This category includes sales directly to the end consumer, including agri-tourism revenues. Examples include sales through farmers' markets, farm stands, u-pick, and community supported agriculture (CSA).

Retail sales: This category includes sales from your farm to a retail or foodservice buyer who prepares or packages your product for sale directly to consumers. Some examples include sales to grocery/specialty stores, restaurants, hotels, and institutions.

Wholesale sales: This category includes sales of undifferentiated, bulk products to traditional buyers, including cooperatives. Examples include sales to processors, packer-shippers, distributors, and brokers.

Expenses

Operating expenses: This category includes all costs associated with running your business's core operations on a daily basis. Common examples include labor costs, cost of inputs, and insurance.

Capital expenditures: Examples include land purchases and the principal portion of mortgage payments, the establishment of permanent plantings such as orchards and vineyards, the development of roads, structures, wells, and other infrastructure, and purchase of vehicles, machinery, and equipment.

I. General Information

1. In which county is your farming operation headquartered? _______________ County.

2. Which specialty crop(s) do you grow? ____
____

3. How many acres of specialty crops did you farm in 2014? __________ acres.

4. For the year 2014, what was your farm's:

Total expenses ($)		Sales revenue		Number of year-round employees		# of seasonal employees	

5. What is the NAICS code for your primary farming operation? __________
Please list the NAICS code(s) for any affiliated or subsidiary entities. _____________________

II. Regulatory Costs

1. The table below provides a list of regulatory areas. Please rank the top 4 based on their possible financial, operational, and managerial impacts on your farm. Assign a 1 to the area with the greatest impact, a 2 to the area with the second greatest impact, etc.

Regulatory Area	**Rank**
Air quality	
Food safety	
Immigration reform (farm labor supply)	
Land use	
Occupational hazards and safety	
Pesticide application	
Pesticide registration	
Solid and hazardous waste disposal	
Technology (e.g. Tier 4 requirement on purchase of new farm equipment)	
Water allocation	
Water quality	
Wildlife protection	
Other:	

2. How would you describe the complexity of the regulatory environment?
a. Very Complex_____ c. Somewhat Complex_____
b. Complex_____ d. Not Complex_____

Inputs and Services	**Expenses ($)**	**Within Sacramento Region (%)**	**Outside Sacramento Region (%)**
Hired labor (including payroll taxes, workers' comp., benefits, etc.)			
Contract labor			
Bookkeeping and tax services			
Custom hire (machine work)			
Freight and trucking			
Fuel, oil, grease			
Car and truck expenses			
Utilities			
Supplies			
Fertilizer and soil amendments			
Pesticides, herbicides, etc.			
Crop advising services			
Seeds and plants			
Processing expenses			
Storage and warehousing			
Insurance			
Land rent or crop share			
Other rent or lease payments			
Repairs and maintenance			
Taxes			
Interest			
Depreciation			
Certifications, licenses, permits			
Office expenses			
Marketing costs (including marketing order assessments)			
Other operating expenses:			
TOTAL			

3. Have you found duplication of effort among federal, state, and local regulatory agencies?
a. A lot_____ b. Some_____ c. None_____

4. Have you found conflicts in policy goals among federal, state, and local agencies?
a. Yes_____ b. No_____

III. Operating Expenses

Please complete the table below by entering information regarding your farm's operating expenses in 2014, including inputs purchased, type of input supplier, and location of input supplier.

IV. Capital Expenditures

Please complete the table below by entering information regarding your farm's capital expenditures in 2014.

Capital Expenditures	Expenditures ($)	Within Sacramento Region (%)	Outside Sacramento Region (%)
Machinery and equipment			
Structures			
Irrigation systems			
Establishment expenses (trees/vines)			
Other infrastructure			
All other capital expenditures			

V. Sales

Please complete the table below by entering information regarding your farming operation's sales in 2014, including the specialty crop sold and proportion of sales within and outside the Sacramento Region. Please provide information for your top crops by value of sales (up to 5).

Specialty Crop (e.g. basil, cling peaches, dry beans, olive oil)	% of Sales Within Sacramento Region	% of Sales Outside Sacramento Region	% of Sales Internationally

Appendix C.2. Processor Questionnaire

As a primary business in the Sacramento area specialty crop food system we are requesting your input in an important study of the economic value and regulatory costs in the specialty crop food sector. We hope that you will take some time to review the study and fill out the survey questions. The information generated in this study will directly benefit your business and will be shared with you upon completion of the project.

Purpose of this Study

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1. Periodic updates on the progress of the research and you will be invited to attend any meetings where SACOG presents results of the study.

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Definitions

Study scope

Specialty crop: The U.S. Department of Agriculture defines specialty crops as "fruits and vegetables, tree nuts, dried fruits, and horticulture and nursery crops, including floriculture." Examples include beans, citrus, grapes, herbs, melons, processing tomatoes, sweet corn, and walnuts. Fiber, forage, grain, livestock, and oil seed crops are NOT considered specialty crops. Examples of local crops that are NOT specialty crops include cotton, dairy, sugar beets, sunflowers, and wild rice.

Within 6-county region: This study focuses on the economic value of specialty crop production, processing, and distribution in the 6-county Sacramento Region, which is limited to the following counties: El Dorado, Placer, Sacramento, Sutter, Yolo, and Yuba. Transactions with entities physically located in these counties (though they may be headquartered elsewhere) fall into this category.

Outside 6-county region: Transactions with entities that are not physically located in El Dorado, Placer, Sacramento, Sutter, Yolo, and Yuba counties fall into this category. Examples include foodservice companies in the Bay Area, confectioners in southern California, grocery stores in other U.S. states, and processors overseas.

NAICS code: The North American Industry Classification System (NAICS) is the standard code used by federal agencies to classify business establishments. It can be found on your tax return.

Sales

Domestic sales: This category includes product sales within the 50 U.S. states and Puerto Rico. This includes sales to retailers, foodservice, other processors, food manufacturers, and consumers in the U.S.

International sales: This category includes product sales that are exported to any entity outside of the 50 U.S. states and Puerto Rico. This includes sales to retailers, foodservice, other processors, food manufacturers, and consumers outside the U.S.

Expenses

Operating expenses: This category includes all costs associated with running your business's core operations on a daily basis. Common examples include labor costs and costs of goods sold.

Capital expenditures: Examples include land purchases and the principal portion of mortgage payments, the development of roads, structures, wells, and other infrastructure, and purchase of vehicles, machinery, and equipment.

I. General Information

1. In which county is your business located? ____________ County.
2. Which specialty crop(s) does your business process? __________________________________
   How many tons of each crop did you process in 2014? ________________________________
   What percent of each crop you processed was grown in the Sacramento Region? __________

3. Does your business send raw materials to be finished at another company facility (for example, you grade nuts but another facility is responsible for processing)? _____ (yes/no)

4. Please enter the NAICS code for your business ____________. If you have any subsidiary or affiliated entities enter them here:____.

5. For the year 2014, what was your:

Total operating expenses ($)		Sales revenue		Number of year-round employees		# of seasonal employees	

II. Regulatory Costs

1. The table below provides a list of regulatory areas. Please rank the top 4 based on their possible financial, operational, and managerial impacts on your business. Give a 1 to the area with the greatest impact, a 2 to the second greatest impact, etc.

Regulatory Area	Rank
Air quality	
Employee regulations (minimum wage laws, right to organize, etc.)	
Nutrition labeling	
Food safety	
Food processing byproduct waste disposal	
Health care (Affordable Care Act compliance, cost, etc.)	
Immigration and E-Verify (e.g. worker availability, reporting requirements, etc.)	
Occupational hazards and safety	
Water allocation	
Water quality	
Other:	

2. How would you describe the complexity of the regulatory environment?
   a. Very complex_____ c. Somewhat complex_____
   b. Complex_____ d. Not complex_____

3. Have you found duplication of effort among Federal, State or Local regulatory agencies?
   a. A lot_____ b. Some_____ c. None_____

Please give an example:

III. Sales

Please complete the table below by entering information regarding your business sales in 2014. Begin by entering the product name in the first column. In the first row of the second column, indicate the percent of the product's total sales that are domestic, then in the second row of the second column indicate what percent of domestic sales were inside and outside the 6-county Sacramento Region. In the third column, indicate what percent of the product's total sales were international sales. Please provide information for your top four products.

Product (e.g. prunes, walnuts)	**Domestic Sales** as % of Total Sales		**International Sales** as % of Total Sales
	% within 6-county region	% outside 6-county region	
Example: Walnuts	*10%*		*90%*
Regional breakdown:	*5%*	*95%*	--
1.			
Regional breakdown:			--
2.			
Regional breakdown:			--
3.			
Regional breakdown:			--
4.			
Regional breakdown:			--

Walnuts. *In this example, NorCal Walnuts, Inc. sells 10% of its in-shell walnuts domestically and 90% are sold internationally. Of the 10% of walnuts sold domestically, 5% are sold to a natural foods store in Davis and 95% are sold to natural foods stores outside the region.*

IV. Capital Expenditures

Please complete the table below by entering information regarding capital expenditures in 2014, including all major capital expenditures. Fill out the first column by estimating the costs for each category then indicate what proportion of each expenditure is spent within and outside the Sacramento region.

Capital Expenditures	**Expenditures ($)**		**Within Sacramento Region (%)**	**Outside Sacramento Region (%)**
Machinery and equipment				
Structures				
Other infrastructure				
Other capital expenditures (please list)				

V. Operating Expenses

Please complete the table below by entering information regarding the share of your business operating expenses in 2014. Fill out the first column by estimating the operating costs for each category then indicate what proportion of each expenditure is spent within and outside the Sacramento region.

Inputs and Services	**Expenses ($ or %)**	**Percent Within Sacramento Region**	**Percent Outside Sacramento Region**
Employee compensation (including wages, benefits, payroll taxes, workers' comp., etc.)			
Cost of raw materials			
Packaging materials			
Bookkeeping and tax services			
Storage and warehousing			
Freight and trucking			
Utilities			
Waste management and remediation			
Insurance			
Rent or lease			
Repairs and maintenance			
Taxes			
Interest			
Depreciation			
Certifications, licenses, permits			
Marketing costs			
Office expenses			
Other operating expenses:			
TOTAL			

Appendix C.3. Distributor Questionnaire

As a primary business in the Sacramento area specialty crop food system we are requesting your input in an important study of the economic value and regulatory costs in the specialty crop food sector. We hope that you will take some time to review the study and fill out the survey questions. The information generated in this study will directly benefit your business and will be shared with you upon completion of the project.

Purpose of this Study

Specialty crop agriculture is a valuable and growing industry in the Sacramento area. Our region has enjoyed robust growth in specialty crop value over the past several years, establishing itself as a growing food hub. In the last 10 years the value of specialty crop production in the Sacramento area has more than doubled, from $400 million to over $900 million annually. The specialty crop food system value chain, including producers, processors, and distributors, generates significant economic activity and jobs in the region. The Sacramento Area Council of Governments (SACOG) wants to better understand this economic web, and the current regulations which may be stifling growth, to encourage continued growth in the sector and ancillary industries.

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Structure of the Study

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Thank you for taking the time to participate in this important study.

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Study scope

Specialty crop: The U.S. Department of Agriculture defines specialty crops as “fruits and vegetables, tree nuts, dried fruits, and horticulture and nursery crops, including floriculture.” Examples include beans, citrus, grapes, herbs, melons, potatoes, tomatoes, sweet corn, and walnuts. Fiber, forage, grain, livestock, and oil seed crops are NOT considered specialty crops. Examples of local products that are NOT specialty crops include cheese, dairy, eggs, sunflowers, and wild rice.

Within 6-county region: This study focuses on the economic value of specialty crop production, processing, and distribution in the 6-county Sacramento Region, which is limited to the following counties: El Dorado, Placer, Sacramento, Sutter, Yolo, and Yuba. Transactions with entities physically located in these counties (though they may be headquartered elsewhere) fall into this category.

Outside 6-county region: Transactions with entities that are not physically located in El Dorado, Placer, Sacramento, Sutter, Yolo, and Yuba counties fall into this category. Examples include farmers in the San Joaquin Valley, foodservice companies in the Bay Area, and grocery stores in other U.S. states.

NAICS code: The North American Industry Classification System (NAICS) is the standard code used by federal agencies to classify business establishments. It can be found on your tax return.

Sales

Sales: This category includes sales and distribution of all specialty crops. In addition to sales of raw products such as garlic, peaches, and squash, this includes sales of specialty crops that are minimally processed before sale such as honey, hulled walnuts, olive oil, and wine.

Retail sales: This category includes sales to retail customers such as grocery and specialty stores.

Restaurant sales: This category includes sales to privately owned restaurants, including restaurant chains.

Institutional sales: This category includes sales to public or private institutions such as hotels, jails, schools, hospitals, casinos, and nursing homes.

Expenses

Operating expenses: This category includes all costs associated with running your businesses core operations on a daily basis. Common examples include labor costs and cost of goods sold.

<u>Capital expenditures:</u> Examples include land purchases and the principal portion of mortgage payments, the development of structures and other infrastructure, and purchase of vehicles, machinery, and equipment.

I. General Information

1. In which county is your business located? ____________ County.

2. Please enter the NAICS code for your business ____________. If you have any subsidiary or affiliated entities enter them here: ____.

3. For the year 2014, what was your:

Total operating expenses ($)		Sales revenue		Number of year-round employees		# of seasonal employees	

II. Regulatory Costs

1. The table below provides a list of regulatory areas. Please rank the top 4 based on their possible financial, operational, and managerial impacts on your business. Give a 1 to the area with the greatest impact, a 2 with the second greatest impact, etc.

Regulatory Area	**Rank**
Air quality	
Food safety	
Food waste disposal	
Health care (Affordable Care Act compliance, cost, etc.)	
Immigration and E-Verify immigration policy (e.g. worker availability, reporting requirements, etc.)	
Occupational hazards and safety	
Transportation (e.g. truck weight limits, lengths, truck availability, etc.)	
Other:	

2. How would you describe the complexity of the regulatory environment?
   a. Very complex_____   c. Somewhat complex_____
   b. Complex_____   d. Not complex_____

3. Have you found duplication of effort among Federal, State or Local regulatory agencies?
   a. A lot_____   b. Some_____   c. None_____

Please give an example:

III. Sales

1. In 2014, what percent of your sales were international? ___
2. In 2014, what percent of your domestic sales were within the 6-county Sacramento Region? _
3. In 2014, what percent (%) of your sales were to:

Retail		Restaurants		Institutions	

IV. Operating Expenses

Please complete the table below by entering information regarding your business operating expenses in 2014. Fill out the first column by estimating the operating costs for each category then indicate what proportion of each expenditure is spent within and outside the Sacramento region.

Inputs and Services	**Expenses ($ or % of total)**		**Percent Within Sacramento Region**	**Percent Outside Sacramento Region**
Employee compensation (including wages, benefits, payroll taxes, workers' comp., etc.)				
Cost of raw materials				
Bookkeeping and tax services				
Freight and trucking				
Fuel, oil, grease				
Car and truck expenses				
Utilities & Office Supplies				
Waste management and remediation				
Storage and warehousing				
Insurance				
Rent or lease (buildings)				
Repairs and maintenance				
Taxes				
Interest				
Certifications, licenses, permits				
Marketing costs				
Other operating expenses:				
TOTAL	100%			

V. Capital Expenditures

Please complete the table below by entering information regarding capital expenditures in 2014. Fill out the first column with an approximate dollar value for the capital expenditures and then indicate where the expenses were spent.

Capital Expenditures	**Expenditures ($)**		**Within Sacramento Region (%)**	**Outside Sacramento Region (%)**
Machinery & Equipment				
Structures				
Other infrastructure				
Other capital expenditures (please list)				

Appendix D. IMPLAN Methodology and Scenario Definition

1. Introduction

The purpose of this appendix is to provide an overview of the methods used to update and customize the IMPLAN input-output model based on primary survey data collected from specialty agriculture producers, processors, and distributors, as well as secondary data collected from a variety of sources.

1.1 IMPLAN Model Overview

This study utilizes the IMPLAN Version 3.1 software package, in conjunction with the 2013 IMPLAN economic data file for El Dorado, Placer, Sacramento, Sutter, Yuba, and Yolo Counties in California. The IMPLAN software functions as an input-output economic model, which estimates the effects of assumed exogenous changes in final demand within the specified geographic region. The model leverages a robust data set of national and regional economic accounts that document purchasing relationships between industries through multiple iterations, or rounds of spending, and makes this estimation possible. The software also incorporates institutional demand and inter-institutional transfers, which reflect purchases made by households and government agencies.

1.2 Understanding the Model Outputs

The output values typically generated through IMPLAN input-output analysis include the direct, indirect, and induced economic impacts. These are most commonly expressed in terms of output, but may also be expressed in terms of employment, labor income, or one of the four components of value added (employee compensation, proprietor income, other property type income, or tax on production and imports). By definition, the direct impacts are associated with the initial dollars spent within the study area. Amounts paid to entities located outside of the study area are excluded from the analysis and considered economic “leakage” because these dollars do not circulate within the local economy and thus cannot be counted among the local economic impacts. As a result, the direct impact estimates reported in the model outputs may differ somewhat from the gross dollar values that are initially reported, since the direct impact estimates account for economic leakage. The indirect impacts are estimated as industries that were the recipients of direct purchasing of the materials and services necessary for production. Induced impacts result from household consumption made possible by wages paid to workers and income generated to proprietors and institutions. When combined, this cycle of spending represent an economic multiplier effect, by which a direct increase in exogenous demand results in a total economic effect that is greater than the initial direct impact.

1.3 The Need for Customization

An evaluation of the data underlying the IMPLAN model identified that at least some of the default data for the 14 agricultural crop and livestock sectors may not be fully representative of economic activity associated with specialty agriculture in the SACOG region. For example, data on the ratio of *Value Added* to *Output* is based on national benchmark data provided by the Bureau of Economic Analysis (BEA). While IMPLAN utilizes detailed county-level data to define the *Output* values associated with agricultural commodities, the model estimates total *Value Added* based on national benchmark data provided by the BEA. The breakdown of *Value Added* is similarly derived, since the BEA reports things like proprietor income only at the farm level, with no detail provided that would help to distinguish between commodities. While the IMPLAN model offers a detailed spending profile for *Intermediate Expenditures*, the list of inputs purchased is held constant across commodities. Likewise, purchasing coefficients are held constant in proportion to the Intermediate Expenditure coefficient. While the model reflects the best information that is available on a national basis, it is possible to leverage the robust systematic methods associated the IMPLAN input-output software, while also improving the accuracy of the resulting multipliers by modifying it using alternative data sources that better reflect the characteristics of Sacramento area producers and related industries.

1.4 Working with Multiple Models

The ERA team initiated this research utilizing the default IMPLAN model using the 2013 IMPLAN dataset for El Dorado, Placer, Sacramento, Sutter, Yolo, and Yuba Counties in California. The default model was used to preliminarily identify the structure of the specialty agriculture industry cluster within the Sacramento region. The default IMPLAN data was then used as the basis for developing two customized IMPLAN models. As noted elsewhere in this appendix, the ERA team incorporated additional local data based on primary survey research, as well as assorted secondary data sources. The method prioritized the use of local data where possible, utilizing the default IMPLAN data where local data sources were incomplete or unavailable. Note that the default model will continue to represent a useful tool moving forward, providing SACOG staff with a useful perspective regarding industries not included within the scope of this research, including, for example, non-agriculture related manufacturing. Also, IMPLAN has announced changes to their methodology for balancing industry accounts. As such, the 2014 data may offer some improvements over the 2013 data used for this research. SACOG may wish to utilize the default IMPLAN data in future years to update the custom models and to incorporate more current information into the decision making process.

The two custom models developed for this research include one that is aggregated to correspond to the default IMPLAN sectoring scheme and one that is disaggregated using re-purposed IMPLAN sectors that represent custom industry sectors that were broken out from the default industries. It is worth noting that both the aggregated and disaggregated models include custom industry data based on ERA's research into the unique economic behaviors associated with each specialty agriculture producer, processor, and distributor industry. In the aggregated model, the custom industry profiles for each break-out sector were simply combined using a weighted average method. For most research purposes, the aggregated custom model will provide the most reliable and internally consistent economic impact results. This is due to the way that the data which drives the IMPLAN software, such as the IMPLAN National Trade Flows Model, are applied, such that the aggregated model better maintains the internal consistency of the modeling framework.

However, under certain circumstances, the disaggregated model may better suite SACOG's research needs, in which case it may be used, but with certain qualifications. For example, the way the IMPLAN software treats *Commodities* implies that the trade flow data associated with re-purposed IMPLAN sectors (i.e., those used to represent custom industry sectors, such as the Tobacco Farming sector which was re-purposed to represent the Processing Tomato Farming sector) might not fully represent the custom industry. This only impacts dollars flowing into the custom sector; therefore, analyses focused on dollars flowing out of custom sectors (i.e., industry spending/purchasing) may be more reliably modeled using the disaggregated model, though the results should still be interpreted with caution.

2. Developing a Custom Model

In order to develop a customized IMPLAN model that more accurately reflects the economic behavior of specialty agricultural producers, processors, and distributors within the SACOG region, the ERA team utilized primary survey data supplemented by assorted secondary data (summarized in appendix A) to develop custom industry profiles for use in the IMPLAN model. This included estimating total *Output*, as well as *Value Added* and *Intermediate Expenditure* coefficients and *Industry Production* coefficients for eleven existing IMPLAN industry sectors and nine newly defined specialty agriculture producer, processor, and distributor industry sectors. However, due to limitations associated with the application of the IMPLAN National Trade Flows Model to custom industry sectors within the IMPLAN software, the ERA team elected to aggregate the 19 custom and revised industry sectors to correspond with the default IMPLAN sectoring scheme using a weighted average method, which reflects the unique industry behavior of each component sector commensurate with its share of the aggregate sector.

In addition, the ERA team has provided a set of industry profiles that contain the unique industry data for each of the 19 sectors, which may be utilized for scenario analysis. Utilizing the methods described below, SACOG staff may not only apply the custom industry profiles developed by the ERA team for scenario analysis, but can also develop new profiles that suit the needs of the agency. The method described below is intended for use by individuals who are at least generally familiar with the IMPLAN software and the techniques commonly used in economic impact analysis. Note that the methodology used to create revised and custom industry sectors uses the baseline IMPLAN data as a foundation, with modifications being made as appropriate to adjust for inaccuracies or irregularities, as identified through the survey results and through a review of the available secondary data. In the absence of more reliable information, the default IMPLAN data is assumed to be representative of the economic activities in question.

2.1 The Structure of the IMPLAN Model

The IMPLAN input-output model contains detailed social accounts data for 536 unique industries, as well as households and assorted institutions. Data for each industry are grouped into four main categories, including: *Study Area Data*, *Industry Production*, *Commodity Production*, and two sets of *Trade Flows*, which include the *Local Use Ratio (RSC)* and *Regional Purchase Coefficients (RPC)*. To view and modify each of these data components, you must enable model customization, which can be done through the *Customize* task bar. If the Customize task bar is not visible, the analyst can enable this and other advanced modeling features on the *User Preferences* window. This is accessed by going to *File* > *User Preferences* > *Analysis* and checking the boxes for *Advanced Modeling*, *Enable Accounts Explorer*, and *Enable Model Customization*. Once enabled, the *Customize* task bar should be visible on the left hand side of the IMPLAN interface, below the *Analyze* and *Explore* options, which provides options to view and customize the following types of data:

- **Study Area Data:** The suite of data defines the size and scope of each industry within the IMPLAN model. Variables included in the study area data for each industry include total industry output, total employment and the ratio of output per employee, and value added, which includes employee compensation, proprietor income, other property type income, and taxes on production and imports. Total output, minus all types of value added, are equal to intermediate expenditures, which is the value routed through the industry production function.

- **Industry Production:** This suite of data defines the production function for each industry included in the IMPLAN model. The production function for each industry identifies the list of commodities that are purchased as intermediate inputs. The coefficients represent the proportion of total output that gets allocated to purchases of each commodity. The sum of the coefficients identified in the industry production function must sum to the proportion of total output spent on all intermediate expenditures (i.e., output minus value added).

- **Commodity Production:** The commodity production function identifies the commodities produced by each industry, including the primary product and any associated byproducts. The coefficients in the commodity production function must sum to 1.0, with the coefficient for each commodity equal to a proportion of the total.

- **Trade Flows:** The trade flow data contained within the IMPLAN Model are broken down into two interrelated components:

- **Local Use Ratio:** The local use ratio defines the proportion of local production of a given commodity that is utilized by other domestic industries. The remainder is assumed to be leakage resulting from foreign and domestic commodity exports.
- **Regional Purchase Coefficient:** The regional purchase coefficient defines the proportion of gross demand for a given commodity that is supplied from local sources, with the remainder being imported from outside the analysis region.

2.2 Creating a Custom Industry Profile

Custom industry profiles for specialty crop agriculture in the SACOG region are developed using the following approach. While the aggregated model combined the profiles using a weighted average method in order to ensure consistency with the default IMPLAN sectoring scheme and the National Trade Flows Model, the custom industry profiles are available and may still be used under certain circumstances and with certain known limitations. The following information is intended to allow SACOG staff to develop additional custom industry profiles as necessary to meet future analytical needs.

2.2.1 Selecting the Baseline Industry

Prior to creating a custom industry profile, identify the IMPLAN sector that accounts for the economic activity in question. For example, this research created custom industry profiles for certain types of specialty agricultural production, like peach farming and walnut farming. In IMPLAN, the economic activity associated with peach production is captured within the broader Fruit Farming sector (IMPLAN 4), while walnut production is captured under the Tree Nut Farming sector (IMPLAN 5). In cases where this is unclear, refer to the NAICS sector to IMPLAN sector bridge file provided by IMPLAN, inc.[1]

2.2.2 Exporting the Default Industry Data

The next step is to export the industry balance sheet.

1) Select *Social Accounts* under the *Explore* task bar (left hand side of the screen).

2) In the *Social Accounts Explorer* window, select the *Balance Sheets* tab, and then export to MS Excel. This file includes all of the information for the baseline industry sector that will be needed to create a new custom industry sector, with the exception of *Total Employment* and the *RSC*. The industry balance sheet Excel file will include three tabs that summarize the IMPLAN data for commodity production, industry demand, and value added. Note that the *Total Commodity Demand* line item on the *Industry Demand* tab,

[1] The NAICS to IMPLAN bridge is provided by IMPLAN, inc., and can be downloaded directly from their website implan.com. Be sure to download the correct version, as there are multiple sectoring schemes and vintages.

plus the *Total Value Added* line item on the *Value Added* tab, equal *Total Output* from the industry sector in question.

3) To identify *Total Employment* for an industry, select *Study Area Data* under the *Explore* task bar and export to MS Excel.

4) To identify the *RSC* for an industry, select *Social Accounts* under the *Explore* task bar, then select the *Social Account Reports* tab and export to MS Excel.

2.2.3 Incorporating Alternative Data

Using the data provided in the industry balance sheet as a foundation, identify which pieces of survey data or secondary data warrant incorporation into a revised and/or custom industry profile. The emphasis is on identifying expenditures as a proportion of total output or sales. Data can be incorporated in a variety of ways and may include the addition or deletion of certain expenditures. Note that in those cases where you are creating a new industry sector, the most important step is to identify the *Total Output* value for the new industry as a proportion of the *Total Output* from the default sector.

Modifications can also be made to the *Study Area Data* and *Value Added* components, though no items may be added or deleted. All changes to the *Study Area Data* and *Value Added* components are input as dollar values, rather than output coefficient values. Changes to the *Industry Production* component may include the addition of new commodities, though commodities that you wish to remove can only be zeroed out. All changes to the *Industry Production* component must be input as output coefficient values, meaning as a percentage of total output.[2] For example, if the default *Industry Production* data do not include purchases of a commodity that is important to the sector you are trying to model, create a new line item and insert the new value. In those cases where you have a survey based expenditure total that does not reflect specific commodities, start by identifying the basket or suite of commodities that would most likely be included in the same expenditure class, then allocate the expenditure value based on the distribution of the default coefficients. For example, the IMPLAN *Industry Production* data for *Fruit Farming* includes a number of commodities that the ERA team roughly grouped as fertilizer and agricultural chemicals. The survey identified expenditures on fertilizers and agricultural chemicals as a single line item. The ERA team allocated that spending proportionally across the array of commodities included in the fertilizer and chemicals group based on the sum of the default coefficient values.

[2] Before finalizing the revised or new industry profile, be sure to re-balance all of the coefficient values. The *Value Added* components, calculated as a share of total output, plus the sum of the *Industry Production* components, should equal 1.0. Similarly, the sum of the coefficients for each of the Commodity Production components should also equal 1.0. If not, the customized IMPLAN model will not function properly once the new and revised data are incorporated.

In those cases where you are creating a new industry sector, you will need to import the *Commodity Production* profile for the original sector, then modify it to reflect the characteristics of the new industry. In all cases, the coefficient for the commodity associated with the repurposed industry must be zeroed out. Not doing so will activate purchasing and production relationships, as well as trade flows, associated with the original sector. For example, if the Tobacco Farming sector (IMPLAN 7) is repurposed as a custom industry, some may be tempted to reutilize the Tobacco commodity (IMPLAN 3007) as a stand-in commodity for the new industry. However, the structure of the IMPLAN software utilizes the IMPLAN National Trade Flows model to exogenously determine foreign export quantities for each commodity. Utilizing the Tobacco commodity (IMPLAN 3007) to represent a custom industry commodity, like peaches or tomatoes, would subject that custom industry to the foreign export values, and other trade flows assumptions, for the Tobacco Industry (IMPLAN 3007). Therefore, the primary commodity produced by any custom industry sector should be the commodity associated with the industry upon which the new sector was derived. For example, when creating a new industry to represent processing tomato farming, the sector should apply the commodity production coefficients associated with the vegetable and melon farming sector (IMPLAN 3).

In addition to updating the *Value Added*, *Industry Production*, and *Commodity Production* components of the industry profile, changes can also be made to the *two Trade Flow* components, the *RSC* and *RPC*. There is only one RSC value for each commodity, which represents the proportion of the local supply that is used within the region. Conversely, the RPC for each commodity can vary based on the industry or institution that is doing the purchasing. Again, RPCs represents the proportion of total commodity demand that is satisfied by suppliers located within the region. Although IMPLAN allows the use of different RPCs for a given commodity that is being purchased by multiple industries, the default model applies the same RPC value for all industries and institutions. Both the RSC and RPC values can be modified as appropriate. However, the value of the RPC coefficients cannot result in *Total Local Demand* that exceeds *Net Commodity Supply*,[3] as calculated based on the underlying IMPLAN data.

2.3 Inputting a Custom Industry Profile into IMPLAN

When simply revising an existing IMPLAN industry sector, select the industry in question, then follow the steps outlined later in this section. Note that the IMPLAN software does not allow the creation of new industry sectors that are outside of the existing industry sectoring scheme. Therefore, to create a new industry sector, click on *Study Area Data* under the *Customize* task bar. Scroll down the *industry list* to identify an existing IMPLAN sector that has zero output, and then rename the industry.

[3] *Net Commodity Supply* is equal to *Total Commodity Supply*, minus *Foreign Exports*. As noted earlier, *Foreign Exports* is an exogenously derived value base on IMPLAN's underlying data, which cannot be modified.

2.3.1 Modifying the Study Area Data

1) Enter the appropriate *Study Area Data* values for the new or revised sector. There are two ways to do this. You can enter either total dollar values or per worker values.

   a. Enter revised data for any of the following variables: *Output*, *Employee Compensation*, *Proprietor Income*, *Other Property Type Income*, and *Tax on Production and Imports*.

   b. Click *Update*, which will re-balance the data and will update the *Total Value Added* field and *Intermediate Expenditures* field. Note that the values may change slightly, as the software will round them as part of the balancing process.

   c. Confirm that the values are still on the same order of magnitude as those entered. If you have not entered a new employment total, this will also be updated based on the default ratio of output per employee.

   d. When satisfied, click *Save*. Note that once saved, modifications cannot be undone.

   e. Select *Options* > *Construct* > *Multipliers* to reconstruct the model.

CAUTION: Be sure to make all of the modifications to the *Study Area Data* at this stage, as making changes later on and reconstructing the model may result in the software reverting back to the default *Industry Production*, *Commodity Production*, and *Trade Flow* data, deleting any changes that you may have already made to those components of the model. For this reason, it is important to keep the number of times that you reconstruct the model to a minimum.

2.3.2 Modifying the Industry and Commodity Production Data

1) Export the data for the industry sector that you are using as the baseline for the revised or new industry sector. If you are only modifying an existing industry, skip this step and simply modify the coefficients as necessary.

   a. Select *Industry Production* or *Commodity Production* under the *Customize* task bar, then select the industry in question.

   b. Select *Options* > *Export*.

2) Select the new industry from the list on the left, then select *Options* > *Import*.

   a. Add commodities and insert revised coefficients as appropriate.

   b. Select *Balance* at the bottom of the screen

   c. If satisfied, click *Save*.

   d. Select *Options* > *Construct* > *Multipliers*, to reconstruct the model.

CAUTION: Recognizing that the software can revert back to the default data under certain circumstances, it is helpful to also export the new or revised production function using the same method described above. In the event that the production function for a new industry sector reverts to its default state, simply import the new revised production function and select *Save*.

2.3.3 Modifying the RSC and RPC Values

1) Select *Trade Flows* under the *Customize* task bar.
   a. To revise the RSC value, select the *Trade Model* tab, then enter a new value that reflects the local use of local supply. This can be either a dollar value, or a percent RSC value.
      i. For the RSC, enter one value per commodity.
      ii. When satisfied, click *Save*.
   b. To revise the RPC values, select the *Industry/Institution RPC* tab. The default IMPLAN assumes the same RPC coefficient for each industry or institution that purchases a given commodity, though these can be different.
      i. Enter the new RPC values, as appropriate.
      ii. When satisfied, click *Save.*
   c. Select *Options* > *Construct* > *Multipliers*, to reconstruct the model.

3. Other Special Considerations

When developing customized IMPLAN models, there are a number of special considerations that should be taken into account to ensure that the resulting input-output model functions properly.

3.1 Wholesale and Retail Margining

In some instances, when expenditures are allocated to the wholesale and/or retail trade sectors, the analysis must also account for margining, which represents sales receipts, less the cost of goods sold, or put another way, equals the trade margin, plus sales taxes and excise taxes. Margining is less of a concern when dealing with Industry Production data, and more so when specifying economic impact events and scenarios. However, margining is an important concept that can impact where in the Industry Production profile certain expenditures are allocated. For example, purchases of gasoline can be coded to *Refined Petroleum Products*, a product of the oil refining industry, or can be coded to *Gasoline Stores*. Margins are not applied to the former, but they are applied to the latter, which can impact the way the dollars associated with that expenditure circulate through the economy.

4. Scenario Analysis using the Integrated Models

In addition to the custom IMPLAN model for specialty crop agriculture, the ERA team developed a primary agricultural production model. The technical details of the primary production model can be found in Appendix B. In contrast to the IMPLAN model, the primary model is an economic optimization model of the farm-level production decisions of growers and the market for specialty crops. As such, it can be used to simulate the response of the specialty agriculture production sector, by crop, to changes in policy, prices, market conditions, and resource availability. For policy analysis the primary model is used to estimate changes in the crop production sector, and the output from this model is linked to the IMPLAN model to simulate changes in the regional economy.

The ERA team developed three scenarios to demonstrate how to apply the primary production and IMPLAN models for policy analysis. Scenarios include a market growth scenario, market contraction scenario, and a business attraction scenario.

4.1 Market Growth Scenario

The market growth scenario considers an increase in the demand for specialty crop production in the Sacramento region. Crop production demand is determined by market conditions, and described using a crop demand curve in the primary production model. In 2014 and 2015 California agriculture suffered through two of the hottest and driest years on record. Surface water deliveries from the major state and federal water projects were zero for many regions in the San Joaquin Valley. In contrast, the Sacramento Valley received higher deliveries and had better access to groundwater, making drought conditions severe but comparatively better than conditions in the San Joaquin Valley. In response, the demand for processing tomato production in the Sacramento region increased, and processing tomato contracts shifted from the San Joaquin Valley back to the Sacramento Valley, reversing a long-term trend. This scenario assumes an increase in the production of processing tomatoes within the SACOG region of 35 percent.

The first step in conducting an impact assessment is to select an appropriate modeling approach. Here we use the primary production model to estimate the 35 percent increase in processing tomato production, and the custom IMPLAN model to evaluate the regional economic impacts. The next step in the modeling process is to identify the necessary inputs. Within the default and aggregate IMPLAN models developed by the ERA team, processing tomatoes are categorized within IMPLAN Sector 3 – Vegetable and Melon Farming. This research identified that total output value of processing tomatoes in the SACOG region equals $135 million[4]. A 35 percent

[4] This output value assigns a share (63.2%) of the IMPLAN Vegetable and Melon Farming output value based on the share of USDA-NASS vegetable and melon revenues represented by processing tomato farming. Total output

increase would equal approximately $47.25 million, which functions as the direct impact input value for this scenario analysis. The variables necessary to specify this impact scenario are summarized in Table D.1.

Table D.1: Impact Event Specification – Scenario 1

Activity Type	Activity Name	Activity Level[1]	IMPLAN Sector	Industry Sales (Output Change)[2]
Industry Change	Increase in Tomato Output	1	3 Vegetable and Melon Farming	$47,250,750

[1] The *Activity Level* represents a multiplier that is applied to all *Event Values* within an *Activity*, which reflects the number of times the event is repeated to create the final demand change.
[2] The *Industry Sales* variable is equal to the change in output, production, or sales volume.

Follow the steps below to enter the impact event values into the IMPLAN software:

1) Open the IMPLAN 3.1 software and open the model titled *SACOG_SpecialtyAgriculture_AggregateModel_2016*;[5]

2) Select *Setup Activities* on the *Analyze* task bar (left side of the window);

3) On the *Activities* toolbar (top of the window under *Setup Activities*), select *New Activity*;

4) Select the parameters on the *Add New Activity* screen that correspond to those identified in Table D.1;

5) In the *Events* area of the screen, select the appropriate *Sector* and enter the *Industry Sales* value as identified in Table D.1;

6) Select *Next* in the bottom right corner of the screen;

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values differ between the two sources because IMPLAN industry data is compiled from Economic Census data based on NAICS codes and NASS data is gathered from grower surveys.
[5] This presumes that the user has already downloaded and installed the necessary IMPLAN data package.

7) On the *New Scenario* window, select a name for the *Scenario* and enter 1 for the *Scenario Level*, then select *Save*;[6] [7]

8) Select the Activity(ies) included in the scenario from the *Available Activities* portion of the screen and move them to the *Selected Activity(ies)* portion of the screen using the *Select* and *Unselect* arrows, then select *Analyze Single Region.*

4.2 Market Contraction Scenario

The market contraction scenario considers a decrease in the farm-gate price of specialty crop production in the Sacramento region. Crop production demand is determined by market conditions, and described using a crop demand curve in the primary production model. A change in the price of a commodity is modeled in the primary production model.

Between 1997 and 2014 the farm-gate price of walnuts was highly variable, with average annual swings of 20 percent change in value. Through 2015 prices received for walnuts were over $1.50 per pound but as of 2016 walnut prices have settled closer to $0.90 per pound, a decrease of approximately 40 percent.

The first step in the analysis is to use the primary production model to simulate the effect of a change in the price received for walnuts. This can be accomplished two ways: simulating the statewide increase in the production of walnuts, which will capture the decrease in the price received for walnuts, or by calculating this shift and imposing the price change. This scenario applies the latter approach because it is simpler to implement, and because this scenario is a backward-looking analysis of a change in the market. The strength of the primary production model is the ability to simulate future changes in market conditions. This approach is discussed in the business attraction scenario. This scenario analyzes the 40 percent decrease in the price received for walnuts.

Follow the steps below to implement the price shift in the primary production model:

1) Copy and paste the GAMS file and data file into your desired folder.
2) Open the GAMS software.
3) Select *File* > *Project* > *New*
    a. Create a project file called "Scenario 2".
    b. Save the project file in the same folder as the GAMS data file and GAMS program.
4) Select *file* > *open*.
    a. Open the GAMS program "SACOG Primary Model".

[6] A *Scenario* represents one or more *Events* that are run through the model at the same time, producing one set of impact estimates.
[7] The *Scenario Level* functions similar to the *Activity Level*, which reflects the number of times the scenario is repeated to create the final demand change.

5) Open the policy analysis Excel Workbook
    a. Enter data to decrease the price of walnuts by 40 percent.
    b. Save the file.
6) Select *file* > *run*.
    a. The program will run and execute output into the Excel file.
7) Open the output MS Excel file in the Project folder.
    a. Go to the desired output tab (prices, acreage, production) and summarize the change in desired extensive margin output metrics.
    b. Record the change in the total value of production (which should approximately equal a 40 percent decrease).

This scenario also uses a version of the IMPLAN model that has been customized to better represent specialty agriculture within the SACOG region; however, this scenario provides an example of how a custom industry profile can be used to add an additional level of accuracy and specificity to the analysis.

<u>Using a Custom Industry Profile</u>

The following are instructions for incorporating one of the custom industry profiles developed by the ERA team into the IMPLAN model:

1) Open the IMPLAN 3.1 software and open the model titled *SACOG_SpecialtyAgriculture_AggregateModel_2016*;[8]

2) Select *File* > *User Preferences* > *Analysis* and make sure the following boxes are checked, then close the window:

    a. Advanced Modeling

        i. Enable Accounts Explorer

        ii. Enable Model Customization

3) Select *Study Area Data* under the *Customize* task bar on the left side of the screen;

4) Scroll down the *Industry List* and locate a sector with zero output and employment, such as *IMPLAN Sector 7 – Tobacco Farming*;

5) Select *edit totals then update per worker values* in the *Edit Options* box;

6) Enter the *Study Area Data* variables as identified in the custom industry profile;

7) Select *Update*, then *Save*;

[8] This presumes that the user has already downloaded and installed the necessary IMPLAN data package.

8) Select *Options* > *Construct* > *Multipliers* to reconstruct the model;

9) Select *Industry Production* under the *Customize* task bar on the left side of the screen;

10) Select the appropriate industry sector, then input the *Coefficient* values as identified in the custom industry profile;

11) Under the column labeled *Fixed*, uncheck all of the boxes, then select *Balance*;

12) Double check the *Coefficient* values, then select *Save*;[9]

13) Select *Options* > *Construct* > *Multipliers* to reconstruct the model;

14) Select *Commodity Production* under the *Customize* task bar on the left side of the screen;

15) Enter zeros in the column labeled *Coefficient* for any commodity category not identified in the custom industry profile commodity production function;

16) Select *Options* > *Add a Commodity*, then select the appropriate commodity from the *Available Commodity List*, then enter a value in the space labeled *Byproducts Coefficient* and select *OK*;

17) Select *Balance* and *Save*;

18) Select *Options* > *Construct* > *Multipliers* to reconstruct the model;

19) Select *Trade Flows* under the *Customize* task bar on the left side of the screen;

20) Select the *Industry/Institution RPC* tab, then select a commodity from the drop down list;

21) Insert updated *Regional Purchase Coefficient* values for each industry and/or institution listed, then select *Save*;[10]

22) Select *Options* > *Construct* > *Multipliers* to reconstruct the model.

The next step in the modeling process is to identify the necessary inputs. While following the steps identified above for entering a custom industry profile into the IMPLAN software, a previously zeroed out industry sector was re-purposed for use as a custom industry. The impact event parameters described below will need to be entered in relation to this new industry.

The output value of walnuts in 2014 was approximately $335.6 million[11]. A 40 percent decrease equals $134.23 million, as shown in the primary production model analysis in the first step,

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[9] The values may change slightly as a result of the balancing process. This is due to rounding within the software.
[10] Though the IMPLAN model applies the same RPC values across all industries that purchase a given commodity, the software allows the user to define unique RPC values.

which is the direct impact input value for the IMPLAN model. The variables necessary to specify this impact scenario are summarized in Table D.2. To enter the impact event values into the IMPLAN software, follow the steps provided under Scenario 1.

Table D.2: Impact Event Specification – Scenario 2

Activity Type	Activity Name	Activity Level[1]	IMPLAN Sector	Industry Sales (Output Change)[2]
Industry Change	Decrease in Walnut Output	1	[Defined by the user]	($134,228,759)

1 The *Activity Level* represents a multiplier that is applied to all *Event Values* within an *Activity*, which reflects the number of times the event is repeated to create the final demand change.
2 The *Industry Sales* variable is equal to the change in output, production, or sales volume.

4.3 Business Attraction Scenario

The business attraction scenario evaluates the economic impact, or contribution, of a new specialty crop processor starting a business in the Sacramento region. The processor is attracted to the region through a RUCS imitative, other specialty crop agriculture initiatives, or business-friendly policies in the SACOG counties. The presence of a processor in the region may lower the production costs (e.g., transportation) or risks (e.g., long-term contracts) to growers, which may incentivize growers to produce the crop demanded by the processor. These changes in production conditions in the SACOG region are simulated using the primary production model. As regional production of the crop increases, the production of other crops decreases.

This scenario evaluates a new peach processing facility for Individually Quick Frozen (IQF) peaches. The market for frozen peaches has been expanding in recent years and the share of total

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[11] This output value assigns a share (75.7%) of the IMPLAN Tree Nut Farming output value based on the share of USDA-NASS tree nut revenues represented by walnut farming. Total output values differ between the two sources because IMPLAN industry data is compiled from Economic Census data based on NAICS codes and NASS data is gathered from grower surveys.

available peaches represented by frozen peaches has tripled since 1970. Currently there is no frozen fruit processor in the SACOG region. It is likely that the frozen processor will be a diversified operation with a range of products including peaches. For simplicity, only peaches are evaluated in this scenario. The frozen peach processor reduces production costs or production risk for growers in the SACOG region. This can be modeled as a decrease in the price of inputs to peach production, or alternatively, as a shift in the demand (price) for peaches in the Sacramento region. The latter approach is used for this scenario, which simulates a 10 percent increase in the gross margin for peaches.

The first step is to evaluate the production response to the new processor. To implement the price shift in the primary production model:

1) Copy and paste the GAMS file and data file into your desired folder.
2) Open the GAMS software.
3) Select *file* > *project* > *new*.
    a. Create a project file called "Scenario 3".
    b. Save the project file in the same folder as the GAMS data file and GAMS program.
4) Select *file* > *open*.
    a. Open the GAMS program "SACOG Primary Model".
5) Open the policy analysis Excel Workbook.
    a. Enter data to change the demand for peaches.
        i. A shift of 10% is assumed for this demonstration
    b. Save the program file.
6) Select *file* > *run*.
    a. The program will run and execute output into the MS Excel file.
7) Open the output Excel file in the Project folder.
    a. Go to the desired output tab (prices, acreage, production) and summarize the change in desired extensive margin output metrics.
    b. Record the change in the total value of production of peaches across all regions.
    c. Record the change in the total value of production of all other crops across all regions.
    d. Record the change in production of peaches (in tons) across all regions.

Next, in the custom IMPLAN model create a new industry by inputting the custom industry profile for the Frozen Specialties Manufacturing sector (IMPLAN 80) using the method described in the previous scenario. Identify the total output that the proposed facility may be expected to generate using the primary production model (step 7.d.). The variables necessary to specify the impact scenario for the first phase of this analysis are summarized in Table D.3. Enter the values into the IMPLAN model using the method described in the previous section. To evaluate the impact of adding a new industry into the economy, the impact event is equal to the inverse of the total Output value for the industry. Prior to evaluating the results, convert them to positive values.

Table D.3: Impact Event Specification – Scenario 3 (Phase I)

Activity Type	Activity Name	Activity Level[1]	IMPLAN Sector	Industry Sales (Output Change)[2]
Industry Change	New Processing Facility	1	80 Frozen Specialties Manufacturing	($88,352,700)

1 The *Activity Level* represents a multiplier that is applied to all *Event Values* within an *Activity*, which reflects the number of times the event is repeated to create the final demand change.
2 The *Industry Sales* variable is equal to the change in output, production, or sales volume.

Next, select the *Detailed Results* tab in the *Scenario Results* window, then select *Export* > *All Detailed Reports to Excel*. On the *Output* tab of the MS Excel document, identify the Fruit Farming sector (IMPLAN 3) and record the total impact value, then convert to a positive number.

The next phase of this impact scenario is to evaluate the change in production for all other crop sectors that are displaced by the increase in peach production.

To enter the outputs of the primary production model into IMPLAN, follow the steps provided in Scenario 1, creating a new *Event* for each crop category under the same *Activity*. Table D.4 summarizes the change in production value for other crops from the primary production model. Select *Analyze* on the *Analyze Scenarios* screen, then select *Detailed Results* on the *Scenario Results* screen. To export the results, select *Export* > *All Detail Reports to Excel*.

Table D.4: Impact Event Specification – Scenario 3 (Phase III)

Activity Type	Activity Name	Activity Level[1]	IMPLAN Sector	Industry Sales (Output Change)[2]
Industry Change	Farm Output Decrease (Oilseed)	1	1 Oilseed Farming	($44,210)
Industry Change	Farm Output Decrease (Grain)	1	2 Grain Farming	($601,768)
Industry Change	Farm Output Decrease (Veg)	1	3 Vegetable and Melon Farming	($33,558)
Industry Change	Farm Output Decrease (Fruit)	1	4 Fruit Farming	($178,835)
Industry Change	Farm Output Decrease (Nuts)	1	5 Tree Nut Farming	($84,315)
Industry Change	Farm Output Decrease (Other)	1	10 All Other Crop Farming	($39,241)
Industry Change	Farm Output Decrease (Ranch)	1	11 Ranching	($67,095)
			Total, All Sectors	($1,044,021)

1 The *Activity Level* represents a multiplier that is applied to all *Event Values* within an *Activity*, which reflects the number of times the event is repeated to create the final demand change.
2 The *Industry Sales* variable is equal to the change in output, production, or sales volume.

The next step is to combine the economic impact estimates associated with the recruitment of a new frozen fruit processing facility, with the impacts associated with changes in farm output. To do this, sum the *Direct*, *Indirect*, and *Induced* impact estimates from the two model runs, as illustrated in Table D.5. To estimate the multiplier, divide the combined impact for both model runs (including the *Direct*, *Indirect*, and *Induced* effects), by the combined *Direct* impact.

Table D.5: Model Output Values – Scenario 3

	Employment	Labor Income	Value Added	Output
New Processing Facility				
Direct Effect	190	$8,968,151	$12,249,991	$88,352,675
Indirect Effect	328	$14,584,420	$23,000,386	$45,272,249
Induced Effect	102	$4,757,845	$8,624,776	$14,290,245
Total, All	620	$28,310,416	$43,875,152	$147,915,168
Change in Farm Output				
Direct Effect	-7	($157,394)	($190,722)	($1,049,022)
Indirect Effect	-4	($180,317)	($298,359)	($502,019)
Induced Effect	-1	($69,093)	($125,185)	($207,507)
Total, All	-12	($406,803)	($614,266)	($1,758,548)
Combined Impact, All Events				
Direct Effect	183	$8,810,757	$12,059,269	$87,303,653
Indirect Effect	324	$14,404,103	$22,702,027	$44,770,230
Induced Effect	101	$4,688,752	$8,499,591	$14,082,738
Total, All	608	$27,903,613	$43,260,887	$146,156,621

Appendix E. Literature Review of Regulatory Compliance Costs for Specialty Crop Agriculture in the Sacramento Valley

1. Introduction

The agricultural sector in California is subject to some of the most stringent and complex regulations in the world. Regulations can provide benefits to producers by, for example, signaling to consumers that California produce is safe and reliable, but regulations also impose compliance costs on agricultural businesses. This analysis includes a review of published and unpublished studies to establish regulatory compliance costs to specialty crop producers, processors, and distributors in the Sacramento area.[1]

Regulatory costs can be classified as either direct, involving a cash outlay in response to the regulation, or indirect, involving an opportunity cost to the business or industry as a result of the regulation. Both direct and indirect costs of regulations have been increasing in recent years. The increasing costs of regulatory compliance, as well as the possibilities of even more stringent regulations in the future, are widely cited as a major source of concern in the agricultural industry. It is difficult to quantify the direct and indirect costs of a regulation because establishing these costs requires access to proprietary financial information. It follows that there is a relatively limited number of studies that estimate plausible regulatory compliance costs. The literature review identified 34 regulatory cost studies that represent the best available estimates.

The total cost of regulatory compliance for specialty crop producers in California is estimated to equal more than $2 billion per year (Hurley and Noel 2006a). There is no comparable estimate for the total cost of regulations to processing and distribution industries because these businesses are much more diverse and are affected by a range of complicated, and often intersecting, regulations. Table E.1 summarizes some of the key state and federal laws that impose regulations on agricultural businesses. In addition to state and federal requirements, there are numerous local regulations that affect agricultural businesses. The following sections summarize total, direct, and indirect costs of major regulations for specialty crop producers, processors, and distributors.

[1] Defined as the six-county area including El Dorado, Placer, Sacramento, Sutter, Yolo, and Yuba counties.

Table E.1: Example Laws Affecting Agricultural Businesses, by Area of Regulation

Environment		**Law**	**Agency**
Federal			
	1969	National Environmental Policy Act	U.S. Environmental Protection Agency
	1970	Federal Clean Air Act	U.S. Environmental Protection Agency
	1972	Federal Clean Water Act	U.S. Environmental Protection Agency
	1972	The Coastal Zone Management Act	National Oceanic and Atmospheric Admin.
	1973	Federal Endangered Species Act	NOAA, U.S. Fish & Wildlife Service
	1974	Safe Drinking Water Act	U.S. Environmental Protection Agency
	1976	Toxic Substance Control Act	U.S. Environmental Protection Agency
	1990	Pollution Prevention Act	U.S. Environmental Protection Agency
	1996	Federal Insecticide, Fungicide, and Rodenticide	U.S. Environmental Protection Agency
State			
	1969	Porter-Cologne Water Quality Control Act	CA Environmental Protection Agency
	1970	California Environmental Quality Act	CA Natural Resources Agency
	1973	California Forest Practice Act	CA Dept. of Forestry and Fire Protection
	1976	California Coastal Act of 1976	CA Coastal Commission
	1986	California Safe Drinking Water and Toxic	CA Office of Environmental Health Hazard
	1988	California Clean Air Act	CA Environmental Protection Agency
	2006	California Global Warming Solutions Act	CA Environmental Protection Agency
	2014	Sustainable Groundwater Management Act	CA Department of Water Resources
Food Safety		**Law**	**Agency**
Federal			
	1906	Federal Meat Inspection Act	USDA Food Safety and Inspection Service
	1938	Federal Food, Drug and Cosmetic Act	U.S. Food and Drug Administration
	1957	Federal Poultry Inspection Act	USDA Food Safety and Inspection Service
	1990	Federal Organic Foods Production Act	USDA Agricultural Marketing Service
	1996	Food Quality Protection Act	U.S. Environmental Protection Agency
	2010	Food Safety Modernization Act	U.S. Food and Drug Administration
State			
	2003	California Organic Products Act	CA Department of Food and Agriculture
Labor		**Law**	**Agency**
Federal			
	1970	Occupations Safety and Health Act	U.S. Department of Labor
	1983	Federal Migrant and Seasonal Worker Protection	U.S. Department of Labor
	1993	Worker Protection Standard	U.S. Environmental Protection Agency
	2009	Federal Fair Labor Standards Act	U.S. Department of Labor
State			
	1975	California Agricultural Labor Relations Act	Agricultural Labor Relations Board

Notes: NOAA: National Oceanic and Atmospheric Administration; USDA: United States Department of Agriculture.

1.1 Regulatory Environment in California

The regulatory environment for agricultural and food production systems in California is stringent and complex, more so than in any other state. The regulation of agriculture is driven mainly by environmental concerns, such as water and air quality issues, as well as worker and consumer health and safety interests. While regulations may be in the public interest and can provide some benefits to the regulated industry, they may also affect firm and industry productivity and competitive performance. The increasing complexity of the regulatory environment in California has been cited by several studies as an area of growing concern for California producers and a factor that is likely to have negative impacts on the future competitiveness of the industry (Hurley 2005; Johnston and McCalla 2004; Noel, Paggi, and Yamazaki 2013).

The main areas of regulation in California agriculture can be classified as: (i) labor regulations, such as safety and health, worker compensation and rights, (ii) regulations pertaining to consumer health and safety, (iii) environmental regulations, such as air and water quality, water rights, threatened or endangered plants and animals, and wetlands, and (iv) regulations related to transportation of materials including hazardous waste (Carter et al. 1996). Specialty crop agricultural businesses face a range of regulations within each of these broader categories. The costs of regulatory compliance vary widely depending on the type of industry and the commodities being produced. For example, transportation regulations impose a proportionally higher cost on distributors than on primary producers, whereas labor regulations, particularly workers compensation rates, are proportionally higher for on-farm jobs.

2. Direct and Indirect Regulatory Costs

Regulatory compliance imposes direct and indirect costs on an industry. Direct costs include cash outlays, which are typically a direct out-of-pocket expense for a business. Examples include permit fees, fees for testing or verification, coalition charges, and other payments made specifically to assure compliance. Indirect costs result from foregone earnings (opportunity cost) and losses that result when a business changes their operations in response to a regulation. For example, labor costs to train and hire additional employees and fill out and submit required paperwork, as well as the time (both employee and proprietor) required to learn about the regulations and to assure compliance. Indirect costs require detailed financial information and are typically more difficult to quantify than direct regulatory costs.

The prevalence of indirect costs of regulatory compliance is discussed in several studies that examine the regulatory environment for producers of specialty crops in California. A survey of over 1,300 California producers of specialty crops, administered by the California Agricultural Statistics Service and analyzed by Hurley and Noel (2006b) and Hurley et al. (2006), found that indirect cost of management time devoted to regulatory compliance increased by 40 percent between 1999 and 2004. Survey respondents reported spending an average of 7.3 percent of their total working hours on regulatory issues in 1999, compared with 10.3 percent in 2004. This indirect cost of additional management time, which is typically at a higher wage rate than farm laborers, can be a significant cost on a per-farm or per-acre basis. In fact, California producers already pay the highest total labor costs in the country, which account for approximately 21 percent of their total costs of production, thus a three percent increase in the labor time for regulatory compliance represents a significant portion of on-farm costs (Hamilton 2006). It is also noteworthy that labor costs can account for upwards of 50 percent of total production costs for some vegetable crops.[2]

Direct cash costs of compliance have increased as well, especially fees associated with environmental regulation. Table E.2 compares estimated average regulatory costs per farm for California producers in 1999 and 2004 (Hurley and Noel 2006a) in 2004 dollars. Additionally, Hurley and Noel estimate that burning permits averaged $38 in 1999 and increased to $129 in 2004, representing a 240 percent increase in costs. Over the same time period air quality fees increased by 940 percent and chemical use fees increased by 127 percent.

Table E.2: Average annual regulatory costs, 1999 and 2004

Regulatory Cost	1999	2004	Change
	$ per farm		*%*
Burning Fees	38	129	240
Air Quality Fees	52	542	942
Chemical Use Fees	252	571	127
Solid Waste Fees	697	733	5
Water Quality Fees	968	993	3
Workers Compensation Costs	6,462	18,087	180

Source: Table 6 in Hurley and Noel (2006a). Costs are in 2004 dollars.

2.1 Business Perceptions of the Regulatory Environment

The regulatory environment in California is constantly changing in response to new laws, policies, and political pressure. The complexity of the regulatory environment is a major factor driving increases in the costs of compliance. Indirect compliance costs are perceived by specialty crop producers as having a higher negative impact on the production process than direct cash costs. This is largely due to the uncertainty created by the regulatory environment. Producers want to comply with regulations, but find it difficult to obtain timely information (Hurley et al. 2006). Local farm bureaus and industry groups offer meetings and information sessions, which requires growers to commit management time to attend these meetings, which can be costly.

A second source of concern for the specialty crop industry is that there are multiple agencies overseeing regulations. California producers face multiple agencies and regulations derived from at least twenty-eight separate state and federal laws governed by various separate state and federal agencies. Table E.3 summarizes some of the key agencies. Producers deal with multiple state and federal agencies separately, in some cases duplicating their efforts and further

[2] For example, see a recent Op-Ed in the Mercury News, available from: http://www.mercurynews.com/opinion/ci_23817065/minimum-wage-santa-clara-county-proposal-would-hit

increasing their costs (Hurley 2005; Hamilton 2006). In addition to state and federal agencies, growers must navigate regulations from local coalitions, water districts, counties, and cities.

Table E.3: Federal and state agencies for regulatory compliance

Federal
United States Department of the Interior (including Reclamation)
United States Department of Agriculture
United States Environmental Protection Agency
United States Department of Health and Human Services
United States Department of Labor
United States Department of Commerce
United States Food and Drug Administration
State
California Department of Food and Agriculture
California Department of Fish and Game
California Department of Water Resources
California Coastal Commission
California Agricultural Labor Relations Board
California Environmental Protection Agency
California Department of Forestry & Fire Protection
State Water Resources Control Board
Department of Industrial Relations
County Agricultural Commissioners

Perceived complexity of the regulatory environment varies between the major agricultural regions in California (Hurley et al. 2006). Producers in Southern San Joaquin and Sacramento Valley regions are most likely to perceive the regulatory environment as complex or very complex, mostly because of strict labor and air quality regulations on emissions and particle pollution. Producers in the Southern Desert regions, including Coachella, Imperial, and Yuma, are less likely to view the regulatory environment as complex because regulations are less stringent. A survey of specialty crop producers who do not farm in California by Paggi et al. (2009) found that 74 percent of respondents viewed that California regulatory environment as more restrictive than that of their home state.

3. Total Costs of Regulatory Compliance for Specialty Crop Producers

The costs of regulatory compliance depend on the size of the farm, crop mix, and location. It follows that there are multiple ways to evaluate the cost of compliance with a specific regulation. For example, one can estimate the total cost of compliance for the entire farm, but how that cost is allocated to each crop grown on the farm, or each acre of a given crop in production, is not a simple calculation. This section summarizes the total costs of regulatory compliance, and the following sections summarize the total regulatory costs for specific regulations.

Research on the total costs of regulatory compliance for producers of specialty crops in California is surprisingly limited. Hurley and Noel (2006a, 2006b) completed initial work including estimates of farm-level costs of regulatory compliance, by farm income level. The authors found that growers, on average, spend about 6.4 percent of total farm income on regulatory compliance. In another study, Hurley et al. (2006) used data from a survey of specialty crop producers to estimate that survey respondents spent about 11 percent of capital investment on regulatory compliance. Of each dollar that was allocated to regulatory cost compliance, 16 percent was allocated to workers safety, 13 percent to abatement of water discharge, 9 percent to abatement of air emissions, and 6 percent toward providing wildlife habitat. The remaining 66 percent of capital investment was spent on other miscellaneous regulatory compliance.

The total costs of regulatory compliance are unevenly distributed by farm size. Approximately 10 percent of the farms in California realize annual income greater than $500,000. Hurley and Noel (2006a) found that these farms spent approximately 6 percent of their total farm income on regulatory compliance in 2004. They also found that that farms with income greater than $500,000 per year accounted for more than 88 percent of total regulatory costs for the state. The total costs of regulatory compliance for producers of specialty crops, including cash and labor costs, both direct and indirect, were estimated to equal between $2.19 billion and $2.21 billion in 2004 (Hurley and Noel 2006a). Table E.4 summarizes the results of the analysis.

Table E.4: Total regulatory cost by farm income

Farm Income Range	Regulatory Cost	Average Regulatory Cost		
	$	*$ per farm*	*$ per acre*	*% farm income*
Under $10,000	9,306,511	262	51	5.24
$10,000–$49,999	39,190,084	2,447	189	8.16
$50,000–$99,999	30,816,042	4,708	152	6.28
$100,000–$249,999	112,659,422	16,078	167	9.19
$250,000–$499,999	82,966,217	20,721	271	5.53
$500,000+	1,924,943,890	252,518	638	6.33
All incomes	2,199,882,166	28,570	162	6.41

Source: Table 3 in Hurley and Noel (2006a). Costs are in 2004 dollars.

3.1 Farm Budget Analyses

Because the regulatory environment is fluid and complex, many studies use stochastic farm-level simulation models to evaluate the impact of specific regulations on the profitability of agricultural producers. These simulation models are based on farm-level cost-of-production budgets (analogous to a standard Profit and Loss annual statement for any business) for representative growers and are used to analyze the impact of changing regulatory costs while holding other factors constant. The model simulates the effect of proposed or existing regulations on the net farm income of producers, typically per acre, taking into account the (stochastic) distribution of prices and yields. Since the model is stochastic it can be used to express regulatory costs both as per-acre cash-costs and probabilistically.

All of the studies using stochastic farm budget models find that increasing costs of regulatory compliance increases the probability of negative net farm income on a per acre basis. In one of the more recent studies, Paggi et al. (2010) found that compared with Texas, where the regulatory burden on the growers is much lower, the probability of incurring annual losses in California is 17 percent higher. Noel et al. (2013) find that regulatory compliance costs to orange growers in the Southern San Joaquin Valley decreased the five year average annual net farm income for orange producers by approximately 1.5 percent. Noel and Paggi (2012) estimate the cost of regulatory compliance to lettuce growers equals about $150 per acre per year, about 53 percent greater than the cost in Arizona. Paggi et al. (2009) use a simulation model to evaluate the effect of waste disposal fees on cling peach and processing tomato producers in Stanislaus County and find a reduction in annual net farm income ranging from 12 percent to 17 percent.

Table E.5 summarizes studies using stochastic farm-level models for producers of specialty crops in California. As discussed above, all studies found that regulatory costs reduce the average net returns and increase the probability of lower or negative returns per acre for agricultural producers. The first two columns summarize the crop and regulations considered by each study, and the simulation period is shown in column 3. Column 4 summarizes the cost of the regulation per acre to growers.

Table E.5: Regulatory costs using farm-level simulation models

Crop	Cost / Regulation	Simulation period	Cost per acre	Source
Oranges	Total cash cost: $216.19–$401.51 per acre	2008–2012	$216 - $402	Paggi et al. (2009, 2010)
Peaches (processing)	Waste disposal charge: $7.68–$10.56 per ton	2007–2009	$124–$176	Paggi et al. (2007, 2009)
Tomato (processing)	Waste disposal charge: $7.68–$10.56 per ton	2007–2009	$273–$376	Paggi et al. (2007)
Iceberg Lettuce	Total cash cost: $150/acre	2006–2010	$150	Noel and Paggi (2012)

4. Regulatory Cost by Type of Regulation

As discussed previously, most regulations affecting specialty crop businesses can be classified as labor, environmental, consumer health, or transportation (distribution). The following sections summarize key regulations and costs for each category of regulation.

4.1 Labor Regulations

Relative to other states, California has higher minimum wages, mandatory workers' compensation insurance, liability insurance, and health care benefits. Workers' compensation rates for agricultural workers vary between 10 and 25 percent of base salary for field and packing shed workers, to as low as 0.5 percent for clerical workers. Because of these regulations California producers spend millions more than farmers in states with lower labor expenses (Hurley 2005; Hamilton 2006). For some growers, workers' compensation can comprise up to half of total regulatory costs (Noel and Paggi 2012).

In recent years piece-rate compensation has been impacted by several case law developments. Under the Federal Fair Labor Standards Act an employer may average an employee's piece-rate earnings over all hours worked to determine whether that employee's pay meets the minimum wage requirement. Under this federal law, piece-rate earnings in excess of the minimum wage required to cover piece-producing time (PPT) may be applied to the minimum wage requirement to cover non-piece producing time (non-PPT). However, under California law, employers must fully pay for all hours worked, including non-PPT, at the regular hourly rate. In several cases, such as Armenta v. Osmose 2005, Cardenas v. McLane Food Services 2011, and Gonzalez v. Downtown LA Motors, LP 2013, California courts ruled the federal law that allows employers to average over all hours in a workweek to compute minimum wage obligations are not acceptable under California law. Therefore, employers who do not separately pay for non-PPT and rest breaks are potentially exposed to a lawsuit and could be required to pay back-pay, fines, and legal fees. Employers that try to minimize exposure by utilizing the piece-rate compensation system have to track PPT and non-PPT, as well as rest breaks, and ensure that employees are directly compensated for non-PPT and break time at more than the minimum wage. In addition, the piece-rate compensation for the PPT is at least equal to minimum wage. The time spent tracking the different categories of time worked, as well as the uncertainty over what constitutes compliance with labor laws, generates an additional cost for employers and employees (Resnick and Moody 2015).

Another important labor regulation in California is the Heat Illness Prevention standard. This is mandated by the Division of Occupational Safety and Health (DOSH or Cal/OSHA), and requires specific training and access to shade and water for outside workers. The requirements also cover an acclimatization period for new workers, high heat and emergency procedures, and require employers to develop written procedures and train employees in how to apply them. In 2010, the Cal/OSHA conducted a three-year campaign to publicize heat illness awareness. The results of the campaign were summarized in report by Teran (2013) to the California Department of Industrial Relations. The report identified several barriers that prevent workers from consistently following heat illness prevention practices. The main obstacle was the conflict between the recommended rest periods and the piece rate compensation structure, with workers being unwilling to stop for water or rest because they would be earning less. Both employees and employers reported that workers are less likely to stop for rest if they are working for piece-rate compensation. In some cases, workers paid by the hour reported not getting permission from supervisors to stop, drink water, and rest. In turn, the employers reported compliance with these regulations is costly, especially for employers with smaller operations.

Table E.6 summarizes the annual costs per acre of compliance with labor and other regulations for specialty crop producers from an in-progress study by McCullough et al. (2016). These labor costs do not include the cost of workers' compensation insurance because, the authors argue, it is a cost-of-business in California and not a separate regulatory cost. Education and training have the highest average compliance costs per acre. All farm labor has to undergo annual safety training. For example, if chemicals were applied to the crop, then the workers handling those chemicals had to go through special training to obtain a private applicators license. This labor time is a direct regulatory cost to the farm. The cost of labor compliance as a proportion of average annual operating costs ranges from less than 1 percent up to 2.5 percent.

Table E.6: Annual labor regulatory costs by crop

	Operating Costs	Education/ Training	Labor Requirements	Total Labor	Share of Operating Costs
			$/acre		*(%)*
Almonds	2,319	50.83	6.07	56.90	2.45
Tomato	2,942	5.25	2.77	8.02	0.27
Peach	8,658	44.72	1.49	46.21	0.05
Grapes	2,706	22.35	11.09	33.43	1.23
Orange	3,614	40.00	0.68	40.68	1.12
Lettuce	3,866			79.00	2.00

Source: McCullough et al. (2016). Costs are in 2012 dollars.

Estimates of costs per acre reported in Table E.6 are consistent with earlier studies of regulatory costs for orange producers. Costs of compliance with labor regulations were reported to equal between $48 and $56 per acre (2008 dollars), or about 3 percent of operating costs, in Paggi et al. (2010) and Noel and Paggi (2012).

4.2 Environmental Regulations

Following the development of the Central Valley Project (CVP) and State Water Project (SWP), California water management has shifted from an era of building dams to one of increased focus on the environment. Environmental concerns have generated many new regulations that affect agricultural producers. These regulations can be broadly classified as water quantity, water quality, air quality, and pesticide regulations. Table E.7 summarizes the annual costs per acre of compliance with environmental regulations for specialty crop producers. The following sub-sections provide more detail on the individual components.

Table E.7 shows that air emissions regulations impose the highest annual cost per acre. Meeting air quality requirements typically requires a capital outlay to purchase new machinery or replace diesel pumps, which carries a significant cost. As a share of operating costs, costs of compliance with environmental regulations per acre range from under 1 percent up to 4.7 percent.

Table E.7: Annual environmental regulatory costs by crop

	Operating Costs	Air Emissions	Water Quality	Pesticide Application	Total Environment	Share of Operating Costs
			$ per acre			*%*
Almonds	2,320	87.19	6.98	14.02	108.19	4.66
Tomato	2,942	22.17	0.06	16.12	38.35	1.30
Peach	8,658	52.88	3.01	6.86	62.75	0.07
Grapes	2,706	31.87	11.44	5.75	59.30	2.19
Orange	3,613	64.50	8.85	19.48	92.83	2.57
Lettuce	3,866				58.00	1.50

Source: McCullough et al. (2016), Noel and Paggi (2012). Costs are in 2012 dollars.

The findings of McCullough et al. (2016) are consistent with earlier studies. Paggi et al. (2010) and Noel and Paggi (2012) found that the costs of compliance with environmental regulations were between $41 and $242 per acre (2008 dollars), or about 12 percent of operating costs. The following subsections provide some background on these environmental costs.

4.3 Water Quantity

Regulation of water supply has been increasing in recent years, mostly driven by environmental concerns. The costs of water quantity regulations typically manifest as regional costs which are difficult to calculate on a per farm basis. When faced with water shortages, farmers typically respond by reducing levels of crop production (fallowing land), deficit irrigating crops, pumping additional groundwater, and switching to less water-intensive crops. As a result, the agricultural profits and the number of agricultural jobs decline. Two recent examples of water quantity regulations that have a direct effect on water use by farms are the 2009 Biological Opinion on Delta Smelt and the Sustainable Groundwater Management Act of 2014.

Under the Endangered Species Act of 1973, a Federal agency is required to request a Formal Consultation if it believes that its project may adversely affect an endangered species. A Biological Opinion (BO) is a formal document that results from this consultation and it contains the determination of whether or not a specific project is likely to jeopardize a listed species or adversely affect a listed species' critical habitat. The original BO issued by the U.S. Fish and Wildlife Service in 2005 determined that CVP and SWP would not jeopardize the Delta Smelt. This opinion was challenged in court, and a 2007 court ruling, known as the Wanger Interim Order for Delta Smelt, mandated a 25 to 30 percent reduction in water exports by the SWP in 2008. In 2009, a new BO was issued on Delta Smelt, stating that pumping by the CVP and SWP is likely to jeopardize Delta Smelt and suggested retaining the restrictions that resulted from the Wanger Interim Order and implementing additional cuts in pumping based on environmental conditions to mitigate the damage. Studies by Sunding et al. (2009) and Howitt et al. (2011)

found that these restrictions resulted in the loss of thousands of farm jobs and millions of dollars in farm revenue.

In 2014 the California legislature passed a set of three laws: AB 1739, SB 1319, and SB 1168, collectively known as the Sustainable Groundwater Management Act of 2014. AB 1739 and SB 1168 establish guidelines for sustainable groundwater management plans and provide rules for state intervention and interim management when local groundwater management agencies do not satisfy management requirements. The key feature of the bills is that management plans must contain measurable objectives to achieve groundwater sustainability within 20 years. In practice, the Sustainable Groundwater Management Act requires several immediate and future actions. Each medium and high-risk groundwater basin (as defined by DWR) must elect a Groundwater Sustainability Agency (GSA) by 2017. The GSA must establish and submit to DWR a Groundwater Sustainability Plan (GSP), which must be implemented by 2022. By no later than 2042 the basin must be brought into sustainable management where groundwater levels are stabilized. If a GSA is not formed, then the management of the basin will default to the county. If a GSA/county is not able to implement a GSP, the State Water Resources Control Board has a duty to take appropriate corrective actions. Preliminary estimates suggest sustainable groundwater management will require some groundwater basins, primarily in the San Joaquin Valley, to reduce groundwater pumping by up to 30 percent. Basins in the Sacramento Valley are in better shape, only overdrafted 3–7 percent, however the statewide reduction in groundwater pumping will increase the value of water, and in turn, increase the North-South economic gradient for water transfers out of the Sacramento Valley.

4.4 Water Quality

As shown in Table E.7, the water quality regulatory compliance cost can be as much as 18 percent of total per acre regulatory costs attributable to the environment. Water quality regulations are primarily paid through local water coalition fees, with the remaining costs being primarily associated with time spent filling out forms, permits, and documentation. Some farms have begun to monitor nitrogen displacement and most anticipate nitrogen management regulations coming soon (McCullough et al. 2016).

The primary federal statutes that mandate water quality in California are the United States Clean Water Act (1972) and Safe Drinking Water Act (1974). The Clean Water Act applies only to surface water and the Safe Drinking Water Act includes both surface and groundwater. The main state law governing water quality in California is the Porter-Cologne Act of 1969, which applies to both surface and groundwater. The State Water Resources Control Board and nine Regional Water Quality Control Boards administer the provisions for water quality regulations. Each regional Water Quality Control Board has the authority to regulate discharges of waste by issuing permits known as Waste Discharge Requirements (WDR). These permits include agricultural inputs, such as fertilizer, pesticides, and sediment discharge into state bodies of water. Growers are required to monitor nonpoint source discharge via an individual WDR, or to participate in a Conditional Waiver Program that charges fees and requires training and voluntary discharge monitoring. Bianchi and Harter (2002) summarize water quality risks from septic waste removal, agriculture, and dairies.

In 2003 the Central Valley Region Water Board created the Irrigated Lands Regulatory Program to address discharge of wastes from irrigated lands to surface water. The program has expanded to include discharges to groundwater. Coalition groups monitor surface water and groundwater at various monitoring points and charge fees to the growers to cover their costs, and the Water Board fees. There are 14 coalition groups, growers join these groups based on the location of their parcels that are required to have regulatory coverage (CA EPA 2016). In addition to monitoring water quality, coalitions provide education and outreach to the growers to inform them about requirements and assist in implementing practices recommended to protect water quality. Therefore, most growers incur the costs of complying with water quality regulations as fees for the coalition group membership ($2–10 per acre) as well as costs of on-farm practices that they may adopt, such as planting cover crops or other practices to reduce run-off.

Waste discharge from crop processing and food manufacturing is also regulated. Land application of effluent occurs when wastewater is applied directly to the land, to irrigate a fodder crop or as groundwater recharge (Paggi et al. 2009, Sexton et al. 2015). Wastewater discharge by food processors is regulated by the State Water Resources Control Board through the regional boards. Concerns over the contribution of food processors to water quality problems in the Central Valley have prompted numerous discussions about more stringent discharge requirements (Rubin et al. 2007, CA EPA 2014). A recent study by the Central Valley Water Quality Control Board found the impact of water quality regulations on the food processors in the Central Valley to be $78 million in direct lost industry output, plus an additional $73 million in indirect and induced output losses (Rubin et al. 2007).

4.5 Air Quality

As shown in Table E.7, air quality regulatory compliance accounts for 50 to 80 percent of total environmental regulatory costs. Senate Bill 700 was signed into law in 2003 and it contained six provisions to establish air quality and regulation requirements in California. The bill established the obligation to reduce fugitive dust emissions as well as particulate matter, commonly referred to as PM10, to improve air quality. California is comprised of 35 air districts with differing air quality compliance requirements. Air pollution is a concern primarily in the San Joaquin Valley region, where emission, dust and particle pollution from farm vehicle operations has been a focus of policy discussion in recent years.

The San Joaquin Valley is one of the two districts in the country classified as an “extreme nonattainment” area for ozone by the Environmental Protection Agency (EPA) and one of nine areas in the country to be classified as “serious nonattainment” for particulate matter. Farm activity has been found to directly emit 21 percent of ozone-forming gases in the San Joaquin

Valley and to account for more than half of direct emissions of particulate (CDFA 2010). Because of these issues, air quality regulations in the San Joaquin Valley region are also strict. Growers are required to file a Conservation Management Plan to limit fugitive dust and PM10 emissions and pay an acreage-based fee (Hamilton 2006). In addition, growers also must obtain an open burning permit, which raises pruning and orchard removal costs.

In the Sacramento Valley, about 30 percent of the air pollution comes from stationary sources including agricultural operations. The remaining 70 percent are from mobile sources, which include on-road and off-road motor vehicles (FRAQMD 2016). The Sacramento Valley is classified as a “moderate nonattainment” area for particular matter, and a “severe nonattainment” area for ozone, especially around the Sacramento metropolitan area. Some of the air quality regulations in the Sacramento Valley are limited to reducing emissions from animal facilities. Additional regulations limit agricultural field fumigations and require special field fumigation emissions permits from growers. Burning permits are required for agricultural burning and may be obtained from agricultural commissioners at a cost.

4.6 Pesticide Regulations

Regulation of pesticide application in California stems from concerns about human health and worker safety and the environment. Registration of pesticides is administered by the Department of Pesticide Regulations (DPR) under the California EPA. In addition to approval by the U.S. EPA, pesticides are subject to an additional review and testing process, which may take several years and cost several million dollars (Ollinger and Fernandez-Cornejo 1998). California DPR also regulates application of pesticides. A Pest Control Adviser (PCA) license is required to make recommendations for commercial pesticide use, and an applicator’s license is required for any application of pesticides for agricultural use. The PCA license and applicator’s license require between 20 and 40 hours of continuing education credits for renewal, the PCA license also requires a bachelor’s degree and requirements of college-level course work in biological sciences, crop health, production systems and pest management methods. A permit is required for each site where pesticides are applied, and each individual pesticide application is registered with the CA DPR by submitting a Pesticide Use Report form.

The EPA Worker Protection Standard (WPS) of 1993 is a federal law that regulates worker safety to reduce the risk of pesticide poisoning and injuries to pesticide handlers and other agricultural workers exposed to pesticides. California DPR includes several regulatory requirements in addition to the WPS. These include more frequent training, more extensive training curriculum, full respiratory protection program equivalent to Cal/OSHA, stricter restricted-entry intervals, larger buffer zones and reduced application rates for soil fumigants, written hazard communication program, mandated outreach and educational activities among workers, and blood testing for pesticide handlers.

4.7 Consumer Health and Safety

The main focus of regulations specific to consumer health and safety is preventing the contamination of food products by foodborne illnesses and harmful chemical residues. Some of the regulations on the use of pesticides also originate with consumer safety in mind, but also fall under environmental regulations, and were therefore summarized in the previous section. This section provides an overview of costs specific to regulations that aim to prevent foodborne illnesses.

4.7.1 Foodborne Illness

The Leafy Greens Products Handler Marketing Agreement (LGMA) was established in 2007 in response to the September 2006 E.coli outbreak in Salinas Valley spinach. A study by Hardesty and Kusunose (2009) found that the cost of LGMA compliance to growers averaged $13.60 per acre. The costs of modifications vary among farms of different size and are summarized below in Table E.8. Larger operations have lower regulatory costs reflecting economies of scale in lettuce production. The same study found that the total food safety compliance costs for lettuce growers average $100 per acre.

Table E.8: Leafy Greens Products Handler Marketing Agreement compliance costs

Farm Revenue Range	Regulatory Cost
	$ per acre
Under $1 million	$14.82
$1 million – $10 million	$18.05
Over $10 million	$8.29
Average	$13.60

Source: Hardesty and Kusunose (2009). Costs are in 2009 dollars.

There is a limited literature that quantifies the crop-specific costs of food safety compliance, and most studies estimate the regional costs of a food safety outbreak. Ribera et al. (2012) estimate that the farm-level losses and marketing losses of food-borne illness outbreaks. Farm gate losses are from sales at the farm and marketing losses are from changes in consumer demand as a result of the outbreak. Table E.9 summarizes the findings of the study.

Table E.9: Economic cost of food illness outbreaks

Farm Revenue Range	Farm cost	Marketing cost
	$ in millions	
Lettuce	12	63
Tomatoes	28	89
Muskmelon	5.8	20.7

Source Ribera et al. (2012). Costs are in 2012 dollars.

The Food Safety Modernization Act (FSMA), passed by Congress in 2010 and signed into law in 2011, requires the adoption of prevention-based controls by food facilities. FSMA requires food facilities to evaluate the hazards in their operation and to implement and monitor effective measures to prevent contamination. FSMA also requires FDA to adopt science-based standards for the safe production and harvesting of fruits and vegetables to minimize the risk of serious illness or death. The annual costs of compliance for domestic farms are estimated to be around $459.6 million (FDA 2013). Efforts to prevent food-borne illness so far have been industry-driven, and even with requirements mandated by FSMA, the food safety standards already voluntarily adopted by most growers will be stricter than FSMA requirements, which may limit the industry compliance costs.

4.7.2 Pesticide Residue

Pesticide residue is both an environmental and food safety concern. The Food Quality Protection Act of 1996 (FQPA) amended previous legislation to focus on new ways to determine and mitigate adverse health effects of pesticides. The most common approach to limit pesticide exposure is to ban certain pesticide application on certain crops. Methyl bromide and organophosphates are two recent examples, in addition to calls for more environmentally friendly integrated pest management (IPM) protocols (Hamilton 2001).

The total costs to the industry from the methyl bromide (MeBr) ban in 2001 were estimated to exceed $25 million for strawberry growers, or about 25 percent of estimated industry returns in that year (Carter et al. 2002). The main economic impacts of the regulation were in the form of foregone profits from sales, from reduced season length ($10.4 million), added labor, machinery, and other costs from longer fumigation periods ($10 million), and added fumigation costs as a result of switching to a new fumigation process and inability to fumigate with methyl bromide in the inner buffer zones ($5.6 million).

Metcalfe et al. (2002) examined the economic cost of banning organophosphates (OP), which affected a number of specialty crops. Their study accounts for alternative pesticides and pest management strategies available to the growers, such as the use of other pesticides, beneficial insects, and adoption of IPM protocols. They estimated an upper and lower bound on the cost of the ban. Table E.10 summarizes the findings of the study.

Table E.10: Per-acre change in cost of organophosphates ban

Crop	Low	High
	$ per acre	
Alfalfa	27	70
Almonds	72	206
Broccoli	65	87
Carrots	0.11	0.69
Cotton	56	56
Grapes	32	163
Lettuce, Head	64	107
Lettuce, Leaf	87	129
Oranges	119	256
Peaches & Nectarines	24	82
Strawberries	141	189
Tomatoes, Fresh	9	44
Tomatoes, Processed	16	16
Walnuts	56	135

Source: Table 5 in Metcalfe et al. (2002). Costs are in 2002 dollars.

4.8 Transportation

Regulatory compliance costs to specialty crop distributors are difficult to identify because most distribution businesses are diversified across crops and industries. Furthermore, distribution is linked to both primary production and processing, so who bears the cost of a new regulation is determined by the relative supply and demand elasticities for these linked industries. That is, a regulation targeted at distributors will be partially (or fully) passed-through to some of their suppliers.

One important regulation which affects distributors in California is the California Global Warming Solutions Act (AB32) of 2006. AB32 mandates reduction of greenhouse gas (GHC) emissions to 1990 levels by 2020. This translates to a reduction of about 15 percent below status quo levels.

Approximately 92 percent of surface transportation for fruit and vegetables in California is by truck. California has more stringent transportation regulations than other states. The California Truck and Bus Regulation, adopted in 2008, requires trucks and buses that operate in California to be upgraded to reduce emissions. As of January 1 2012, trucks are required to have particulate matter filters to meet the new requirements, with replacement of old engines beginning in January of 2015. By 2023 most trucks and buses are required to have 2010 model year engines or equivalent.

Paggi et al. (2012) surveyed agricultural transport companies and found that 45 percent of respondents list the California Air Resources Board (CARB) regulations as a serious regulatory concern, with 21 percent of respondents specifically listing truck and trailer regulations. Preliminary estimates show that, if left unchanged, current CARB regulations would increase the costs of transportation by about 30 percent over the next decade, in real terms, and truck and trailer regulations would increase transport costs by about 19 percent.

5. Primary Survey of Regulatory Costs

Stakeholders in the local specialty crop value chain were surveyed to determine the effects of the regulatory environment including regulatory costs, complexity, duplication, and conflicts. Regulatory surveys were conducted from October 2015 to April 2016 and survey respondents include specialty crop growers, processors, and distributors in the Sacramento Region including El Dorado, Placer, Sacramento, Sutter, Yolo, and Yuba Counties.

Qualitatively, survey respondents offered a range of responses when asked about regulatory compliance. Some treat regulations as a fact of life and a cost of doing business similar to any input cost. Others report feeling that agriculture bears an undue regulatory burden and that California's agricultural industry is at a disadvantage compared to farmers, processors, and distributors in other U.S. states and in other countries. Some regulatory areas affect businesses up and down the specialty crop value chain. For example, at least one grower, processor, and distributor note they have hired an employee specifically to manage food safety regulatory issues. When applicable, similarities in responses based on operation size or commodity were identified.

As of April 13, 2016, a total of 31 individuals completed the survey. However, not all respondents completed all parts of the regulatory survey and the total number of complete regulatory cost surveys is 25. The 25 complete responses are included in the summary statistics presented in this section.

5.1 Regulatory Costs

Specialty crop growers, processors, and distributors in the Sacramento Region were asked to identify regulatory areas with the greatest impact on their business based on possible financial, operational, and managerial impacts. Each sector was given a list of potential regulatory areas to reflect relevant regulations for each sector. Each respondent was asked to identify and rank the top four regulatory areas. Other regulatory areas not in the top four were not ranked. Table E.11 summarizes the percent of each regulatory cost category ranked in the top four by all specialty crop growers, processors, and distributors (jointly). For example, 41 percent of specialty crop producers, processors, and distributors surveyed reported that food safety was one of their top four regulatory compliance concerns. The following sections describe the response for each of the specialty crop sectors individually.

Table E.11. Proportion of regulatory areas ranked in the top 4 by specialty crop industry

Regulatory Area	Response
Food Safety	41%
Occupational Hazards and Safety	41%
Immigration Reform	36%
Water Allocation	36%
Water Quality	36%
Air Quality	32%
Pesticide Application	32%
Employee Regulations	27%
Health Care	23%
Pesticide Registration	14%
Technology	14%
Transportation	14%
Nutrition Labeling	9%
Waste Disposal	9%
Other (Liability insurance)	5%

5.1.1 Producers

Specialty crop growers were presented with eleven options for regulatory areas (as shown in Appendix C.1) and asked to rank the top four areas of concern based on their possible financial, operational, and managerial impacts. Twelve producers were surveyed.

Table E.12 summarizes the percent of each regulatory cost category ranked in the top four by all specialty crop growers. No survey respondents identified land use, waste disposal, or wildlife protection as a top regulatory area. Since growers were only asked to identify and rank the top four areas, this does not mean that regulations in these areas do not affect growers. Rather, it shows that these areas are relatively less important that the others included on the list.

Table E.12: Proportion of regulatory areas ranked in top 4 by specialty crop producers

Regulatory Area	Response
Pesticide Application	100%
Air Quality	57%
Immigration Reform	57%
Occupational Hazards and Safety	57%
Water Allocation	57%
Water Quality	57%
Pesticide Registration	43%
Technology	43%
Food Safety	29%
Other	14%

At least one survey respondent listed the following regulatory areas as the most significant: air quality, immigration reform, occupational hazards and safety, technology, water allocation, other (health care). These top regulatory areas identified by growers reflect the top current concerns in the industry: labor and water. Immigration reform and occupational hazards and safety are key regulations affecting farm labor supply in California. Water availability uncertainty is an ever-present threat to the viability of farming. Although the Sacramento region generally enjoys better water availability than areas in the San Joaquin Valley, growers cited it as a top regulatory concern.

Overall, the most frequently identified regulatory area is pesticide application. Fumigants are specifically mentioned as pesticides with significant regulatory costs for both pesticide application and pesticide registration, and this is of particular concern for nurseries. Among the occupational hazards and safety concerns for specialty crop growers are worker health and heat stress compliance. Sixteen percent of growers' surveyed (two responses) cited occupational hazards and safety compliance, and heat stress compliance in particular, as the number one regulatory area. Other labor issues noted by growers include paid time off costs, piece-rate tracking, and tracking overtime hours, particularly when employees are switching between activities at a vertically integrated operation.

5.1.2 Processors

Specialty crop processors were presented with ten options for regulatory areas (as shown in Appendix C.2) and asked to rank the top four based on their possible financial, operational, and managerial impacts. Nine processors were surveyed.

Several processors ranked fewer than the maximum of four regulatory areas due to lack of significance. Others said the regulatory areas were "all the same" or wrote "none" next to the list of regulatory areas. Table E.13 summarizes the percent of each regulatory cost category ranked in the top four by all specialty crop processors.

Table E.13: Proportion of regulatory areas ranked in top 4 by specialty crop processors

Regulatory Area	Response
Employee Regulations	67%
Food Safety	44%
Water Allocation	44%
Immigration and E-verify	33%
Water Quality	33%
Nutrition Labeling	22%
Byproduct Waste Disposal	22%
Health Care	22%
Occupational Hazards and Safety	22%
Air Quality	11%
Other	0%

The most mentioned regulatory area is employee regulations. Two-thirds of respondents note it is among the top regulatory areas. Workers' compensation and tracking piece-work are frequently noted in the surveys. In addition, labor shortages and the need for a legal system for farm workers were also mentioned. Regulations that were identified by processors include food safety, health care, immigration and E-Verify, water allocation, and water quality. All of the survey respondents who marked food safety as an important regulatory area noted the Food Safety Modernization Act as the primary food safety concern. These include smaller processors and processors of relatively low hazard products that have not previously been subject to food safety stipulations from buyers. While food safety is a concern for smaller producers, health care is only reported as a top four regulatory area for larger firms. One large food processor reports hiring part-time and seasonal employees through a temp agency to circumvent requirements under Affordable Care Act. Wineries note that water discharge is a significant cost, and they also deal with storm water discharge permits and high regulatory fees for water quality compliance in their vineyards.

5.1.3 Distributors

Specialty crop distributors were presented with six options for regulatory areas (as shown in Appendix C.3) and asked to rank the top four based on their possible financial, operational, and managerial impacts. Four distributors were surveyed.

Not surprisingly, the most significant regulatory area for distributors was transportation. Among the Transportation costs mentioned are hours of service limitations, diesel exhaust fluid regulations, and U.S. Department of Transportation compliance. Food waste disposal was not reported as a concern for any distributors. Table E.14 summarizes the percent of each regulatory cost category ranked in the top four by all specialty crop distributors.

Table E.14: Proportion of regulatory areas ranked in top 4 by specialty crop distributors

Regulatory Area	Response
Food Safety	75%
Occupational Hazards and Safety	75%
Transportation	75%
Air Quality	50%
Health Care	50%
Other	50%
Immigration and E-verify	25%
Food Waste Disposal	0%

In addition to transportation, 75 percent of distributors surveyed identified food safety and occupational hazards and safety as top regulatory areas. The other regulatory area included several write-in responses. A broadline distributor noted the cost to meet liability insurance requirements for large institutional buyers was burdensome. In addition, a farm product transportation company reported water quality is among its top four regulatory areas because of the costs associated with storm water pollution control.

5.2 Regulatory Complexity

Specialty crop growers, processors, and distributors were additionally asked: "How would you describe the complexity of the regulatory environment?" They were provided four possible responses to the question including very complex, complex, somewhat complex, and not complex. Table E.15 summarizes the percent of survey respondents who responded for each option. Roughly nine in ten survey respondents reported that the regulatory environment is either very complex or complex. No respondents characterized the regulatory environment as not complex.

Table E.15: Degree of complexity of the regulatory environment

Complexity	Response
Very complex	50%
Complex	38%
Somewhat complex	13%
Not complex	0%

There were some interesting differences between producers, processors, and distributors, although with the limited sample size these results should be viewed with caution. Over half of the specialty crop processors stated that the regulatory environment is very complex. Two out of five distributors found the regulatory environment is complex.

Anecdotally, some survey respondents reported that regulations are so complex they are not able to fully comply with them or they are certain they are overlooking a regulatory requirement and will not find out what it is until they are fined. Respondents reported a need to be well-versed in water regulations. One respondent reported that it is challenging to determine appropriate compliance efforts because of inconsistent responses provided by staff at regulatory agencies.

5.3 Regulatory Duplication

To determine the extent of duplication of effort among regulatory agencies, specialty crop growers, processors, and distributors were asked: "Have you found duplication of effort among federal, state, and local regulatory agencies?" They were asked to select from among three available options including: a lot, some, and none. Table E.16 summarizes the results of the survey. Half of survey respondents report they have found some duplication of effort among federal, state, or local regulatory agencies.

Table E.16: Extent of duplication of effort among regulatory agencies

Duplication	Response
A lot	29%
Some	50%
None	21%

Survey respondents were also asked to provide examples of regulatory duplication. One respondent who reported "none" for the regulatory duplication question noted that regulatory agencies have come a long way to streamline and consolidate reporting processes. However, a different survey respondent reported survey duplication, specifically the U.S. Department of Agriculture (USDA) surveying for information that farms have already provided to the County Agricultural Commissioner Office. Another respondent notes the U.S. Environmental Protection Agency (EPA) and the federal Occupational Safety and Health Administration (OSHA) have many redundancies, but did not specify what they are. Other respondents cited redundancy among OSHA and the California Division of Occupational Safety and Health (Cal/OSHA). One respondent lists the agencies with employee protection mandates: OSHA, Equal Employment Opportunity Commission (EEOC), the Office of Federal Contract Compliance Programs (OFCCP), and Department of Fair Employment and Housing (DFEH).

Duplication of efforts in food safety was reported numerous times. Redundancy is specifically reported among the federal Food and Drug Administration (FDA) and California Department of Public Health's (CDPH) Food and Drug Branch (FDB). For air quality, duplication of effort between the California Air Resources Board (CARB) and local air quality management district's (AQMDs) was reported. A nonspecific report of duplication related to nutrition labeling was also reported. Water was repeatedly named as a regulatory area with duplication of effort, though the only specific regulation mentioned is U.S. EPA's recent Waters of the United States (WOTUS) rule.

5.4 Regulatory Conflicts

Specialty crop farmers were also asked about conflicts in policy goals among regulatory agencies. They were asked to answer Yes or No to the question: "Have you found conflicts in policy goals among federal, state, and local agencies?" The response is mixed, with just under half of respondents stating they have found conflicts in policy goals among federal, state, and local agencies and just over half stating they have not.

6. Summary

The costs of regulatory compliance are a significant burden to agricultural producers in California, but many of these regulations also provide an economic benefit. This study has reviewed the available literature to establish a range of regulatory costs to producers, processors, and distributors. This study has also summarized the results of a survey of 25 specialty crop producers, processors, and distributors. The Sacramento Valley is the focus of the study, but many analyses use data from the San Joaquin Valley. It follows that the estimates presented here apply to a much broader area. There were three main findings from this literature survey: (i) quantifying the cost of individual regulations for specific crops is complex and difficult, (ii) limited research on processor and distributor regulatory costs exists, and (iii) specialty crop businesses find the regulatory environment to be complex with overlapping management agencies and goals.

It is difficult to quantify regulatory costs because detailed and proprietary financial data are required to estimate the additional cost imposed by a regulation. For example, without detailed accounting it is difficult, if not impossible, to estimate the cost of management time required to fill out forms, learn about new regulations, and participate in informational meetings. The economic analyses reviewed in this study provide a careful analysis of the direct and indirect costs of regulatory compliance.

There is very limited research on regulatory compliance costs to processors and distributors. This is, in part, the result of some of these costs being passed-through to the producers. Processors and distributors are typically diversified operations and it is difficult to identify the cost of one specific regulation. Another finding in the literature is the importance of regulatory uncertainty. Regulatory uncertainty is described qualitatively, but not quantified.

The duplication of efforts by the controlling agencies and the lack of a centralized information source for regulatory compliance create significant indirect costs for agricultural producers. In addition, some of the direct regulatory costs, especially those related to labor laws and water and air quality, are much higher than in other states, and have caused some labor-intensive facilities such as dairies to consider relocation elsewhere. Many of the studies reviewed in this report focused on state regulatory issues, and less has been done to evaluate the impact of federal and local regulatory bodies, which also have significant regulatory power. Many of these policies overlap which creates confusion and increases regulatory costs to the businesses.

Future work could consider:

- Completing a “meta-analysis” of the literature survey results. This could involve a benefits transfer-type approach where San Joaquin Valley regulatory costs are adjusted to fit conditions in the Sacramento Valley.
- A primary analysis of the cost of regulatory uncertainly. This is an intuitive and widely-cited cost to business, particularly processors and distributors, which is not quantified in the current literature.
- Further work on the differences in costs of regulatory compliance among farms by size would show how the changing regulatory environment would affect the regional economy.

    - Most of the studies summarized consider average costs of production. However, regulatory costs are unequally distributed among facilities of different sizes. Smaller operations are likely to spend a larger share of their operating income on regulatory compliance, although not necessarily for all areas of regulation.
- An extended analysis that includes a survey of pending and future regulations that are likely to affect specialty crops in the Sacramento Valley.

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Appendix F. Communication of Outcomes in Regional Economic Impact Studies

1. Introduction

Studies of regional economic impacts examine the effects of a program, regulation, or other event on the level of economic activity in a given area. It is important to identify the best ways to present the typical outcomes of such studies to facilitate the understanding of key findings by government, industry, or other participants, and to promote adoption of main recommendations. The ERA team examined studies of regional economic impact with a particular emphasis on studies that use the IMPLAN model.

2. Communicating Outcomes from Economic Impact Studies

The IMPLAN model is to estimate regional economic impacts by government agencies, trade groups, private industry, and academic researchers. The primary outputs of the IMPLAN model are multipliers that measure the amount of total economic activity that results from an industry spending an additional dollar in the local economy. The multipliers show the direct, indirect, and induced impacts from a one-dollar increase in direct output by the corresponding sector. The economic interpretation of the multipliers is not necessarily intuitive to an audience who is not familiar with economic input-output analysis. A useful impact report must present the results in way that highlights the key findings and allows the audience to absorb the main takeaway message, especially if the purpose of the analysis is to motivate a specific action or highlight areas of special consideration for local government bodies. At the same time, reports should also include the level of detail that may be useful to a technical user for further modeling and analysis.

Economic studies that use the IMPLAN model range from analysis concerned with economic impact of a single industry in a specific region (for example, MFK Research LLC 2005 reviews the wine industry in Napa County), to complex custom models of multiple industry sectors and regional economies (for example, Hackett et al. 2009, Sexton et al. 2015, Howitt et al. 2015). Two examples highlight the difficult task of synthesizing complex information for a broad audience.

The first example is a study of the impact of commercial anglers in California. This study used survey data on operating costs to develop an input-output economic model of California commercial fishing operations (California Ocean Fish Harvester Economic model, or COFHE) (Hackett et al. 2009). The analysis was funded by the California Department of Fish and Game. While the model and the results are very detailed and potentially useful, there is very little big-picture analysis, no executive summary, and no graphical presentation of the outcomes, which makes it difficult to establish the main conclusions of the report or to understand the structure of the commercial fishery industry and its connection to the state economy. A typical output table from this report is presented in Example F.1. The report is rich in data, but the results are difficult for non-technical readers to interpret.

Example F.1: Summary Output Table

Table 5. Total Annual Costs by CA Coastal Region and Operational Configuration (in 2006 $)*

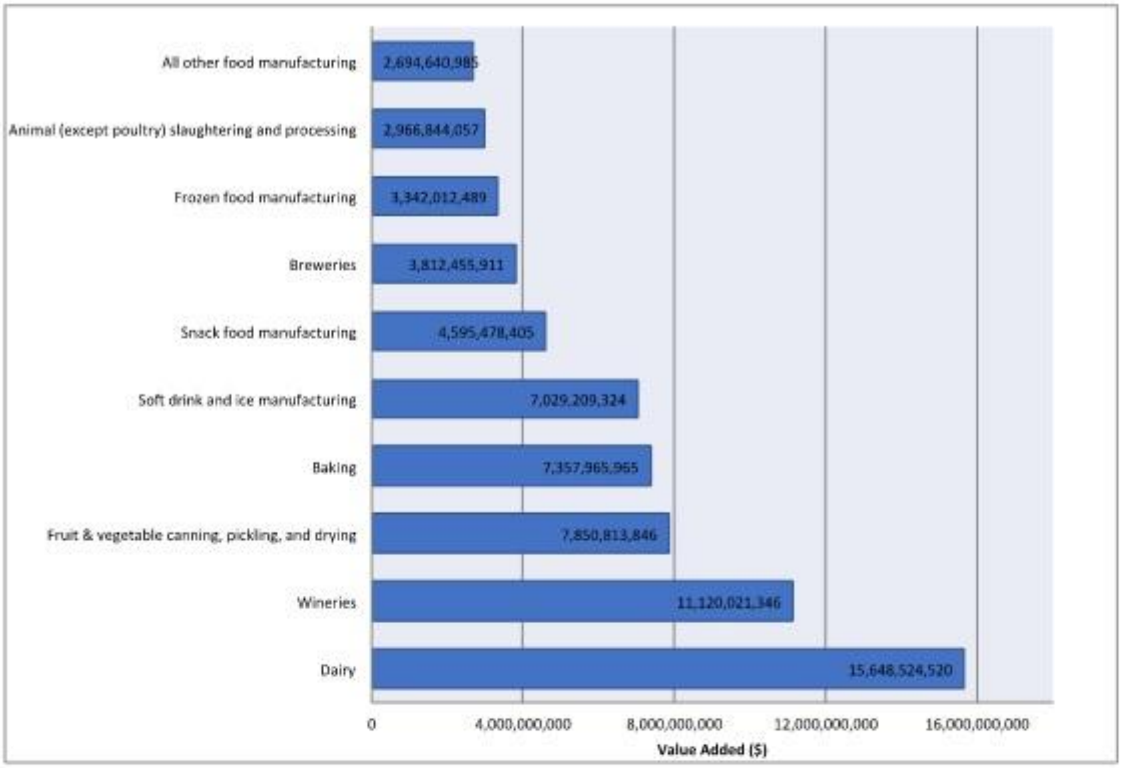
Northern California

OC	Fixed Costs	Variable Costs	Total Costs
Dungeness Crab - Medium and Large Vessels	5,798,289	5,590,307	11,388,596
Trawl - Northern	701,997	2,087,711	2,789,708
Salmon & Dungeness Crab - Medium and Large Vessels	1,236,866	855,733	2,092,599
Salmon	648,720	356,049	1,004,770
Nearshore & Groundfish Trap	466,918	371,906	838,824
Dungeness Crab - Small Vessels	164,043	512,210	676,253
Longline	345,868	181,424	527,293
Sea Urchin	300,923	202,887	503,811
Hook & Line Live	295,453	198,612	494,064
Hook & Line	208,089	169,596	377,685
Salmon & Albacore	145,021	94,886	239,907
Prawn Trap	79,819	36,372	116,191
All Other	47,938	67,028	114,966
Total	**10,439,945**	**10,724,723**	**21,164,668**

Source: Table 5 in Hackett et al. 2009.

A better example can be found in a report prepared for the California League of Food Processors on the economic impact of food and beverage processing in California (Sexton et al. 2015). Like the commercial angler analysis, this study presents estimates of the multiplier impacts generated by the food and beverage processing industry in California. The outputs of the analysis are presented in a tabular format similar to Example F.1. However, before each summary table the authors provide intuitive graphics that summarize the key results. Figures are used to highlight the important results and tables provide additional details, making it easier for technical and non-technical readers to digest the results of the analysis. Example F.2 illustrates an example summary figure from the report.

Example F.2: Summary Output by Sector



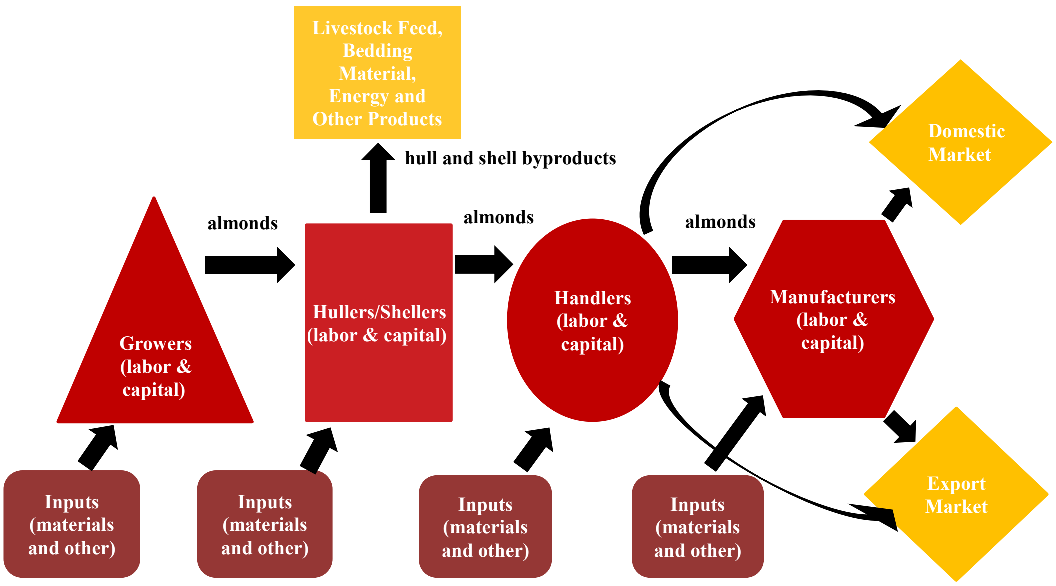
Source: Figure 2 from Sexton et al. 2015.

2.1 Example Approaches to Presenting Economic Impact Study Results

It is useful for the reader if the economic impact analysis presents figures that characterize the flow of inputs and outputs in the industry(ies) being studied. This helps readers that are unfamiliar with the industry visualize the economic web, and at the same time, sets the stage for summarizing the economic impact results. Example F.3 illustrates an example from a recent report prepared for the California Almond Board. Almond production and post-harvest handling is a complicated process with many linked businesses and industries. The flow chart is a simple yet useful display of the industry linkages.

Example F.3: Industry Flow Chart

Figure 1.1: Flow of almonds and other inputs through the production and marketing chain



Source: Figure 1.1 from Sumner et al. 2015.

Example F.4 illustrates a flowchart from another study of California agriculture focusing on the economic impact of drought. Instead of a complicated industry representation, the authors use a flow chart to convey the complex modeling framework used for the analysis. Again, this visual representation adds another way for the reader to understand the process used to generate the output estimates. The font, shapes, and colors shown in Examples F.3 and F.3 could arguably be improved, but they clearly convey the key components of the analysis.

Example F.4: Input-Output Modeling Flow Chart

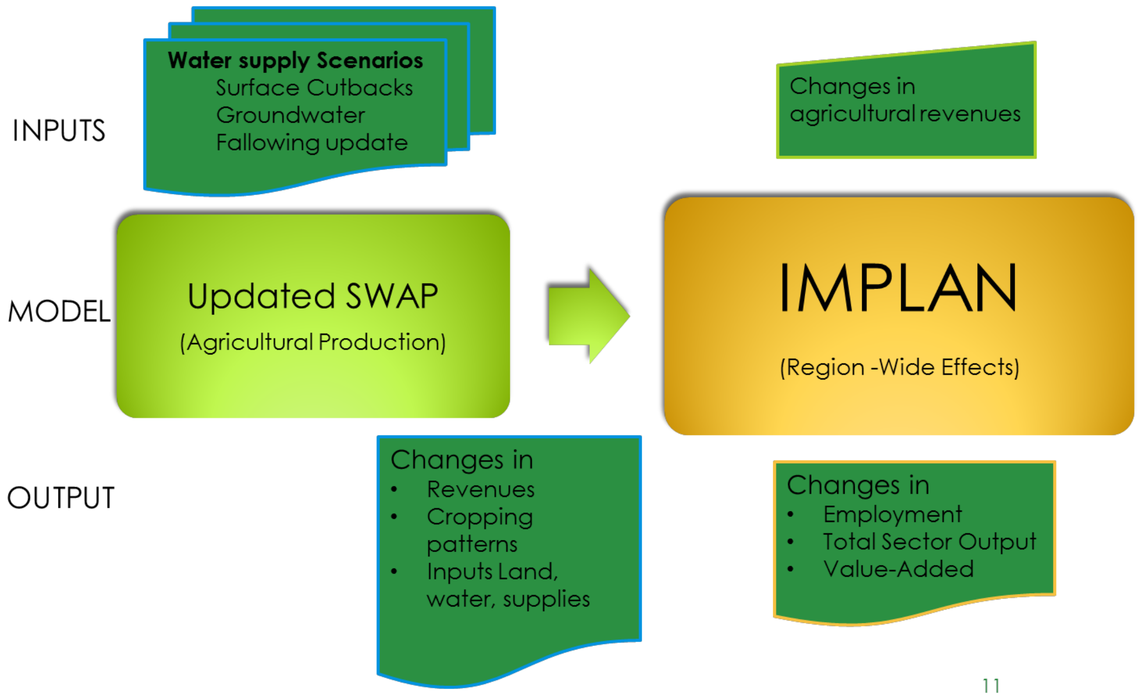


Figure A-2. Interaction of SWAP and IMPLAN modeling with inputs and results

Source: Figure A-2 from Howitt et al. 2014.

Using a flowchart to illustrate the industry linkage and modeling framework is a useful first-step in a summary report. The next, and more important, task is to convey the results of the analysis. Impacts are typically reported in terms of jobs, tax revenues, output value, and value added. As discussed previously, a table is the most common method for summarizing economic impact analyses, but tables are difficult to interpret. Example F.5 illustrated another impact summary table from a report on the economic impact of the wine industry. This table is clearly formatted and easy to read but the reader may be overwhelmed with the range of impacts presented in a single table.

Example F.5: Economic Impacts Table

THE IMPACT OF WINE, GRAPES AND GRAPE PRODUCTS ON THE AMERICAN ECONOMY 2007

HIGHLIGHTS

FULL ECONOMIC IMPACT OF US WINE, GRAPES AND GRAPE PRODUCTS ON THE AMERICAN ECONOMY

$ 162 Billion[1]

	ECONOMIC IMPACT
Full-time Equivalent Jobs	1.1 million
Wages Paid	$ 33 billion
Number of US Wineries[2]	4929
Number of Grape Growers	23,856
Grape Bearing Acres	934,750
US Winery FOB Revenue	$ 11.4 billion
Retail and Restaurant Share of Revenue from Sales of US Wine	$9.8 billion
Distributor Share of Revenue from Sales of US Wine	$2.7 billion
Grape Sales	$3.5 billion
Retail Value of Table Grape Sales	$3 billion
Retail Value of Raisin Sales	$560 million
Retail Value of Grape Juice and Juice Product Sales	$2.8 billion
Number of Wine-Related Tourist Visits	27.3 million
Estimated Wine-Related Tourism Expenditures	$3 billion
Federal Taxes Paid	$9.1 billion
State and Local Taxes Paid[3]	$8 billion

Source: MKF Research LLC. 2007.

Another way to summarize the results of an economic impact analysis is to show the economic multipliers. The reader can quickly review the direct, indirect, and induced effects. On the other hand, these tables are also difficult to interpret for non-technical readers. Thus, as discussed in the following section, figures are useful ways to supplement the information in the tables. Examples F.6 and F.7 illustrate multiplier tables from the economic impact analysis of the California almond industry.

Example F.6: Industry Economic Impact Multipliers

Table 1.1: California Statewide Almond Impact Multipliers

Multiplier	***Growing***	***Hulling Shelling***	***Handling***	***Manufacturing***
Value of Output	*$ of output for economy per $1.00 output by Almond sector*			
Direct Effect	1.00	1.00	1.00	1.00
Indirect Effect	0.37	0.48	1.12	1.38
Induced Effect	0.50	0.47	0.53	0.33
Total Effect	1.87	1.95	2.65	2.71
Value Added	*GDP($) per $1.00 of output*			
Direct Effect	0.52	0.60	0.17	0.10
Indirect Effect	0.21	0.31	0.68	0.43
Induced Effect	0.32	0.30	0.34	0.21
Total Effect	1.04	1.20	1.19	0.73
Employment	*Jobs per $1 million of output*			
Direct Effect	2.86	5.96	0.67	1.12
Indirect Effect	3.23	2.94	7.89	4.18
Induced Effect	3.23	3.02	3.44	2.11
Total Effect	9.31	11.91	12.00	7.42

Source: Input-output multipliers were generated in IMPLAN using revenue and costs information provided by industry sources.

Source: Table 1.1 from Sumner et al. 2015.

Example F.7: Industry Grower Impact Values

Table 1.2: Statewide Economic Impacts of California Almond Growers, 2012-2014[1,2]

	2012	**2013**	**2014**
		$1,000,000	
Value of Grower Output			
Direct Effect	$4,863	$5,828	$7,315
Indirect Effect	$1,809	$2,167	$2,720
Induced Effect	$2,434	$2,917	$3,662
Total Effect	$9,106	$10,913	$13,697
Value Added			
Direct Effect	$2,515	$3,014	$3,782
Indirect Effect	$1,011	$1,211	$1,520
Induced Effect	$1,533	$1,837	$2,305
Total Effect	$5,058	$6,061	$7,608
Employment		Number of jobs	
Direct Effect	13,893	16,649	20,897
Indirect Effect	15,692	18,806	23,603
Induced Effect	15,704	18,819	23,620
Total Effect	45,289	54,274	68,120

Source: Values were estimated by UC AIC staff by applying input-output multipliers generated in IMPLAN and using revenue and costs information provided by industry sources.
[1]Each year reported reflects the almond crop year and not calendar year.
[2]Values for 2014 crop year are estimated based off of crop volume and value projections provided by industry sources.

Source: Table 1.2 from Sumner et al. 2015.

3. Visualizing the Results of Economic Impact Analyses

Flowcharts and tables are essential for describing the results of an economic impact analysis, but they are difficult for the non-technical reader to interpret. Using graphics in combination with the main set of results presented in tabular form can make it much easier to understand the key findings of the analysis. One or to visually appealing graphics in the executive summary of an economic impact report can greatly improve readability, and in turn, allow the report to reach a much broader audience.

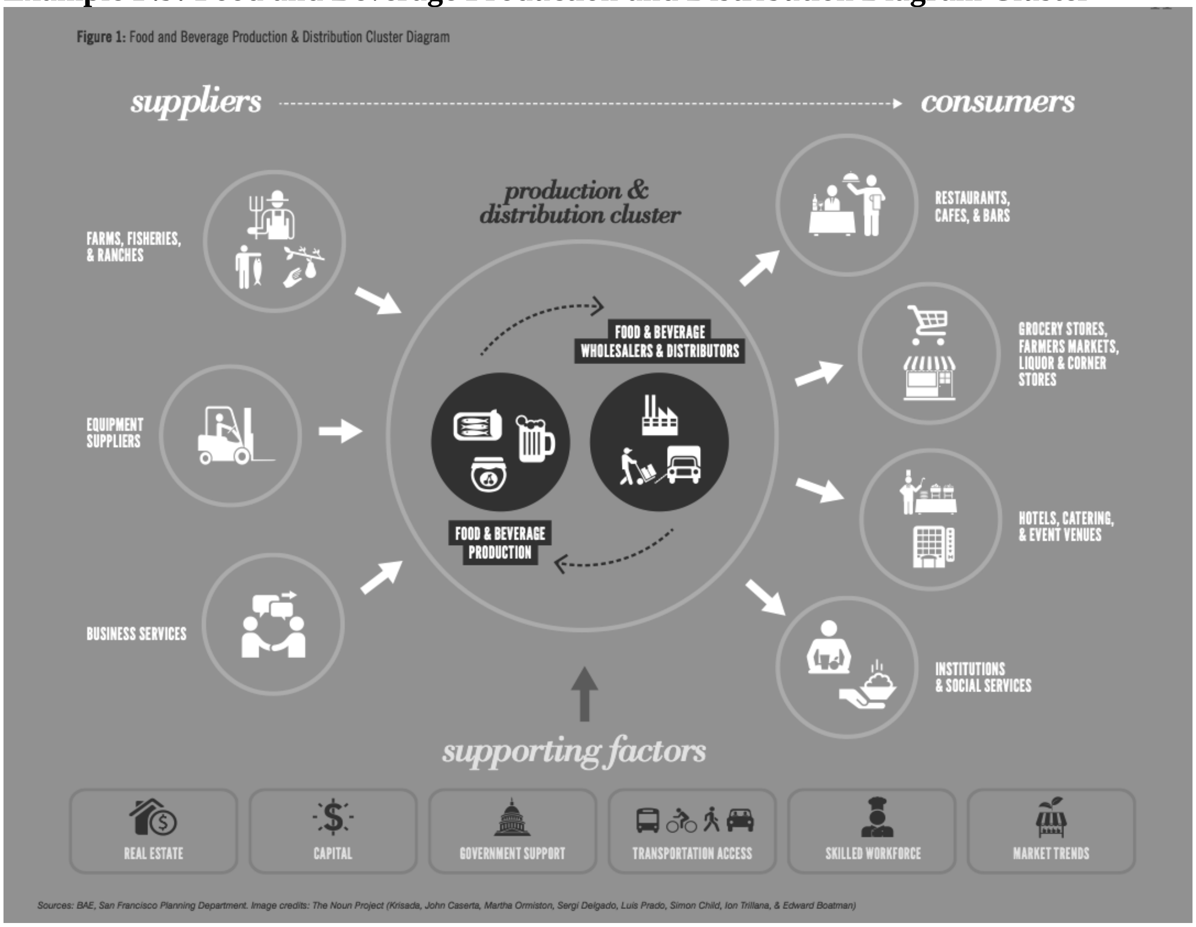
Example F.8 illustrates a figure that is part flowchart and part impact summary. It shows the inputs and outputs for the San Francisco food system. The reader can quickly see that the system includes production and distribution sectors, and the number of employees/businesses in each sector.

Example F.8: Economic Impacts of the Food and Beverage Sector in San Francisco

Source: San Francisco Planning Department. 2014.

Example F.9 illustrates another figure from the San Francisco food and beverage study. This example does not include any impact numbers and instead focuses on illustrating the flowchart of the industry. Examples F.8 and F.9 combined paint a clear picture of the San Francisco food system.

Example F.9: Food and Beverage Production and Distribution Diagram Cluster



Source: Figure 1 from San Francisco Planning Department. 2014.

Finally, Example F.10 illustrates another figure from the same San Francisco study that includes an economic impact summary positioned alongside explanatory text. The pie chart on the right allows the reader to quickly visualize the distribution of employment and firms among different sectors of the food system, and the text on the right provides an interesting narrative. This presentation allows the reader to quickly view information in the pie chart, and if they are interested, they can read the text on the left to get more details. A combination of graphics and short paragraphs is a useful way to summarize the components of a specific industry impact and provide interesting background information that might not fit in a figure.

Example F.10: Food and Beverage Production and Distribution

REGIONAL SNAPSHOT AND TRENDS

BAY AREA SNAPSHOT

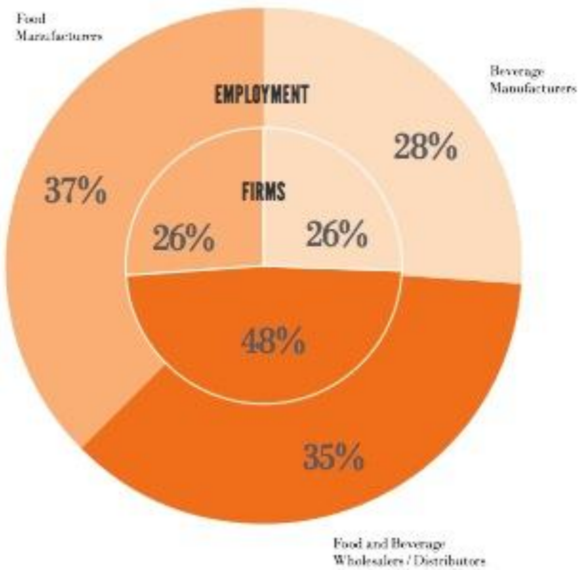
The nine-county Bay Area[2] is home to roughly 3,000 firms in Food and Beverage P&D industries. Half of these firms are in the wholesale/distribution sector, including grocery, alcoholic beverage, and farm product wholesalers. The remaining firms fall into the Food and Beverage Manufacturing sectors.[3]

Nearly 65,000 Bay Area workers are employed at Food and Beverage P&D firms. Over one-third of these jobs are in the food manufacturing sector and wholesale/distribution sector, respectively, and one in four jobs are in beverage manufacturing.

The largest share of Bay Area Food and Beverage P&D jobs are located in the East Bay, with Alameda and Contra Costa Counties accounting for over 22,000 jobs (just over one-third of the region's total; see Figure 4). Napa and Sonoma Counties dominate beverage manufacturing, with over 80 percent of regional jobs in this sector, while the East Bay has the largest share in food manufacturing and wholesale/distribution.

San Francisco has the third largest wholesale/distribution employment base among the region's counties, with nearly 3,000 employees. In the food manufacturing sector, San Francisco's workforce of 1,850 employees makes it the fifth largest employer of food makers, out of nine Bay Area counties. San Francisco's beverage manufacturing sector employs just over 200 people, a relatively small share of the region's beverage manufacturing.

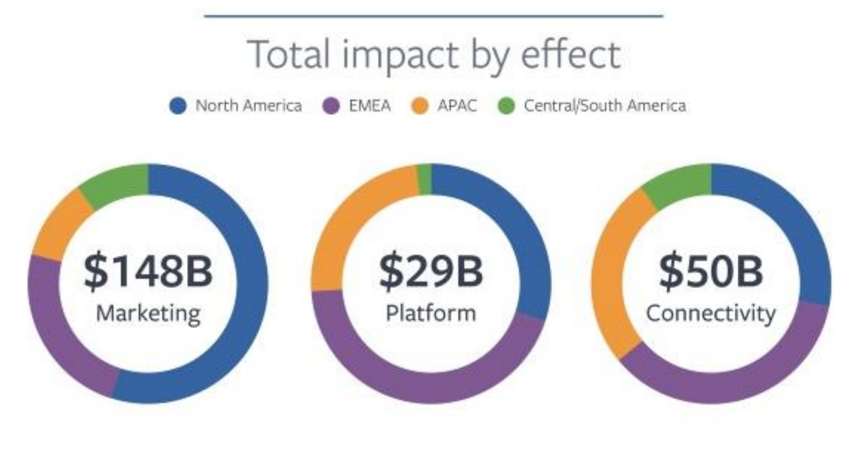
Figure 2: Bay Area Food and Beverage Production & Distribution Firms and Employment, 2012



Source: Figure 2 from San Francisco Planning Department. 2014.

Another approach is to use very simple charts with key results. Example F.11 shows a figure from an analysis of the economic impact of Facebook. In this approach, the authors use a simple graphic with bright colors to illustrate the total economic impact by region and sector. Details found in the multiplier tables are suppressed in favor of presenting only the total impact. This approach may be preferable if the intended audience does not need to see the technical details.

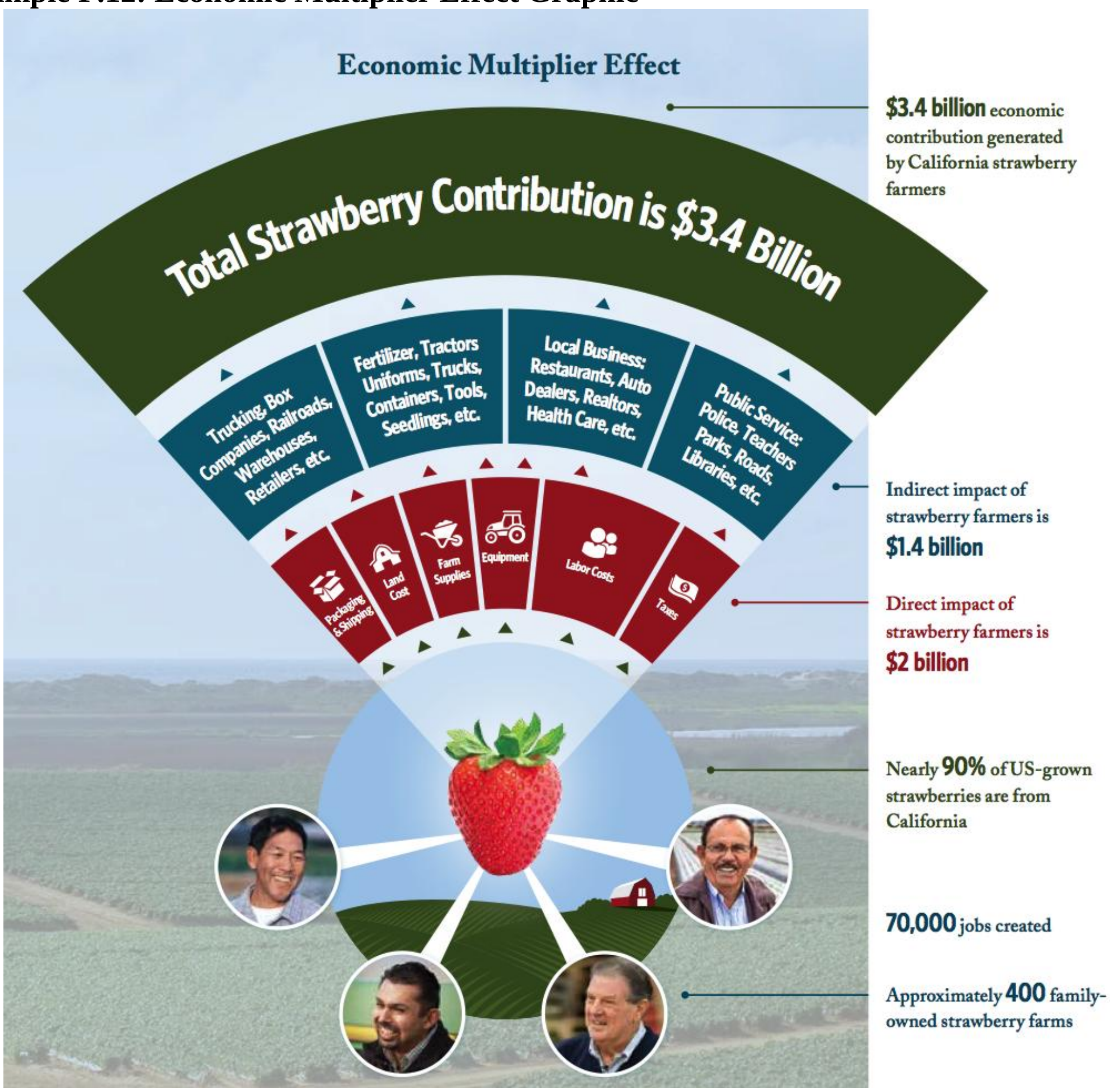
Example F.11: Disaggregated Economic Impact for Facebook



Source: Deloitte. 2015.

In addition to figures, flowcharts, and tables, there are a number of visually appealing graphics used in economic impact reports which combine various technical and non-technical results of the analysis. For instance, Example F.12 illustrates how an economic multiplier can be presented graphically from a study of the contribution of the California strawberry industry. The graphic shows the components of each sector (horizontally) and the components of the multiplier (vertically) used to generate the total economic impact.

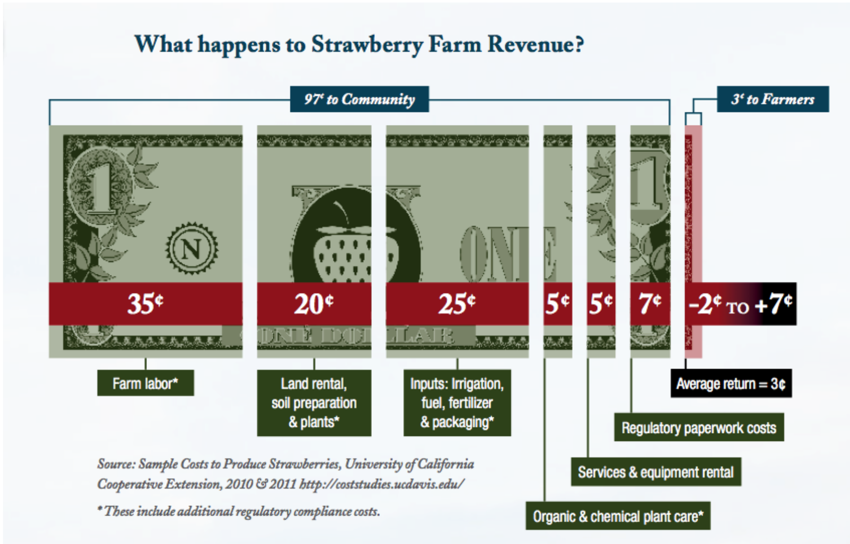
Example F.12: Economic Multiplier Effect Graphic



Source: California Strawberry Commission. 2014.

Example F.13 illustrates a revenue breakdown from the same study which illustrates how money lows within the strawberry industry. This is a useful way to illustrate input expenditures within a given sector of the economy.

Example F.13: Revenue Breakdown

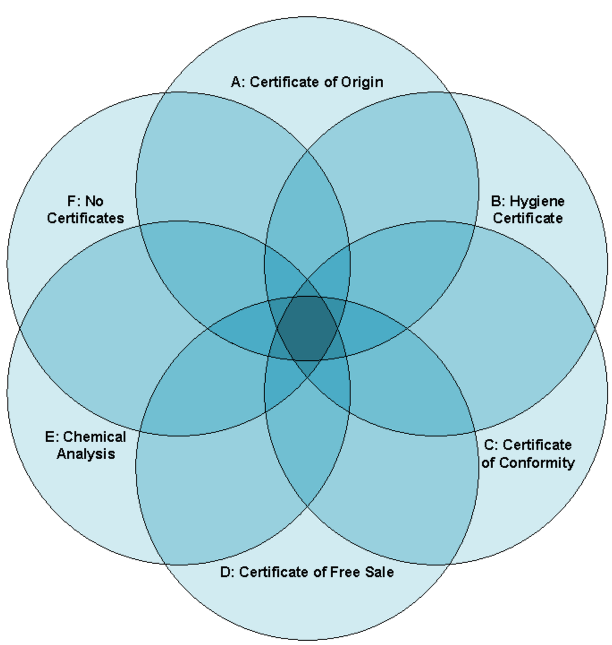


Source: California Strawberry Commission. 2014.

Another component of the study conducted by the ERA team on behalf of SACOG was to survey growers on the cost of regulatory compliance. The key finding of the study is that the California regulatory environment is complex, costly, and often redundant. Example F.14 illustrates one way to use quasi-Venn Diagrams to depict the wine certification regulations in the Asia-Pacific Economic Cooperation (APEC) regulatory forum. It is an example of how overlapping regulatory jurisdictions can be illustrated for specialty crop producers in California.

Example F.14: Overlapping Regulatory Jurisdictions

Diagram of the Certification Requirements in APEC



Australia: F

Brunei: No importation of alcohol beverages

Canada: A (The individual provinces require business and/or agent registration paperwork)

Chile: E (Only for bulk shipments (density, alcohol content, TA, VA, RS, total dry extract, sulfites, chlorides))

China: A

Chinese Taipei: A (Not required, but encouraged (sulfur dioxide, methanol, lead))

Hong Kong: B (not required, but encouraged), F

Indonesia: C, D, E (Either Certificate of Conformity or Certificate of Free Sale, but not both)

Japan: B, E

Malaysia: A

Mexico: A, B, D, and sometimes E

New Zealand: F

Papua New Guinea: F

Peru: A, D, E

Philippines: B, D, E

Republic of Korea: F

Russia: A (not required, but recommended), B, C, D and E (Required to get Certification of State Registration; Hygiene Certificate replaced by Certification of State Registration; Certificate of Conformity replaced by Declaration of Conformity)

Singapore: A, B, E, F (Not required, but encouraged))

Thailand: A

USA: C, E (None required for EU and WWTG grape wines)

Vietnam: E

Source: Asian Pacific Economic Corporation (APEC) Sub Committee on Standards and Conformance, APEC Committee on Trade and Investment. 2011.

4. Summary

The purpose of the analysis and the intended audience will dictate the format of the final report. A literature survey of recent economic impact studies finds that there are several common approaches to providing clear and concise results. In particular, conveying the results of an impact study requires judicious use of flowcharts, tables, figures, and graphics. Using graphics to provide an overview of the industry and to map out the analysis is great for setting the scene for the analysis. Similarly, using a figure to summarize the key findings can help the reader better grasp the outcomes and to focus on key points of interest. Providing additional details in text and tables can add to the depth of the report without confusing the key messages.

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