ERA Economics
Environment • Resources • Agriculture

ERA Economics
1111 Kennedy Place, Suite #4
Davis, CA 95616

Technical Memorandum

Subject: Economic Considerations for Conceptual Organic Policy Targets

By: ERA Economics LLC

To: California Bountiful Foundation

Date: August 8, 2022

Purpose and Background

California Bountiful Foundation is working with a consortium of California agricultural sector representatives to evaluate conceptual proposals related to organic crop production that have been discussed by policymakers in California. ERA Economics (ERA) is assisting the project team by analyzing the economic implications of California's organic production policy strategy.

ERA was asked to analyze the effects of a policy to increase the share of California irrigated acreage that is in organic production. The policy is loosely based on conceptual European Union targets, which would include 30 percent of acreage in organic production for all crops by 2030. Increasing organic production to 30 percent of the total acreage as proposed in California policy would represent a substantial agricultural sector change. Organic acreage currently represents just a few percent of total acreage for most California crops. A substantial increase in the share of organic acreage would affect the retail and farm-gate price for both conventional and organic products. It would also affect downstream agriculture-related industries in processing, transportation, and manufacturing, as well as input suppliers and labor. International exports could also be affected for some crops. It would ultimately result in impacts to food prices and consumers at a state and national level.

The European Union policy, upon which the California policy is based, is based on general principals. Domestic policy could, and perhaps should, be more evidence-based. To our knowledge, there has been no economic analysis to evaluate the potential implications of the organic policy in California. Of particular interest to stakeholder is how such a policy could affect California's farmers, ranchers, and consumers.

This technical memorandum (TM) describes the conceptual policy and its implications for California growers, other businesses, individuals, and food prices. The TM describes both general economic effects (e.g., how changes in organic production affect crop prices) and specific potential impacts based on an economic analysis of a representative crop/industry: processing tomatoes. The economic analysis framework and policy conclusions are summarized in the following subsections.

It is important to emphasize that this TM describes the results of a reconnaissance-level economic assessment of the proposed organic policy. It was developed to help the reader understand practical limitations to implementing organic production policy, the economic implications of the policy if it were implemented, and specific examples of economic impacts for the representative processing tomato industry. The analysis is intended to support better-informed discussion about agricultural policy. The economic analysis framework can be refined and applied in the future as additional information about the conceptual policy becomes available.

Summary Conclusions

This technical memorandum summarizes the results of a reconnaissance-level economic analysis that was developed to evaluate the economic implications of a proposed state organic policy to increase organic acreage to 30 percent of total irrigated acreage in California.

A typical economic analysis of a proposed policy starts with a review of how the policy would be implemented. This, in turn, informs the analysis approach to assess how the policy would affect decisions of businesses and individuals, and then quantify different measures of economic costs and benefits attributable to the policy. The conceptual organic policy is based on the concepts described in the European Union Farm to Fork Strategy.[1]

It is not clear how a policy to aggressively increase organic acreage would be implemented or achieved from a practical perspective without affecting food prices, which is probably why there is no specific implementation plan accompanying the proposed policy target. Growers, processors, shippers, buyers, and consumers all make production and purchasing decisions in global markets. That is, the amount of organic production for any given crop is determined by the fundamental economics of supply and demand for that organic crop, the supply and demand for the conventional crop, and supply and demand for other crops that are substitutes to it. On the supply-side, producers make planting decisions for conventional, organic, or other crops based on the costs to produce those crops and expected prices and yields. On the demand-side, consumers choose to purchase conventional, organic, or alternative crops based on preference and relative prices.

An external policy to increase organic acreage would fundamentally need to increase consumer demand for organic production, increase organic supply (i.e., lower the cost to grow an organic crop), or some combination of the two. These mechanisms can be successful for achieving small changes in supply or demand. For example, effective marketing/advertising can modestly increase consumer purchases of specific foods[2]. However, achieving a substantial increase in organic acreage is difficult and practically challenging, if not outright impossible.

Restrictive regulations are an alternative approach to achieving the policy target. For example, acreage restrictions could limit conventional acreage to be no more than 70 percent of the total. This would

[1] The broader EU strategy documents are available at: https://food.ec.europa.eu/horizontal-topics/farm-fork-strategy_en.

[2] See, for example: Alston, J.M. and J.P. MacEwan. "The Returns to Promotion of Healthy Choices—Implications from a Market Experiment in Tasmania: Are You in the Dark about the Power of Mushrooms?" Australian Journal of Agricultural and Resource Economics 56(3)(2012): 347–365.

effectively force growers to increase organic acreage and/or decrease conventional acreage. Since there would be no new consumer demand for additional organic production, this would substantially decrease farm-gate organic crop prices. In turn, a decrease in the price of organic crops would encourage growers to produce less organic acreage, which is the exact opposite intended outcome of the policy[3].

A series of economic analyses were developed to illustrate these industry dynamics and provide the reader with an understanding of how a policy to increase organic acreage would affect crop prices and outputs. The economic analysis was developed for an example crop/industry (processing tomatoes), the results of which were used to illustrate the broader economic implications.

The summary conclusions of the economic analysis are as follows:

1. It is not possible to force a substantial increase in demand or supply for organic crops because growers and consumers make production and purchasing decisions in a domestic and global competitive market. Any specific regulations—or similar policies—to increase organic acreage would affect the price of both conventional and organic crops at the farm and at the store.
2. The organic policy target represents a substantial increase in organic acreage over current conditions for California in total, and for most individual crops. For processing tomatoes, achieving 30 percent organic acreage would represent a 5- to 6-fold increase over current conditions. That is, based on historical data for the processing tomato industry, organic production has never represented more than 3-5 percent of total acres in the state. Growers and processors interviewed for this study confirmed what is obvious in industry data: there is simply a limited consumer willingness to pay a premium price for organic tomato products (diced, stewed, sauce, paste, etc.).
3. Increasing organic production is not possible without substantial impacts to both conventional and organic producers and consumers. Some growers specialize in organic but many growers farm both conventional and organic fields and will adjust acreage in response to changes in farming costs and returns (crop prices). Consumers are price sensitive and substitute between organic and conventional food as retail prices change. As such, a policy that would seek to expand organic farming would affect both conventional and organic prices and production. These prices increases generally effect the lower to middle income families that other state policies work to support (e.g., disadvantaged communities)
4. Organic farming has higher costs and greater risk than conventional farming given increased crop yield losses. Land must be rested and/or farmed as organic in order to be certified as organic, which imposes a direct certification cost on the grower plus the opportunity cost of managing land that could otherwise be farmed using conventional practices. For example, this can include farming land as organic at higher costs, realizing lower organic yields, and not receiving any organic price premium because the crops cannot be labeled as organic. Organic input costs have also been increasing in recent years. Moreover, organic yields are typically

[3] In a recent meta-analysis, Crowder and Reganold (2015) found that without price premiums organic farming would be significantly less profitable than conventional agriculture due to 10–18% lower yields, showing the importance of price premiums for profitability in organic farming.

lower on average and exhibit higher variability than conventional yields due to the inability to effectively respond to pest pressure in all years. Consequently, net returns are more variable than conventional.

5. For the California processing tomato industry organic production is typically less than 5 percent of total production. Both organic and conventional processing tomato consumption in the U.S. and around the world is stable and has been for more than the last decade. Increasing organic consumption would require consumers to substitute away from conventional to organic processing tomatoes, but current demand patterns do not indicate that they would willing to pay the price premium.
6. Consumers that purchase organic produce tend to have higher incomes (see Organic Baseline section of this report). Lower income consumers both spend a greater total share of their income on food and purchase fewer organic products than higher income consumers. Changes in the price of organic or conventional crops would have a proportionally greater impact on food prices for lower-income consumers. Further, a policy that forces a reduction in lower-cost conventional production would raise prices and disproportionately impact lower-income consumers
7. Requiring organic acreage to be 30 percent of the total could strain other resources, such as water, fertilizers, and land, that are inputs to farming. For example, fertilizer inputs depend on conventional animal production (poultry and dairy manure), and other wild caught fish emulsions also raise sustainability concerns. Organic production per acre is lower than conventional. Therefore, to maintain the same level of production more organic acres would need to be farmed, irrigated, and supplied with other inputs. This is particularly problematic in resource constrained parts of the state (e.g., groundwater stressed areas).

In summary, requiring organic acreage to be at least 30 percent of total acres would cause substantial disruptions in the organic and conventional markets. A policy is typically intended to achieve specific benefits. It is not clear what benefits an expansion of organic acreage would achieve, and therefore it is not possible to evaluate if there might be lower-cost ways to achieve the desired benefits. These could be evaluated under future iterations of this analysis. The economic analysis illustrates that an arbitrary increase in organic acreage can have the exact opposite effect: namely, lowering organic prices, which would push organic producers out of the industry.

Consumer demand drives production decisions and innovation, including potential changes in organic production. The processing tomato industry offers a useful case study. Organic production increases and decreases over time in response to processor demand for organic tomatoes. A large organic crop in 2016 led to large organic carry-over inventory, which pushed organic contracts and prices down in subsequent years. In short, substantial expansion in organic production can only be achieved if there are consumers that want to buy it. Regulatory policies that conflict with consumer demands and preferences are likely to be ineffective and/or expensive and disruptive.

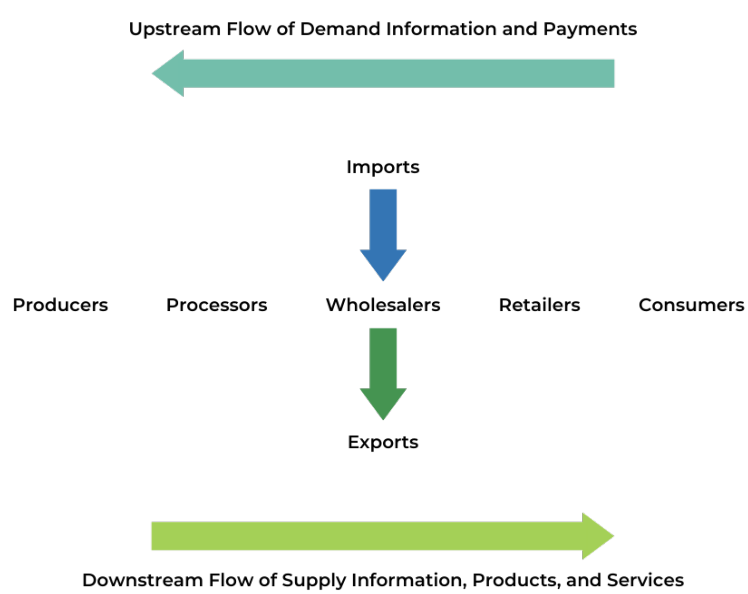
Economic Analysis Approach

An economic analysis framework was developed to evaluate how the proposed policy would affect growers, businesses, and individuals in California. The economic analysis considers different ways to implement the organic policy and how that would affect the broader agricultural supply chain. Since the policy has not been specifically defined, this analysis should be viewed as a reconnaissance-level assessment to support a broader discussion about the merits of the policy. The analysis framework can be refined in the future to analyze more specific policy proposals.

A new policy or regulation creates direct costs and indirect costs through its effects on the broader agricultural supply chain. It is helpful to first provide an overview of the key sectors in the supply chain and how they are linked.

Figure 1 summarizes key components of the agricultural supply chain. The supply chain starts with input suppliers and specialized service providers, and ultimately ends with exporters/retailers to consumers in domestic and export markets. A change to the system, for example from a new regulation, policy, or other shock, that affects one sector will affect other sectors across the entire supply chain. For example, the 2020 COVID-19 pandemic shutdown affected food service demand and labor availability across all businesses. Consumers shifted purchases to online stores and delivery take-out food orders. Greater overall demand for online delivery services has led to increasing packaging and transport costs. These in turn have led to increasing costs for input suppliers, growers, and wholesale buyers, which affects the aggregate supply of crops, and ultimately affect retail food prices for consumers.

Figure 1. Conceptual Illustration of the Agricultural Supply Chain



An economic analysis framework represents the entire supply chain and is tailored to evaluate specific impacts at specific industry points. Figure 2 illustrates the key components of a typical agricultural economic assessment of a proposed policy or regulation. Farm-level costs typically represent the direct cost of a new policy or regulation. These, in turn, affect the industry supply curve for that crop, which affects the market clearing price of the commodity. As industry supply and prices change this affects businesses and individuals in the regional economy. These changes ultimately affect the retail consumer. Each component of the impact analysis is evaluated using a different set of linked economic models that are tailored to a specific crop or market.

Figure 2. Illustration of Agricultural Impact Analysis Components

Farm-Level Costs	Market Effects	Supply Chain Effects	Regional Impacts	Consumer
• How does the policy affect farm-level costs/finances?	• How does the policy affect the market (crop prices and production)?	• How does the policy affect ancillary businesses, import, and exports?	• How does the policy affect regional jobs, income, taxes, DACs, etc.?	• How does the policy affect consumer demand (food prices) for affected products?

The organic acreage policy was evaluated for an example commodity of processing tomatoes. Processing tomatoes were selected because these are produced and processed in California for domestic and export markets, and the share of organic acreage (3 – 5%) is comparable to the statewide average across all crops. Therefore, it offers a representative case study of a typical agricultural supply chain. The results of the processing tomato industry-specific assessment are used to illustrate the broader economic logic and considerations for this policy.

Data to support the analysis were developed from industry sources, published literature, and a series of industry interviews with growers, processors, and other industry professionals. Since this policy would represent a substantial change to the industry, most of the economic impact measures are costs (i.e., losses). Industry benefits can also be quantified and described where appropriate. The general analysis framework can be extended in the future to evaluate more specific formulations of the proposed policy once it is developed.

As illustrated in Figure 2 above, the economic analysis was tailored to different questions based on the organic policy target. This economic analysis focuses on the effect of the shift to organic production on farm-level costs and the broader market. These include:

- **Farm-level Costs**. The direct effect of increasing organic acreage is a change in costs to a grower. Organic production requires fields to be certified, and only approved USDA National Organic Program inputs can be used once the field is certified. This affects the input costs to growers. Yields are also affected[4]. These direct costs were estimated based on a series of interviews with industry experts, analysis of industry data and farm budgets, and review of peer-reviewed studies and industry publications. Measures of farm-level costs are expressed as changes in annual costs and farm net income, as well as the change in farm income risk.

[4] Based on a comparison of USDA reported conventional and organic yields. See subsequent discussion in this report.

- ***Net Income***. Net income is a standard measure of the financial returns to a grower defined as gross revenue minus appropriate input costs. It provides a simple measure of the effect of a proposed policy on growers' profit and loss statements. Financial impact measures can also be expanded to consider growers' economic position, and net earnings after depreciation and taxes. This affects grower's ability to obtain loans, borrowing costs, working capital needs, and, importantly, return on investment.

  This analysis developed a farm budget for organic and conventional processing tomatoes. These include an accounting of input costs and a time series of yields and prices. To simulate impacts on net farm income a stochastic farm budget model was developed. In contrast to a static accounting measure of net income, a stochastic farm budget models how net income changes as specific cost and return parameters vary, namely crop prices and yield.

- ***Downside Risk***. The economic analysis also explicitly measures net income risk, which is typically overlooked in assessments of direct costs attributable to a proposed policy or regulation. Organic production typically has somewhat lower yields with higher yield variability. For example, organic tomato fields can suffer from weed pressure due to loss of use of conventional herbicides that is replaced by more expensive hand or mechanical weeding. This can result in substantially lower yields. The historical yield distributions under conventional and organic production were developed and the cost of downside risk was then calculated.[5] This illustrates the impact of the organic policy on farm net income risk.

* **Market Effects**. Changes in the cost and financial returns (risk) to produce a crop, or a policy that mandates a specific change in organic production, affects the aggregate industry supply. Risk is an important consideration because it affects grower's production decisions, access to lending, and economic well-being. Ultimately, as supply shifts, this affects the price of the crop. A standard economic equilibrium displacement model (EDM) was developed to illustrate the effect of increasing organic production on the price of conventional and organic processing tomatoes.

A quantitative analysis for the processing tomato industry was developed. The analysis illustrates how the policy affects the agricultural sector and specific economic effects on the entire food supply chain.

[5] Sortino, F., & Van der Meer, R. (1991). Downside Risk. The Journal of Portfolio Management, 17, 27-31.

Organic Acreage Policy

ERA was asked to analyze the effects of a policy to increase the share of California irrigated acreage that is in organic production. The proposed target is 30 percent of acreage in organic production for all crops by 2030.

The policy is broadly based on the European Union (EU) Farm to Fork and Biodiversity Strategies.[6] The rationale for the EU policy is that organic production has been growing and is more consistent with their view of transitioning European "agriculture towards agroecology." The EU policy vision clearly focuses on the perceived benefits of organic farming, but there is no evaluation of those benefits and how they compare to the potential costs of achieving them. Importantly, there is no discussion of how that change would impact the market for EU agriculture, or how it would affect food prices in the EU and its many export markets, including low-income countries around the world.

Researchers at the United States Department of Agriculture (USDA) Economic Research Service (ERS)[7] and Wageningen University[8] separately analyzed the potential macroeconomic implications of the broader EU policy strategy. The conclusion of both independent studies was that the EU policy would result in negative economic impacts (i.e., costs) across the agricultural industry. Primary costs include lower agricultural output from the EU, associated regional economic impacts from those losses in the EU, and higher food prices in the EU and around the world. The USDA ERS study estimated global welfare impacts (losses) of the proposed EU strategies between $96 billion and $1.1 trillion.

This analysis illustrates potential impacts in California under an organic acreage target modeled after the EU policy. This analysis does not attempt to identify or quantify potential environmental or health benefits of organic farming.

Organic Baseline

Organic acreage currently represents just a few percent of total acreage for most California crops. Increasing it to 30 percent of the total acreage would represent a substantial shift in production practices on, potentially, over 2.7 million[9] acres of California farms and ranches.

Organic production has been expanding over the last several years. Increasing consumer interest in organically grown foods has opened new market opportunities for a number of food supply chain participants from California farmers and ranchers to domestic retailer/food service and export markets. Total U.S. organic food and beverage retail sales increased by about 260 percent between 2010 and

---

[6] The broader EU strategy documents are available at: https://food.ec.europa.eu/horizontal-topics/farm-fork-strategy_en.

[7] Beckman, J., M. Ivanic, J. L. Jelliffe, F. G. Baquedano, S. G. Scott. Economic and Food Security Impacts of Agricultural Input Reduction under the European Union Green Deal's Farm to Fork and Biodiversity Strategies. USDA ERS. Economic Brief Number 30. November 2020.

[8] Bremmer, J., A. Gonzalez-Martines, R. Jongeneel, H. Huiting, R. Stokkers, M. Ruijs. Impact Assessment of the EC 2030 Green Deal Targets for Sustainable Crop Production. Wageningen University. Report 2021-150.

[9] There are currently around 9 million irrigated acres in California. If this policy were applied to all lands, this would represent 30%, or about 2.7 million acres.

2020, from approximately $26.3 billion to $69.1 billion. Organic food and beverage sales as a percentage of total food and beverage sales from 2010 to 2020 increased from 3.8 to 7.3 percent.

A recent U.S. study[10] evaluated eight product groups that characterize organic food and beverages: fruit and vegetables, dairy, packaged/prepared, beverages, bread and grains, snack food, meat/fish/poultry, and sauces/condiments. Table 1 shows the organic food and beverage sales as a percentage of total sales by product category for 2020.

Table 1. Retail Organic Sales as Percentage of Product Category Totals

Category	2020
Fresh Fruit and Vegetables	41.9%
Dairy	12.1%
Packaged/Prepared	14.2%
Beverages	11.8%
Bread and Grains	8.1%
Snack Food	5.5%
Meat/Fish/Poultry	3.5%
Sauces/Condiments	3.0%

Source: Sundale Research. 2021. Organic Foods Industry Report – Trends, Statistics, and Analysis. June 2021.

Organic retail sales in the U.S. have increased over the last decade, but there is a limit to this potential growth. Growth in demand for organic food is driven by consumers preferences and perceptions about health and nutrition, taste, food safety, and environmental concerns.

Consumers that purchase organic food are typically higher-income families that can afford to do so. Nelson et al. (2017) conducted a multi-year analysis of price and income elasticities for organic fruit, which is typically the food group that has higher organic purchases. This included quantifying organic fruit purchases by income group over the period 2011 to 2013.[11] Table 2 summarizes the share of fruit purchases that are organic by consumer income group for the period 2011 to 2013. Table 2 also shows the share of overall income spent on total food purchases. Higher income customers purchase more organic fruit (which is a proxy for other organic food purchases). Lower income consumers both spend a greater total share of their income on food and purchase fewer organic products. As a result, low-income consumers generally spend a greater share of their total income, but a lower share of total food spending, on organic food than middle and high-income consumers. Changes in the price of organic or conventional produce will therefore have a proportionally greater impact on food prices for lower-income consumers.

[10] Sundale Research. 2021. Organic Foods Industry Report – Trends, Statistics, and Analysis. June 2021.

[11] Nelson, E., Fitzgerald, J., Tefft, N., and Anderson, J.L. 2017. US Household Demand for Organic Fruit.

Table 2. Share of Income Spent on Food and Organic Fruit Purchases, by Income Group

Year	Income Group	Share of Income Spent on All Food [a]	Share of Fruit Purchases that are Organic [b]
2011	Low	36.18%	1.72%
	Middle	12.17%	2.33%
	High	6.81%	3.01%
2012	Low	35.06%	1.90%
	Middle	12.27%	2.44%
	High	6.79%	3.65%
2013	Low	37.84%	2.37%
	Middle	12.50%	2.84%
	High	6.87%	4.47%

[a] Source: U.S. Bureau of Labor Statistics. 2011 – 2013 Consumer Expenditure Reports.
[b] Source: Nelson, E., Fitzgerald, J., Tefft, N., and Anderson, J.L. 2017. US Household Demand for Organic Fruit.

Organic crops require certified ground that is more expensive to farm, require the use of organic inputs, and can suffer from pest pressure that results in lower yields and higher yield variability. Therefore, growers need a price premium for organic crops to justify taking on the higher costs and risks that come with organic farming. If organic production increases, the increase must be purchased by consumers currently less willing or able to pay the price premium, resulting in downward pressure on prices.

California is already leading the nation in terms of number of farms (3,093),[12] land in organic production (1,015,854 acres[13]), and organic gross sales[14] ($4,109,254,903).[15] Table 3 shows the current share of California farmed acreage in organic production for selected fruit, vegetable, and nut crops. It also shows the additional land needed to achieve the 30 percent policy target. The data show there is variability in the share of organic production by crop type. Most fruit and nut crops have less than 10 percent of acreage in organic production, whereas some vegetable crops, particularly those sold fresh, are already near or past 30 percent organic. Almonds, the largest crop in California by total value, currently have less than 2 percent of acreage in organic production, meaning over 450,000 acres would have to be converted to meet the 30 percent target.

[12] Sundale Research. 2021. Organic Foods Industry Report – Trends, Statistics, and Analysis. June 2021.

[13] Includes pasture and rangeland. Other land associated with organic livestock production and organic fallow ground are omitted.

[14] Includes crops and animals/animal products.

[15] California Department of Food and Agriculture (CDFA). 2021. Agricultural Organics Report 2020-2021.

Table 3. Current Share Organic Acreage, Current and under Conceptual Policy

Crop	Conventional Acres [a]	Organic Acres [b]	Percent Organic	Converted Organic Acres Needed	Percent Increase
Almonds [c]	1,573,433	26,567	1.7%	453,433	1707%
Broccoli	77,524	11,976	13.4%	14,874	124%
Carrots	40,861	19,439	32.2%	0	0%
Citrus	250,651	19,049	7.1%	61,861	325%
Grapes (Table) [c]	120,556	9,444	7.3%	29,556	313%
Grapes (Wine) [c]	594,964	25,036	4.0%	160,964	643%
Lettuce	155,056	44,044	22.1%	15,686	36%
Spinach	17,676	24,424	58.0%	0	0%
Strawberries	27,599	5,501	16.6%	4,429	81%
Tomatoes [d]	236,099	12,801	5.1%	61,869	483%

[a] Source: California Department of Food and Agriculture (CDFA). 2021. California Agricultural Statistics Review 2020-2021. Agricultural Organics Report 2020-2021.
[b] Source: California Department of Food and Agriculture (CDFA). 2021. Agricultural Organics Report 2020-2021.
[c] Includes bearing and non-bearing acres
[d] Includes both processing and fresh market tomatoes.

California Processing Tomato Baseline Overview

Processing tomatoes were selected as the representative crop for a more detailed economic analysis of the effects of expanding organic acreage for a specific industry. This section describes current conditions for the processing tomato industry.

California produces 95 percent of U.S processing tomatoes. Processing tomatoes are in the top ten of all California agricultural commodities by total gross farmgate sales. The supply chain for processing tomatoes consists of growers, processors, and buyers. Most raw processing tomatoes are processed into tomato paste, with the remaining processed in various products. Major tomato pastes buyers include large pizza restaurant chains, food manufacturing companies, and international buyers.

Currently about 5 percent of processing tomato acres in California are organic. Organic processing tomatoes are, like their conventional counterparts, largely processed into tomato paste. No (or very little) organic tomato paste is exported from the U.S.

Average processing tomato acreage for the last three years was around 228,000 acres, of which 217,277 acres (95%) were conventionally farmed and 10,723 acres (5%) were organic. Total organic processing tomato acreage would need to increase by over 600 percent by 2030—over the next 8 years—to meet the 30 percent policy target.

Table 4 shows example changes over time, assuming an even annual increase in organic acreage and decrease in conventional acreage. This assumes a linear increase starting in 2027 with conventional ground shifting to organic. By 2030, conventional acreage would be 159,600 (70%) and organic would be 68,400 (30%). That would represent a 638% increase in organic processing tomato acreage. The 68,400 acres of organic tomatoes, given a yield of 49 tons per acre, would increase organic production from a three-year average of 484,471 tons to 3,332,000 tons, or an increase of 688%. For context, the largest organic processing tomato crop ever reported in California was only 700,000 tons.

Table 4. Example Processing Tomato Acreage Organic Conversion

	2026	2027	2028	2029	2030	2030+
Conventional Acreage	217,277	202,861	188,445	174,029	159,600	159,600
Current Organic	10,723	10,723	25,139	39,555	53,971	68,400
New Organic Acreage	0	14,416	14,416	14,416	14,429	0
Total Acreage	228,000	228,000	228,000	228,000	228,000	228,000

The expansion in organic production would require a year-over-year increase of approximately 25.5%. That is, each year organic processing tomato production would need to increase by 25.5%. And this would need to happen for 7 years in a row. This would represent an unprecedented increase in organic production.

An additional consideration is the location of organic processing production. The counties of Fresno, Kern, and Kings account for over 60 percent of the current organic processing tomato production. Water availability in those counties is likely to be substantially reduced over the next several years. Surface water supply is becoming more uncertain, and implementation of the Sustainable Groundwater Management Act (SGMA) will eventually reduce the amount of groundwater that will be available for crop production in those counties. This will increase the cost of water, which affects the cost to raise a crop, and ultimately grower production decisions. Quantifying the relationship between the proposed policy and water availability is beyond the scope of this reconnaissance-level study but could be explored in future work.

Direct Costs

The direct cost of organic farming considers the additional costs to the grower as well as changes in yield and yield variability relative to conventional farming. In general, organic farming costs are higher, typically due to more farm labor input, the cost of organic inputs, and the direct plus opportunity cost of organic certification. However, growers interviewed for this study indicated that in years when pest (in processing tomatoes in particular, weed) pressure happens to be minimal, conventional and organic cash farming costs[16] can be comparable. Growers and industry data show that organic crop yields are typically lower and exhibit much greater variability from year-to-year than conventional.

A series of crop cost of production budgets were developed to quantify the direct, farm-level costs of switching to organic farming.[17] Based on information provided by surveyed growers, operating costs to produce organic processing tomatoes are approximately $500 per acre more than for conventional processing tomatoes. This difference is primarily due to alternative pest and weed protection practices used on organic fields. Growers interviewed noted that early season weed pressure is key for a successful organic crop. Late season rains that support weed growth before plants leaf out can result in substantial crop losses. In addition, growers noted that insect pressure can be problematic in some years.

[16] Cash farming costs do not include all overhead capital costs.

[17] Costs and other dollar values in this analysis are reported in 2020 dollars, converted using a Gross Domestic Product Implicit Price Deflator (GDP-IPD). A baseline of January 2020 is used based on consistency with other data, and to avoid results biased by the COVID-19 pandemic, ensuing supply chain problems, and recent inflation.

Growers try to locate organic fields in specific areas, such as farther away from waterways and near well-managed conventional fields, to avoid pest pressure that can result in crop losses.

In addition to direct farming costs there is an opportunity cost for certifying organic ground. It takes three years to convert a conventional field to certified organic. During the three-year period land can be fully rested, farmed organically but not certified (and therefore receive no price premium for the crop), or farmed in an alternative crop. The opportunity cost of organic certification was not monetized as part of this reconnaissance-level assessment. In addition, the cost of organic was not monetized as part of this initial assessment. However, tomato processors interviewed for this study indicated that lines are managed to process organic at one time and separate from conventional to avoid intermittent shutdowns and cleanouts. These shutdown/clean out costs can amount to several hundreds of thousands of dollars per occurrence.

The policy that would increase organic production to 30 percent of acreage statewide. Based on the most recent agriculture census data, there are approximately 7.35 million acres[18] of irrigated cropland and 460,000 acres[19] of certified organic cropland in California. That is, only about 6 percent of total irrigated cropland in the state is certified organic (note that this is certified ground, not all of this land is farmed in any given year). Increasing this to 30 percent statewide (in aggregate across all crops) would therefore require certifying an additional 1.74 million acres.

Market Effects

There are two mechanisms to increase the production of organic crops in California: increase supply of organic acreage and/or increase demand for organic food. This means reducing the cost to farm organic crops and/or affecting consumer tastes and preferences for organic food. Growers and consumers substitute between organic and conventional crops. Therefore, the mechanisms could be expanded to lowering (raising) the cost to produce organic (conventional) crops or increasing (decreasing) demand for organic (conventional) crops. Importantly, changes in the supply or demand of organic production will affect the supply or demand of conventional production.

This reconnaissance-level analysis develops an Equilibrium Displacement Model (EDM) of the supply and demand for conventional and organic processing tomatoes based on McFadden et al. (2021).[20] It considers conventional, organic, and segmented demand for organic produce. The model was applied to illustrate the effect of increasing organic production by artificially decreasing production costs (i.e., increasing the supply of organic production by shifting the supply curve down and to the right).[21] This

---

[18] USDA. 2017. Census of Agriculture. Table 10. Irrigation: 2017 and 2012.

[19] USDA. 2019. Organic Survey (2017 Census of Agriculture Special Study). Table 1. Farms, Land, and Value of Sales on Certified Organic Farms: 2019.

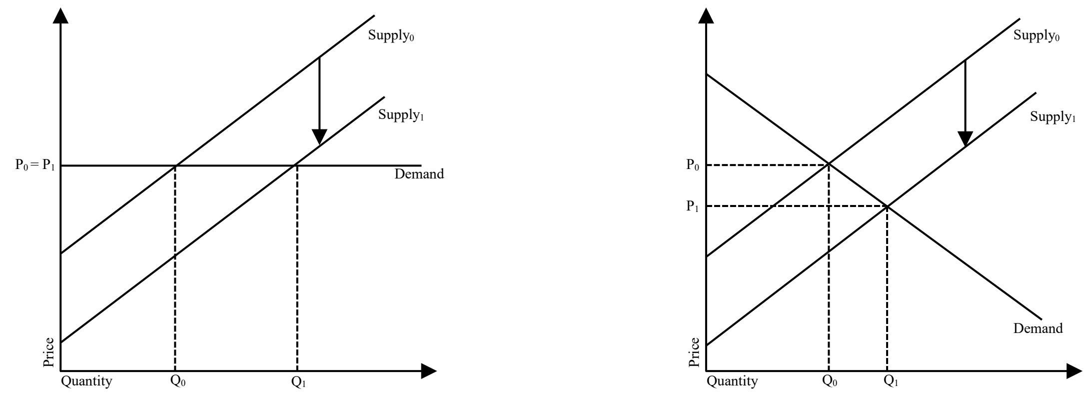
[20] McFadden, Brandon R., Bovay, John, and Mullally, Conner. 2021. What are the overall implications of rising demand for organic fruits and vegetables? Evidence from theory and simulations. Q Open 1.1 (2021): qoab008.

[21] It is noted that this assessment illustrates the effects of (arbitrary) changes in the supply of organic production. An alternative, and perhaps more plausible, interpretation of the proposed organic policy would mandate (limit) the amount of conventional acreage to be no more than 70 percent of the total. This would cause substantial impacts by effectively limiting production and raising the price of conventional supply. This scenario was not modeled or evaluated in this study.

analysis uses a baseline year of 2022, with the total acreage of tomatoes at 239,628 and organic share at 4.85 percent.

Figure 3 illustrates the market changes considered in this analysis. The figure on the left shows a market with a supply curve and perfectly elastic demand curve. The figure on the right illustrates the same shift in supply as the image on the left but with a downward sloping demand curve. Equilibrium quantity increases but not at the same rate as the shift in supply, and equilibrium price decreases. This effect is exacerbated if consumers substitute purchases between organic and conventional food, as would be the case.

Figure 3. Illustrating Effect of Supply Shift on Price of Processing Tomatoes



As described under the Direct Costs section, the YOY change in organic production would need to be 25.5%. Because demand for processing tomatoes (and all California specialty crops) is downward sloping, and supply is upward sloping, an increase in supply by 25.5% would result in an increase in equilibrium quantity of less than 25.5%[22]. Specifically, to achieve 30 percent organic acreage by 2030, the supply curve of organic tomatoes would need to be increased by 52.5% while the supply curve of conventional tomatoes is decreased by 15.5% each year.

An example policy simulation was developed to illustrate the effects of such a change. It shows decreasing (increasing) the marginal cost of producing organic (conventional) tomatoes by 52.5% (15.5%).

Table 5 summarizes the results of the analysis. The resulting market equilibrium price for organic tomatoes decreases by 27.92%. The price for conventional tomatoes increases by 11.25%. At current prices for organic and conventional tomatoes of $165/ton and $105/ton, this change would result in new equilibrium prices of $118.92 and $116.81 respectively. Essentially, the necessary shifts in supply of organic and conventional tomatoes will erase any organic price premium in the first year of transition. In addition, this would only result in a 1.38% increase in the share of tomatoes grown organically.

[22] To achieve 30 percent organic by 2030, the supply curve of organic tomatoes would need to be increased by 52.5% while the supply curve of conventional tomatoes is decreased by 15.5% each year for 8 years.

Table 5. Year-over-Year Change in Processing Tomato Prices

		2022	2023
Industry Size (Acreage)	Organic	11,628	14,675
	Conventional	228,000	220,592
	Total	239,628	235,267
Annual % Change	Organic	-	26.20%
	Conventional	-	-3.25%
	Total	-	-1.82%
Industry Share	Organic	4.85%	6.24%
	Conventional	95.15%	93.76%
	Total	100%	100%
Price	Organic	$165.00	$118.92
	Conventional	$105.00	$116.81

An additional analysis was developed to illustrate the effect of a 25.5 percent increase in organic acreage in one year. This represents the more modest annual change that does not account for the price effect on equilibrium quantity. A shift of this more modest magnitude would cause organic price to fall by 12.7 percent. A price decrease of 12.7 percent is applied to the subsequent analysis of multiplier effects and risk.

Multiplier Effects

Changes in organic production would have additional regional economic effects. These are sometimes called "multiplier" effects. These capture how changes in the organic and/or conventional farming industries ripple through ancillary businesses, and impacts to jobs, income, and regional tax base. A multiplier analysis was beyond the scope of this initial reconnaissance-level assessment, but could be conducted to support future evaluation of the policy.

Grower Net Returns and Downside Risk

An industry can only remain viable if its producers can consistently make positive net returns without unreasonable risk of losses. This section examines how the dynamics of net returns and downside risk change with the introduction of the organic policy. Net returns are analyzed using a stochastic farm budget and downside risk is analyzed using a financial statistical analysis. The following subsections summarize the results.

Net Return

Processing tomato growers are willing to take the yield risk associated with organic processing tomato production because of the price premium organic processing tomatoes receive compared to conventional processing tomatoes. Table 6 shows organic processing tomato price premiums before and after a 12.7 percent decrease in organic processing tomato prices.

Table 6. Organic Processing Tomato Price Premium

Crop Year	Organic Price Premium	Premium After Organic Price Reduction
2010	$38.38	$23.76
2011	$39.39	$24.32
2012	$39.39	$24.38
2013	$39.32	$24.34
2014	$45.45	$28.14
2015	$32.52	$17.38
2016	$37.01	$22.02
2017	$41.59	$26.88
2018	$32.89	$18.53
2019	$31.01	$16.84
2020	$37.28	$20.40
Average	**$37.28**	**$22.33**

Note: Price premia all adjusted using the GDP-IPD, reported in 2020 dollars. Includes reduction in organic prices due to increased supply.

Agricultural management decisions are almost always made in the face of uncertain consequences, i.e., risk. A stochastic organic processing tomato farm model was constructed based on cost data described in the previous section. The model serves as a case study that can be useful for identifying the possible impacts that California organic processing tomato producers can expect to face if the 30 percent organic acreage by 2030 policy is enacted. It illustrates the impacts of increasing organic acreage in the initial year. It does not show the impact of achieving 30 percent organic acreage – which would be substantially greater.

Ten years of organic price and yield data[23] (2010 – 2020) were fitted to empirical probability functions. A monte carlo simulation was developed to compare baseline organic price and yield distribution, and a distribution with organic prices facing an average estimated decrease of 12.7%.

The results are summarized in Figure 4. The bar charts represent the probabilities of making large net returns ($1,500 per acre or more), losses ($250 per acre or less), or small/moderate net returns (between $250 and $1,500 per acre). The low-end threshold of $250 per acre was selected assuming that some return on capital is required to remain viable, with $250 likely a conservative estimate for this. The high-end estimate of $1,500 was selected assuming that, based on the annual risk of net losses, growers seek substantial profits during good years.[24]

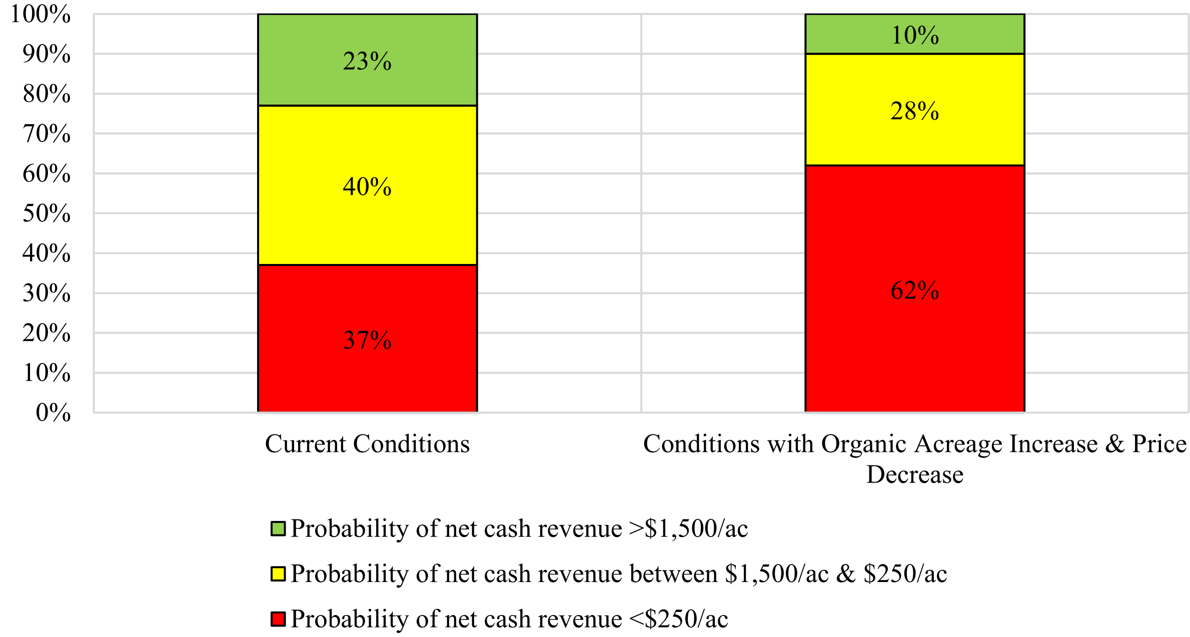
Figure 4 shows that even under current conditions there is a large risk to farming organic processing tomatoes, with a higher chance of expected losses (37%) than of large net returns (23%). Under the

[23] Agricultural Issues Center. UC Davis Organics. Organic processing tomato acreage data 2010-2016. Available at: https://aic.ucdavis.edu/tag/organic/ ; California Department of Food and Agriculture (CDFA). 2021. California Agricultural Statistics Review 2018-2019, 2019-2020, and 2020-2021.

[24] A sensitivity analysis of the results reported in Figure 4 shows that small to moderate changes to these thresholds does not substantially affect the reported probabilities.

proposed policy and corresponding price reduction, the chance of expected losses jumps up to 61%, with the probability of high net returns dropping to 10%.

Figure 4. Net Cash Revenue Probabilities under Current Conditions and Policy



Downside Risk

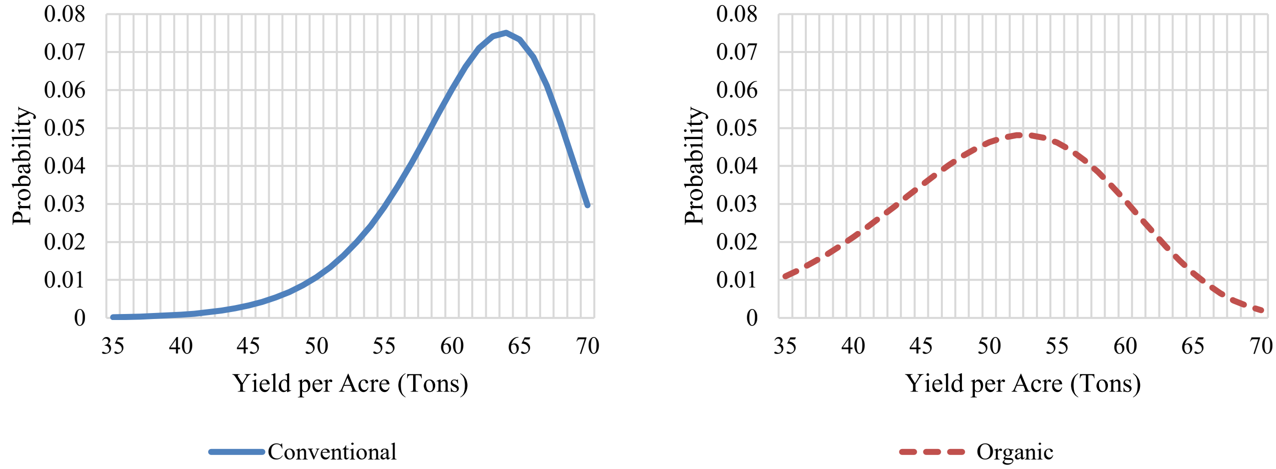
Given the probability of uncontrollable pest outbreaks, weeds, and other factors, the downside risk of organic production is likely to be greater than under conventional production. As shown in the previous section, there is substantial price uncertainty and risk in both conventional and organic production. In this section the expected price is held constant at its average value to isolate the downside effect on yields of the switch from conventional to organic production.

Estimated yield distribution[25] parameters were used to calculate a set of yields under organic and conventional production over the whole range of yields. Yield data were developed from USDA and confidential grower surveys that were aggregated into an anonymous database. The average price of conventional production was set at its mean of $76/ton. The price of organic processing tomatoes was reduced by 12.7 percent over its historical average to a fixed price of $100/ton.

Figure 5 illustrates the yield distribution under conventional and organic processing tomatoes. The results show that, in terms of yield, organic production has both a much wider downside (flatter curve) and a lower expected yield. The expected yield from conventional production is 61 tons per acre compared with 51 tons under organic production. That is, organic production realizes a lower mean yield and greater yield variability.

[25] An asymmetric Weibull function is used to estimate the probable effect on yields of a switch to organic production. The Weibull function is very flexible and widely used in finance, insurance, hydrology, and engineering.

Figure 5. Processing Tomato Yield Probability Estimates



The net returns under different yields were estimated using the budget data described in earlier sections of this TM. The expected net return as a percentage of operating costs is calculated using typical operating costs of conventional tomato production at $5,000 per acre, and organic production at $5,300 per acre. The expected net revenue is $446 per acre for conventional production and $505 per acre for organic production. Organic production has higher per-acre production cost when compared with conventional production. However, given the price premium for organic production, organic production shows greater average (expected) net returns.

The cost of downside risk was calculated using a conservative 5 percent rate of return as the target rate. As shown above, conventional production shows higher yields with a tighter distribution, while organic production shows a larger expected rate of return given the organic price of $100 a ton versus $76 for conventional production. However, when adjusted for downside risk, conventional production is higher (better) than organic production and the ratio of downside risk cost to expected return is worse for organic than conventional production.

Table 7 summarizes the expected returns and the expected cost of downside risk. The expected cost of downside risk is calculated by taking the expected return that is below the target rate of return, assumed to be 5 percent in this example analysis[26], and expressing it as a percentage of expected net return. For this case study of processing tomatoes, the results show that conventional production has an expected downside cost of 17% of the expected net return ($75.82) while organic production has a downside cost of 36% of the expected return ($180.79). In short, organic processing tomato farming has a greater downside risk than conventional.

[26] The alternative rate of return would typically be defined based on real rates of return for alternative investments, such as the stock market or a mix of stocks and bonds. For this illustrative analysis a return of 5% was assumed.

Table 7. Expected Net Returns and Downside Costs

	Conventional	Organic
Expected Net Revenue	$446.00	$505.00
Downside Cost	-$75.82	-$180.79
Percent of Net Revenue	17%	36%

Organic Policy Economic Considerations

Achieving an expansion in organic production should consider the market demand for these outcomes, and not simply be imposed on the suppliers (growers). A policy that would impose this type of change in the market faster than can be supported by any concurrent increase in demand for organic products would result in outcomes that run counter to the intended policy. Namely, it would push organic prices down, which would drive organic growers out of the industry, and affect food prices for both conventional and organic products. Importantly, it is higher income consumers that typically purchase organic produce, and impacts would be disproportionately felt by lower income consumers.

The economic analysis of the processing tomato industry was developed to illustrate the changes in grower costs, supply and demand for organic and conventional crops, and the effects on equilibrium price and quantity. These changes affect growers' net returns and risk, and ultimately affect consumer food prices.

Increasing the supply of organic production has a much greater impact on the profitability of growers than it does on stimulating demand for organic produce. It is not clear how this policy would be implemented. And even if it was implemented it would result in quantifiable negative economic impacts.

The summary conclusions of the analysis are:

1. It is not possible to force a substantial increase in demand or supply for organic crops because growers and consumers make production and purchasing decisions in a competitive market. Any specific regulations—or similar policies—to increase organic acreage would affect the price of both conventional and organic crops at the farm and at the store.
2. The organic policy target represents a substantial increase in organic acreage over current conditions for California in total, and for most individual crops. For processing tomatoes, achieving 30 percent organic acreage would represent a 5- to 6-fold increase over current conditions. That is, based on historical data for the processing tomato industry, organic production has never represented more than 3-5 percent of total acres in the state. Growers and processors interviewed for this study confirmed what is obvious in industry data: there is simply a limited consumer willingness to pay a premium price for organic tomato paste and associated products.
3. Increasing organic production is not possible without substantial impacts to both conventional and organic producers and consumers. Some growers specialize in organic but many growers farm both conventional and organic fields and will adjust acreage in response to changes in farming costs and returns (crop prices). Consumers are price sensitive and substitute between

organic and conventional food as retail prices change. As such, a policy that would seek to expand organic farming would affect both conventional and organic prices and production.

4. Organic farming has higher costs and greater risk than conventional farming. Land must be rested and certified as organic, which imposes a direct certification cost on the grower plus the opportunity cost of resting land that could otherwise be farmed using conventional practices. Organic input costs have also been increasing in recent years. Moreover, organic yields are typically lower on average and exhibit higher variability than conventional yields due to the inability to effectively respond to pest pressure in all years. Consequently, net returns are more variable than conventional.
5. For the California processing tomato industry organic production is typically less than 5 percent of total production. Both organic and conventional global processing tomato consumption is stable and has been for more than the last decade. Increasing organic consumption would require consumers to substitute away from conventional to organic processing tomatoes, but current demand patterns do not indicate that they would willing to pay the price premium.
6. Consumers that purchase organic produce tend to have higher incomes. Lower income consumers both spend a greater total share of their income on food and purchase fewer organic products than higher income consumers. Changes in the price of organic or conventional crops would have a proportionally greater impact on food prices for lower-income consumers. Further, a policy that forces a reduction in lower-cost conventional production would raise prices and disproportionately impact lower-income consumers
7. Requiring organic acreage to be 30 percent of the total could strain other resources, such as water and land, that are inputs to farming. Organic production per acre is lower than conventional. Therefore, to maintain the same level of production more organic acres would need to be farmed, irrigated, and supplied with other inputs. This is particularly problematic in resource constrained parts of the state (e.g., groundwater stressed areas).