The 2014 Farm Bill, Commodity Subsidies, and California Agriculture

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In many ways the Agricultural Act of 2014, signed by the President on February 7, represents a “business as usual” farm bill. Weighing in at about 360 pages of dense text, it updates a myriad of government subsidies such as those for nutrition assistance, farm commodity programs, farm environmental investments, rural internet service, international commodity promotion, and research and development. Despite its scope and complexity, many food and agricultural programs, including school lunch programs, milk marketing orders, most crop insurance provisions, and most environmental regulations continue to remain mostly outside the farm bill.

The Supplemental Nutrition Assistance Program (SNAP), which was modified only slightly, again dominates the budget. SNAP accounts for almost $76 billion per year of projected spending, out of about $960 billion of the farm bill budget for the next ten years. The rural and agricultural programs account for about $20 billion per year in projected outlays. Overall, the agricultural titles replace some outmoded commodity subsidies with new versions, consolidate some environmental subsidies, and renew or update hundreds of individual programs.

Although many provisions of the 2008 farm bill were scheduled to expire in September 2012, contentious debate over SNAP, dairy policy, and farm subsidies delayed passage of the new farm bill for about 18 months. Some programs were continued on a temporary basis and some simply lapsed in the interim. In the end, many of the most contentious proposals were left aside and a consensus developed to move forward with less change than many proponents had advocated. For example, efforts to significantly reduce SNAP outlays by tightening rules were not included. Likewise, a program to manage dairy supplies in times of low prices was not included in the final bill.

This article will not attempt to summarize hundreds of individual programs; rather, we will characterize the likely economic implications of modifications to the farm commodity subsidies under the new farm bill that seem most relevant to California. We begin with dairy program changes because the dairy industry is the largest farm commodity industry in California by revenue, and is tied closely to the hay and forage industries and the cattle feed industry.

Dairy Programs

Balagtas, Sumner and Yu (2013) previewed the state of the farm bill dairy deliberations. As expected, the Agricultural Act of 2014 did eliminate the long-standing price support and export subsidy programs that had slipped to irrelevance. It also avoided the complex farm-by-farm federal supply management that had been supported by the National Milk Producer Federation, but had mixed support among producers more broadly. Processing firms, other than farm cooperatives, generally opposed federal supply management, pointing out that it would disrupt market signals and milk...
availability just as the United States had become competitive in export markets.

As expected, the 2014 Act also leaves aside changes to Federal Milk Marketing Orders, which regulate prices that private buyers must pay for farm milk and how revenues from such sales are allocated among farms. That means the complex of federal regulations for milk pricing, which apply regionally, remains unchanged from what was implemented 15 years ago.

California has operated outside the federal order system for about 80 years, but there is much current attention to the potential for California to shift from state to federal dairy pricing regulation. The Agricultural Act of 2014 offers California the option to join the federal system on a state-wide basis, if producers vote to do so. The Act also reaffirms that a federal order that encompassed California could use a milk quota system to allocate some of the pooled milk revenues back to producers—a procedure that California has used for about 45 years to distribute what is now about 4% of milk revenues under the California order. The Act gives no specifics about how the California system would be incorporated into a newly created federal order, which generally involves a long and complex process.

The main new federal dairy program, the Milk Margin Protection program, offers payments to make up for low margins between milk revenue and feed costs. More specifically, after the program is implemented on or before September 1, 2014, enrolled dairy farms would receive payments based on the difference between the monthly national average “all milk” price per hundredweight and an index of national corn, soybean, and alfalfa hay prices converted to represent the typical feed cost per hundredweight of milk.

The legislation sets premiums that start at zero for coverage at the lowest margin ($4 per hundredweight) and rise as the coverage trigger rises up to $8 per hundredweight. Premiums are higher for a production history of more than 4 million pounds of milk per year (production of about 170 cows at the California average production per cow). Given the size distribution of dairy farms in California, the higher premium schedule will apply to almost all milk production here.

Milk prices have risen while corn and soybean prices have fallen dramatically since the legislation and the basic premium schedule was developed in 2012. That means the probability of margins falling below any specified margin has declined and the expected value of payments for any given coverage level has also fallen. Thus, while still positive, the expected net payoff to margin protection may be relatively low for most California producers and the incentive to pay for the higher coverage levels is lower than it may have seemed just a year or two ago.

### Subsidies for Traditional Program Crops

Program crops (primarily feed grains, wheat, rice, oilseeds, and cotton) have received the bulk of farm bill support over the years and the Agricultural Act of 2014 is no exception. However, as has occurred with several recent farm bills, the form of payments to these farms has changed in response to political trends and market conditions.

Government payments triggered by low commodity prices dried up after the jump in farm prices in 2008 and 2009. Since then, program crop subsidies have consisted primarily of $5 billion per year in direct payments that are based solely on each farm’s production history of specific program crops—not on current production or prices. Direct payments, originating with the 1996 farm bill, were designed specifically to reduce the link between subsidies and incentives to produce program crops, with the aim of reducing distortions in crop planting and commodity markets. The Agricultural Act of 2014 reverses this approach, by replacing direct payments with new subsidy programs that reconnect subsidies to specific production, prices, or revenues of specific crops.

Under the 2014 Act, eligible farms that produce “covered” crops, mainly grains and oilseeds, will choose between payments triggered by commodity prices, county-wide revenue, or individual farm revenue. Farms have the option of price-based payments (Price Loss Coverage) or one of two forms of revenue-based payments (Agricultural Risk Coverage). The “Price Loss Coverage” pays producers of covered crops whenever the market price falls below the reference prices written into the law.

Besides payments being tied to production of specific crops, the new law raises “references prices” that are used to trigger payments from their counterparts in the 2008 farm bill. It also allows farmers the option to use a revenue trigger for payments if the new reference prices do not seem attractive.

In California, with limited production of feed grain, wheat and oilseeds, rice farms have the greatest potential payments from these programs. The Act raises the reference prices that trigger payments. For example, the reference price for rice is now $14 per hundredweight—up from $10.50 per

<table>
<thead>
<tr>
<th>Commodity</th>
<th>2014 Farm Bill Reference Price</th>
<th>2008 Farm Bill Reference Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>$2.63/bushel</td>
<td>$3.70 per bushel</td>
</tr>
<tr>
<td>Wheat</td>
<td>$4.17/bushel</td>
<td>$5.50/bushel</td>
</tr>
<tr>
<td>Medium grain rice</td>
<td>$10.50/cwt</td>
<td>$14.00/cwt</td>
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</tbody>
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Table 1. Commodity Program Payment Triggers for Crops Important to Some California Farms: Comparing New Reference Prices to the Old Target Prices
hundredweight under the 2008 Act (Table 1). The new farm bill raised the expected values of price-triggered payments for all the covered commodities. Nonetheless, given high projected market prices for medium-grain rice, the expected payments for rice are probably lower than the payments under the previous law.

Alternative subsidies under the Agricultural Act of 2014 can take the form of revenue guarantees under the Agricultural Risk Coverage (ARC) program. For farms with a base acreage of covered crops, the county-wide revenue version of the program pays when the county’s average revenue for that crop falls below 86% of a five-year moving average of past revenue (adjusted for lots of complications). Thus, the county-based ARC pays off crop-by-crop.

Alternatively, a farm may enroll in an ARC program that pays when the revenue of the whole farm falls below 86% of that farm’s average revenue (again, subject to many complicated provisions). This farm-specific trigger does not apply crop-by-crop and therefore more diversified farms, which have less-variable farm revenue, would be more likely to choose the county-based program. Conversely, more specialized farms with more variable revenues would be more likely to choose the farm-based program. In California, rice farms tend to be specialized, and while rice yields do not vary much from year-to-year, prices may move enough to trigger payments—especially given very high medium-grain rice prices within the past five years.

**Crop Insurance**

Most features of the federal crop insurance program, which is permanently authorized under the Federal Crop Insurance Act and not in the farm bill, do not change under the Agricultural Act of 2014. The subsidies include administration and operations costs, reinsurance provided to insurance companies, and about 60% of the premiums charged to growers. As summarized by Lee and Sumner (2103), crop insurance programs now cover many fruit and nut crops, some vegetables, as well as most field crops—except hay. For the field crops, most participants choose revenue insurance while for many tree, vine and vegetable crops, only yield insurance is available.

Even though most features do not change, the Congressional Budget Office (CBO) scored Title XI, the crop insurance title, as adding about $5.7 billion to the likely costs of the 2014 Act over the next decade. About 90% of this new spending derives from two new programs authorized in the new law.

First, a new area-wide program for program crops, the Supplemental Coverage Option (SCO), provides additional coverage on the portion of revenue shortfalls that would fall under the deductible amounts under most individual crop insurance policies. The SCO, with 65% premium subsidies, adds about $1.7 billion over 10 years. The SCO is unlikely to be of much use to California producers.

The new Stacked Income Protection for cotton (STAX), which operates similarly to SCO, but with 80% premium subsidies, replaces the previous upland cotton programs. The STAX program adds about $3.3 billion to CBO-projected outlays over the nine years after it begins operation in 2015. Upland cotton used to be a significant crop in California, but USDA surveys indicate farmers plan to plant only 60,000 acres in 2014.

As a part of its effort to expand crop insurance coverage, the 2014 Act directs USDA to develop more attractive crop insurance programs for organic crops, including basing insurance offerings on organic crop prices. Currently, crop insurance indemnities for organic crops often use prices of conventional counterparts because it has been difficult to establish organic market price benchmarks. USDA must offer the new policies by 2015. Using the lower conventional crop prices reduces the cost of insurance to growers and the USDA, but reduces the benefits to growers and may inhibit participation. The CBO projects outlays for the initiative at less than $1 million per year, so they do not expect widespread new participation.

**Other Features of Interest to California Agriculture**

The Agricultural Act of 2014 includes a Horticulture title that builds on programs included in the 2008 farm bill. The Research, Nutrition and Trade titles also include provisions of interest to horticultural industries. Continuation of the specialty crop block grant programs funds projects in marketing, research, food safety, and other purposes. Funding ranges from $72.5 million to $85 million per year, which is somewhat higher than the 2008 farm bill authorized. Targeted horticultural research authorized in the Research title is even larger and attempts to redress what had been perceived as a lack of appropriate support for horticultural commodities.

The 2014 Act continues two long-standing international marketing programs, the Market Promotion Program and the Foreign Market Development Program. Funding is authorized at $234.5 million per year and a significant share of the funds are available to California export commodities such as wine, almonds, and many more. These funds are crucial to the operations of several California organizations that undertake global marketing efforts.

Organic agriculture receives particular attention. The Act sets $100 million of mandatory research funds dedicated towards projects tailored specifically to organic agriculture. The Act allocates an additional $30 million over a decade in subsidies for organic certification. Of course, since organic certification is now more common in California, this subsidy may increase competition for California organic producers. Other provisions support farmers markets,
additional market news and data, produce safety education, and more.

Provisions Not Included in the 2014 Act

Of course many proposals never make it into legislation and most of those proposals interest only a few advocates. For this farm bill cycle, two issues garnered an unusual amount of national attention.

California’s Proposition 2 and subsequent legislation are scheduled to regulate the housing for egg-laying hens beginning in 2015. The egg industry urged a farm bill provision that would set national standards for hen housing that would have superseded the California rules. Most of the egg industry, which generally opposed California standards, urged that a uniform national standard was preferable to state-by-state standards. That provision was also supported by certain animal welfare advocates, but failed to gain sufficient support to be included in the final negotiations.

The other egg-related provision would have blocked application of California standards for hen housing on eggs produced in other states and shipped into California. That amendment also failed to gain sufficient support, so the 2014 Act left the status quo in place under which, unless blocked by legal changes in federal court, California will apply hen housing standards for shell eggs consumed in California—no matter where they are produced.

Another livestock-related provision dealt with labeling certain retail meat cuts based on the country of origin of the livestock from which the meat is derived. The proposed amendments, supported by the major meat processing, hog and cattle organizations, would have rolled back somewhat current regulations that have implemented provisions of the 2008 farm bill. The proposals failed to find sufficient support in the conference committee writing the final bill and so the regulations implemented in November 2013 remain in force. This issue remains controversial. On April 3, 2014, Frank Lucas, the Chairman of the House Agricultural Committee stated, “It is hard to think of a greater disappointment than our inability to address the economic dislocations that have already occurred, as well as those yet to come, associated with our flawed mandatory county-of-origin law.”

Final Remarks

As usual, the Agricultural Act of 2014 contains hundreds of programs and provisions that will distribute billions of dollars in small amounts to millions of individuals and groups. SNAP recipients dominate the numbers of direct beneficiaries and the total outlays. Within agriculture, hundreds of thousands of groups and individuals, ranging from local farmers’ markets to large olive producers and wildlife preserves, all have programs that distribute funds tailored for their use. In the end, this collection of beneficiaries finally overcame policy objections and fiscal restraint to add the latest in the string of farm bills that go back more than 80 years.

Given the distribution of crops grown in the state, California continues to be a small beneficiary of farm commodity subsidies relative to its share of the value of agricultural production. The importance of payments from commodity subsidies declines further as California shifts even more land and water away from field crops such as cotton.

Two trends represented in the 2014 Act offset the reduction in commodity subsidies. First, crop insurance subsidies have become more important for fruit and vegetable crops and Congress has signaled that this trend will continue. Second, the expanding collection of programs, each with relatively small budgets, focus benefits on specialty crops, organics, locally marketed produce, and related topics of interest in California.
Labor, Water, and California Agriculture in 2014
Rachael Goodhue and Philip Martin

Labor and water are critical inputs for California agriculture, and both were in the news in 2014. Over half of the hired workers on California farms are unauthorized, and a recent slowdown in unauthorized Mexico-U.S. migration has pushed up farm wages and left farmers unsure if they will have sufficient seasonal workers. California is in its third consecutive year of drought, prompting reduced allocations of water for San Joaquin Valley farmers and others, and renewed discussions of mechanisms to store and move more water from north to south.

The major farm labor issue has been unchanged for the past two decades, viz, at least half of the workers employed on U.S. crop farms are unauthorized. Two-thirds of foreign-born crop workers are unauthorized. Since almost all California farm workers are foreign-born, two-thirds of the state's farm workers are unauthorized, versus about 40% in the rest of the United States where the share of foreign-born workers almost 60% (Figure 1).

California farm employment has been expanding despite the uncertainties associated with unauthorized workers and, in recent years, uncertain water supplies. As illustrated in Figure 2 (page 6), average employment in California agriculture rose 30,000 or 8% between 2004 and 2013. Almost half of the state's agricultural employment is in the San Joaquin Valley, followed by a sixth each in the Central Coast (Monterey) and South Coast (Ventura) regions. Employment rose in each of these three regions, which together account for almost 85% of the state’s farm employment over the past decade.

The three major features of California's farm labor market over the past half century include seasonality, intermediaries, and exits. Unlike agriculture in most other states, crops dominate California farm sales. In 2012 crops were 73% of California's $45 billion in farm sales, while crops were 55% of U.S. farm sales of $375 billion. Most of California's crop sales are fruit, vegetable, and horticultural (FVH) commodities; these include fruits and nuts, vegetables and melons, and horticultural specialties such as nursery and greenhouse products. Labor's share of production costs in FVH commodities are 20–30%, while labor costs are a very small share of production costs in corn, soybeans, and grains.

FVH commodities have a seasonal demand for labor. The peak-trough ratio in California, average agricultural employment in the peak

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**Figure 1. California and U.S. Crop Workers, Shares Foreign-born and Unauthorized, 2007–2009**

- **Unauthorized**
  - U.S.: [Graph]
  - CA: [Graph]

- **Foreign-born**
  - U.S.: [Graph]
  - CA: [Graph]
month divided by the trough month, is 1.5—significantly higher than the 1.3 ratio for the United States. The peak-trough ratio is higher in California’s various farming regions, and much higher on individual farms.

Seasonality means that employers want workers to be available when they are needed. Since almost all California’s hired workers are immigrants, most of whom speak Spanish rather than English, intermediary labor contractors, custom harvesters, and other non-farmer employers typically assemble workers into crews and move them from farm to farm. Intermediary contractors should be a win-win mechanism for employers and workers, but the business model of some relies on taking advantage of immigrants not familiar with the U.S. labor market or not paying all taxes that are due. Commissions or overheads charged by some contractors do not cover mandatory payroll taxes, suggesting that they are cheating the government or charging fees to workers for rides to work, housing, or other services.

The third farm labor market feature is exits. Workers dissatisfied with their jobs have two major options: exit or quit to find a better job, or voice concerns to the employer to make changes that improve wages and working conditions and lead to a longer period of employment. Workers with few employer-specific skills tend to exit, as with fast foods, while those with skills that make them more valuable to their current employer than to other employers tend to speak up, often via unions. Farm work has typically been an exit industry, explaining why farm employers have a keen interest in immigration policy, since most new farm workers come from abroad.

Three recent changes may modify the farm labor market and change farm worker characteristics. First, the sharp slowdown in new entrants from Mexico has led to rising farm earnings. The reduced supply of new farm workers amid continued exits of experienced farm workers may encourage mechanization and efforts to reduce seasonality so that farm employers are assured of sufficient workers. Second, the prospect of obtaining new workers as legal guest workers may encourage more farmers to form or join labor cooperatives and associations that bring guest workers into the United States and shift them from one farm to another. In this way, farm work can be done with fewer workers.

The third potential change in the farm labor market may come from the buyers of farm commodities. Larger grower-shippers of commodities often make contracts with retailers that require farmers to abide by food safety and other regulations that are often more stringent than federal and state laws. Retailers may exert similar supply-chain pressure on farm employers to abide by labor standards and pay wages that exceed legal requirements. In the past, such pressures for higher wages and standards usually arose in a bottom-up fashion from unions; in the future, they may come in a top-down fashion from buyers of fruits and vegetables.

California has been at farm labor crossroads several times, worrying that an end to the supply of Chinese workers in the 1880s would force structural changes such as family farms that rely on family members rather than large farms that employ hired workers. The most recent labor crossroads was in the mid-1960s, when the end of the Bracero program set the stage for sharp wage increases, labor-saving mechanization and union activity, including a 40% wage increase in table grape contracts signed in 1966. More recently, the Immigration Reform and Control Act of 1986 was (wrongly) expected to give agriculture a legal and more expensive farm work force as farmers either raised wages to retain newly legalized farm workers or built housing in order to employ H-2A guest workers.

Immigration is the major factor affecting the number and cost of farm workers. While the immigration reform debate continues, farmers have learned to live with over half of their workers unauthorized, often by hiring workers via intermediaries who act as risk absorbers in the event of enforcement activities.

However, as the supply of new workers has dwindled, average hourly earnings have risen, prompting the use of mechanical aids that make existing workers more productive by reducing the lifting and carrying that often drives women and older workers out of farm work, as with conveyor belts in strawberry, lettuce, and melon fields. Earlier
Figure 3. Average Value of Water by Commodity, San Joaquin Valley, 2012

Source: Authors' calculations using CA Department of Food and Agriculture value of production and Department of Water Resources average water data.

In the Central Valley, the rapid growth of the wine industry and other ripening raisin grapes whose canes can be cut so that grapes dry into raisins on the vine, and new and retrofitted vineyards designed for mechanical harvesting, have reduced the peak raisin harvest work force from 50,000 to 25,000 over the past quarter century. The farm labor market could move toward either end of the spectrum. At one end would be continued wage increases that spur the adoption of mechanical aids and labor-saving mechanization and lead to larger and more specialized farms. At the other end would be more reliance on foreign workers, perhaps through new programs that allow farm guest workers to stay in the United States three years or longer and thus justify the cost of bringing them from further afield than Mexico.

**Water**

Governor Jerry Brown declared a drought emergency in January 2014, citing lack of rain and snow that lowered water levels in dams for the third consecutive year. Many farmers said that they would not plant annual crops in order to save scarce water for orchards and vineyards. Since 1987, there have been 13 drought emergency proclamations, most for part of the state.

The State Water Project (SWP) announced zero allocations for its 29 public agency customers, and the federal Central Valley Project (CWP) assigned zero allocations for agricultural contractors and offered municipal contractors, wildlife refuges, and others 40–55% of their usual allocations or their historical usage—depending on the water source and other criteria. Water users north of the Sacramento-San Joaquin river delta with senior water rights pre-dating the federal project, are slated for 40% of their usual allocation from the CVP and 50% from the SWP, plus limited 2013 carryover.

Recent rains may lead to upward adjustments in allocations; however, growers have already made many 2014 production decisions so timing may limit the value of these increases. On the other hand, districts that receive additional water that their members will not use may be able to sell it, reducing the impacts of the drought elsewhere.

The drought operation plan released by the California Department of Water Resources and the U.S. Bureau of Reclamation in April 2014 loosens water quality regulations so that the CVP and SWP can retain as much water as possible in their reservoirs in case of continued drought. The CVP’s Shasta Lake was at 50% of its 4.5 million acre-foot capacity in April 2014, while the SWP’s Lake Oroville was at 50% of its 3.5 million acre-foot capacity. Many water contractors have additional water supplies, including groundwater.

Will three years of drought change water storage and management? Many California farmers and residents rely on water and snow that falls during the winter months in the Sierra Nevada mountains and melts to fill 50 reservoirs in northern California. Some water is used in the Sacramento River basin for agricultural, industrial, urban and environmental uses, but much of northern California’s water is moved south via the Sacramento-San Joaquin river delta and the 1,200 miles of canals of the CVP and SWP.

About two-thirds of the 15 million acre-feet of water used in the San Joaquin Valley comes from local sources; four million acre-feet arrive via the delta from northern California, and another one million acre-feet are currently obtained by overdrafting groundwater.

The bedrock principle of water law in the arid west is “first in time, first in right,” meaning that the first person to put river water to a beneficial use has senior rights to that water, regardless of the value of the products produced with the water. Pre-1914 “riparian” water rights are senior to post-1914 “junior” water rights.

Selling, rather than putting water to “beneficial use,” can be difficult. Many water users belong to water districts,
and users who object can block district water sales. Even when water districts agree to sell water, it may be hard to find ways to convey the water to willing buyers. Proposed water transfers are subject to regulations that evaluate their possible environmental impacts.

Projections of how many farm jobs may be lost due to reduced water supplies are made by estimating how much farm revenue is likely to fall and how many farm jobs are associated with each $1 million in reduced farm revenue. When there is less water, farmers normally switch available water from lower- to higher-value crops, as from hay and pasture to perennial trees, vines, and vegetables. These higher-value crops tend to be more labor intensive, which tends to preserve farm jobs. The crops grown on land that is fallowed tend to be less labor-intensive.

Figure 3 shows the average value of water applied to various commodities in the San Joaquin Valley, defined as the average revenue per acre for the commodity divided by the average amount of water applied. Water is far more valuable, in terms of farm revenue generated, when applied to fruits, vegetables, and nuts than when applied to grains and hay. If the cost of water rises, farmers would likely shift water from lower-value commodities to higher-value fruits and nuts and vegetables.

Each $1 million reduction in farm revenue reduces farm employment by about 20 jobs. Reduced crop revenues in 2014 are expected to raise unemployment rates in areas that already have high jobless rates. For example, the unemployment rate in Mendota, the self-proclaimed Cantaloupe Center of the World, ranged from a low of 31% in September 2013 to a high of 41% in January 2013. Mendota is on the eastern edge of the Westlands Water District, which will receive a zero allocation.

The prospects of more unstable weather and less water mean longer-term changes, perhaps including reduced diversions of water from northern California via the Sacramento-San Joaquin river delta and abandoning farming on some of the islands in the river delta. Fresh river water must flow through the delta in order to prevent salt water intrusion.

San Joaquin Valley farmers want more water sent south during the winter months and stored in the San Luis Reservoir, which can hold two million acre feet of water, and other south-of-delta reservoirs. However, environmental groups and delta farmers insist that fresh water must flow through the delta year-round to preserve fish and keep out salt water. The 9th U.S. Circuit Court of Appeals in March 2014 reaffirmed the authority of the U.S. Fish and Wildlife Service to recommend restrictions on pumping water through the delta to protect fish.

Some water experts expect reduced imports of northern California water via the delta and less groundwater will lead to the fallowing of 20–40% of the San Joaquin Valley’s five million acres of crop land by 2050. They predict reduced acreage of water-intensive and lower-value crops, such as cotton, hay and pasture, as farmers use more costly water on higher-value orchard and vineyard crops.

What’s Next

Labor and water are two of the major challenges facing California agriculture in 2014; farmers worry that there are not enough workers or sufficient water for crops, while worker advocates want higher wages for farm workers and environmentalists more water for fish. Both labor and water are complex and controversial issues in which the legacies of past policies make sudden changes difficult.

Even when the agricultural community reaches a consensus, as on a preferred immigration reform and more water storage, it can be hard to translate that consensus into public policy because immigration and water policies affect the larger community that may not agree. The agricultural consensus to combine legalization of unauthorized farm workers with a new employer-friendly guest worker program, and to replumb the Sacramento-San Joaquin river delta so that more water can be moved and stored in the San Joaquin valley, has proven difficult to enact into public policy.

The interactions of researchers, farmers, and policy makers can assess the data and evidence, understand the needs of farmers, and explore the opportunities and constraints facing policy makers. The mutual learning that occurs can lay the basis for the development and implementation of evidence-based policies in the complex and controversial issues of farm labor and water.

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For additional information, the author recommends:
Crediting Uncertain Ecosystem Services from Working Landscapes: Balancing Program Integrity and Cost-effectiveness

Michael Springborn

The use of market-based instruments is expanding beyond traditional pollutants to include incentivizing voluntary ecosystem service provision from working landscapes, such as agriculture and forestry. These services are estimated with much greater uncertainty than traditional point source pollutants. Using protocols for greenhouse gas offsets in California as an example, I discuss the use of discounting ecosystem services to ensure program integrity and highlight tradeoffs between achieving reported service provision with high confidence and program cost-effectiveness.

Incentivizing the provision of ecosystem services (ES) from working landscapes like forestry and agriculture is a key component to achieving a host of environmental goals. Improved management holds promise for bolstering services like greenhouse gas (GHG) mitigation, water pollution mitigation, soil protection, and species conservation. There is growing interest in developing policy options for encouraging the participation of private landowners in supplying ES.

Market-based approaches offer a promising approach for incentivizing the voluntary provision of ES without imposing new obligations on landowners. For example, offsets, mitigation banking, or payments for ES can be used to encourage changes in private land management that provide environmental benefits. However, quantifying the level of services provided presents a distinct challenge since direct measurement of many ES is not economically feasible at large scales.

In lieu of direct measurement, in many cases quantification will rely on models to map management changes into ES improvements—a process sensitive to both model and input uncertainty. In this context, protecting the integrity of environmental programs requires a mechanism for ensuring that reported outcomes are achieved with the requisite level of confidence. However, achieving high confidence involves tradeoffs.

Requirements for intensive monitoring or the use of purposely conservative estimates will likely reduce net returns to landowner participation and therefore increase overall program costs. Realizing the potential of working landscapes to provide ES will require balancing the competing objectives of cost-effectiveness and confidence.

Greenhouse Gas Offsets

Recent developments in the use of GHG offsets in California provide a rich case study for exploring issues of measurement and uncertainty in the context of ES provision. The final regulation order for California’s Global Warming Solutions Act of 2006 specifies the terms for GHG permit trade and for the voluntary provision of GHG offsets from sectors that are not covered by the cap (e.g., agriculture and forestry).

Relative to smokestack emissions, the determination of avoided or sequestered GHG emissions from land management changes is subject to large uncertainty. Instead of direct measurement of emissions, which is not economically feasible, emissions from rice farming, for example, are slated to be modeled using a biophysical process model (DAYCENT).

Since verification of GHG offsets from management of working landscapes is difficult to do with precision, the California Air Resources Board (CARB) requires offset suppliers to conservatively account for uncertainty, largely via use of a confidence deduction. This is illustrated in Figure 1 (page 10), which depicts a probability distribution, f, summarizing uncertainty surrounding the true level of ES provided, y.

If f(y) is symmetric (e.g., a normal distribution) then the expected level, E(y), is also the most likely outcome—crediting at this level would ensure a 50% chance that the true level of ES
met or exceeded the credited level. A typical target level of confidence (shaded area) in this setting is substantially greater, e.g., 90% in the case of existing and proposed offset protocols in California. This conservative approach involves crediting a lower level of ES, e.g., $y_c$, and thus involves a confidence deduction relative to $E(y)$. The greater the uncertainty about the true level of ES provided, the greater the dispersion in the distribution and the larger the confidence deduction.

While such conservative crediting of ES reduces the likelihood of over-crediting, it is also likely to impose costs. A leading concern is that discounted compensation may reduce landowner participation. Even if participation is held fixed, the credited level of ES made available to the market is decreased by the confidence deduction. As the number of ES credits made available to the market is discounted and as potential sources of low-cost mitigation drop out, the overall cost of achieving GHG reduction targets is likely to rise.

**Aggregation and Uncertainty**

Uncertainty in the level of ES provided can be ameliorated to some degree by aggregating over multiple sites. As long as drivers of measurement uncertainty are uncorrelated across sites, pooling contributions will reduce uncertainty about the average level of ES being provided. Intuitively, we might expect errors of over-estimation and under-estimation to tend to cancel out as the number of bundled sites increases.

In the context of GHG offsets, CARB is allowing for “Authorized Project Designees” to act as intermediaries to bundle together emissions reductions across multiple sites to achieve economies of scale. Figure 2 illustrates this pooling process from sites to bundles, and finally to the aggregate level of GHG offsets provided to the market.

While uncertainty may attenuate to some degree due to aggregation, this process raises challenging policy design questions. Not least of these is the question of where in this process of aggregation should preferences with respect to uncertainty be imposed? For example, if the regulator wishes to be 90% confident that true provision of ES meets or exceeds the credited level, should that requirement be imposed at each site, each intermediate bundle, or the overall pool provided to the market? While this may appear at first to be a relatively minor consideration, the following example illustrates the surprisingly strong implications of this choice.

Suppose an intermediary bundles together emissions reductions from 10 sites (assuming for simplicity that each site shares the same mean and standard error of estimated ES provided). If a confidence level of 90% is imposed for each of the individual sites, this results in a surprisingly stringent implicit level of confidence achieved at the bundle level of 99.998%.

In California, GHG offset protocols adopted for forestry and under development for crops include confidence deductions applied at the site or project level. This creates the potential for particularly stringent response to uncertainty when viewed from an aggregate perspective.

While the example above shows that applying risk preferences at the site level may lead to an unintentionally stringent aggregate response, there are information and coordination challenges to applying risk preferences at aggregate levels. These challenges arise due to a potential mismatch between the scale of participation (site) and the scale at which uncertainty matters.

For some ES, it may be the case that achieving credited outcomes with high confidence at each individual site is desirable. This would be true if the benefits of ES provided at a site are non-linear. For example, this concern could be salient given changes to a pollutant subject to hotspots concerns or spatially dependent biodiversity objectives.

However, when dealing with an ES like GHG mitigation for which benefits are essentially linear and not spatially dependent, it is less clear that achieving high levels of confidence at the site level is required. Thus, uncertainty might matter at an aggregated scale while decisions about participation occur at a disaggregated scale.

Addressing uncertainty at an aggregate level requires measurement information from all sites to be known before any confidence deduction can be evaluated. While the average confidence deduction falls as uncertainty requirements are imposed at higher levels of aggregation, potential participants have less certainty over what deduction to expect.

The basic model of confidence deductions and aggregation presented above is complicated by the potential
for correlated error across sites in the estimation of ES provided. When error is random, accounting for uncertainty is relatively straightforward and aggregation across sites ameliorates uncertainty to some degree. However, estimation error may be correlated across sites when, for example, there is error in a particular model for estimating ES that is applied across sites (e.g., the DAYCENT model proposed for rice crop offsets).

If present, bias has two important implications. First, in contrast to random error, uncertainty generated from bias is not ameliorated by aggregating across sites. Second, the uncertainty generated by bias will be overlooked if confidence deductions occur solely at the site level.

Under the basic model discussed above, it was also suggested that as the desired level of conservativeness increases, confidence deductions increase and participation likely falls. However, this relationship is not as clear cut as it first appears. When a confidence deduction is imposed, two competing effects determine supplier participation and welfare.

First, for each unit of expected mitigation provided, suppliers are credited for less than a unit. But the deduction also means that buyers have to secure more units of expected mitigation to achieve the same level of credited mitigation. If demand is sufficiently inelastic (unresponsive to price) and the latter effect dominates, the imposition of a confidence deduction could on balance drive an increase in the quantity of expected mitigation demanded, and thus increase supplier participation and welfare.

Transactions Costs, Co-benefits and Additionality

Some level of participation costs associated with monitoring and reporting are essential but nonetheless a disincentive for participation. Given likely increasing returns to scale in this activity, we might expect smaller landowners to be less likely to participate since they would be less likely to recoup these transactions costs. While this may raise distributional concerns, implications for cost-effective provision of the ES itself appear limited. However, in the presence of co-benefits, such selection on participation by size may be a cause for concern.

Changes in agricultural practice to reduce GHGs can affect soil erosion and water pollution. Changes in forestry practice can affect biodiversity. To the degree that such co-benefits provided differ by landowner size, the presence of transactions costs could have unintended consequences for the type and spatial distribution of co-benefits. For example, small agricultural landholders may be concentrated near populated areas or small forestry landholdings might support a different set of species than large landholdings.

Conclusions

Regulators face difficult policy design tradeoffs in the design of market-based policies for the provision of ES from working landscapes. How should uncertainty be addressed to find the right balance between maximizing confidence in program integrity and minimizing the overall cost of achieving environmental objectives? Furthermore, at what scale should the regulator impose preferences with respect to uncertainty when the scale at which uncertainty matters diverges from the scale of participation?

In the case of GHG offsets in California, there are compelling reasons to move from imposing risk preferences at the site level to a higher level of aggregation. However, such an approach generates information and coordination challenges for implementation. Finding the balance between tradeoffs in these design questions will be an empirical challenge to address as new markets get off the ground.

Suggested Citation:

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For additional information, the authors recommend: