Agriculture in Inyo & Mono Counties
An Economic Profile

Agricultural Impact Associates
"Quantifying the value of California agriculture"

AGRICULTURE IN INYO & MONO COUNTIES
AN ECONOMIC PROFILE

CONTENTS:

Counties of Inyo & Mono

Nathan D. Reade
Agricultural Commissioner / Director of Weights and Measures
207 W. South Street, Bishop, CA 93514
Telephone – (760) 873-7860 Fax – (760) 872-1610
Email – inyomonoag@gmail.com Web - www.inyomonoagriculture.com

The Honorable Board of Supervisors, County of Inyo

Mark Tillemans, *Chair*

Matt Kingsley
Jeff Griffiths
Rick Pucci
Dan Totheroh

The Honorable Board of Supervisors, County of Mono

Stacy Corless, *Chair*

Bob Gardener
John Peters
Fred Stump
Larry Johnston

I am pleased to share **Agriculture in Inyo & Mono Counties: An Economic Profile**. This report takes an important step beyond the annual *Crop and Livestock Report* we have published over the past several decades. Instead of stopping at production values and acreage, it quantifies agriculture's total economic contribution through food production, employment, and economic "multiplier effects." It also examines agriculture's economic diversity, ecosystem services, production across different land ownership types, inter-county relationships, and opportunities to expand through greater diversification.

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

Agriculture has a long tradition in both Inyo and Mono Counties. For more than 150 years, it has been a pillar of our economy and culture. With this report, we renew our commitment to sustaining that tradition well into the future.

Sincerely,

Nathan D. Reade
Agricultural Commissioner

Each Year*, Inyo and Mono Counties' Agriculture Industry:

Provides:

$78.6 Million

in local economic activity, including

$49.7 Million

in direct production value, and

$28.9 Million

In associated economic activity

Pays:

$6.2 Million

In federal, state and local taxes

Maintains:

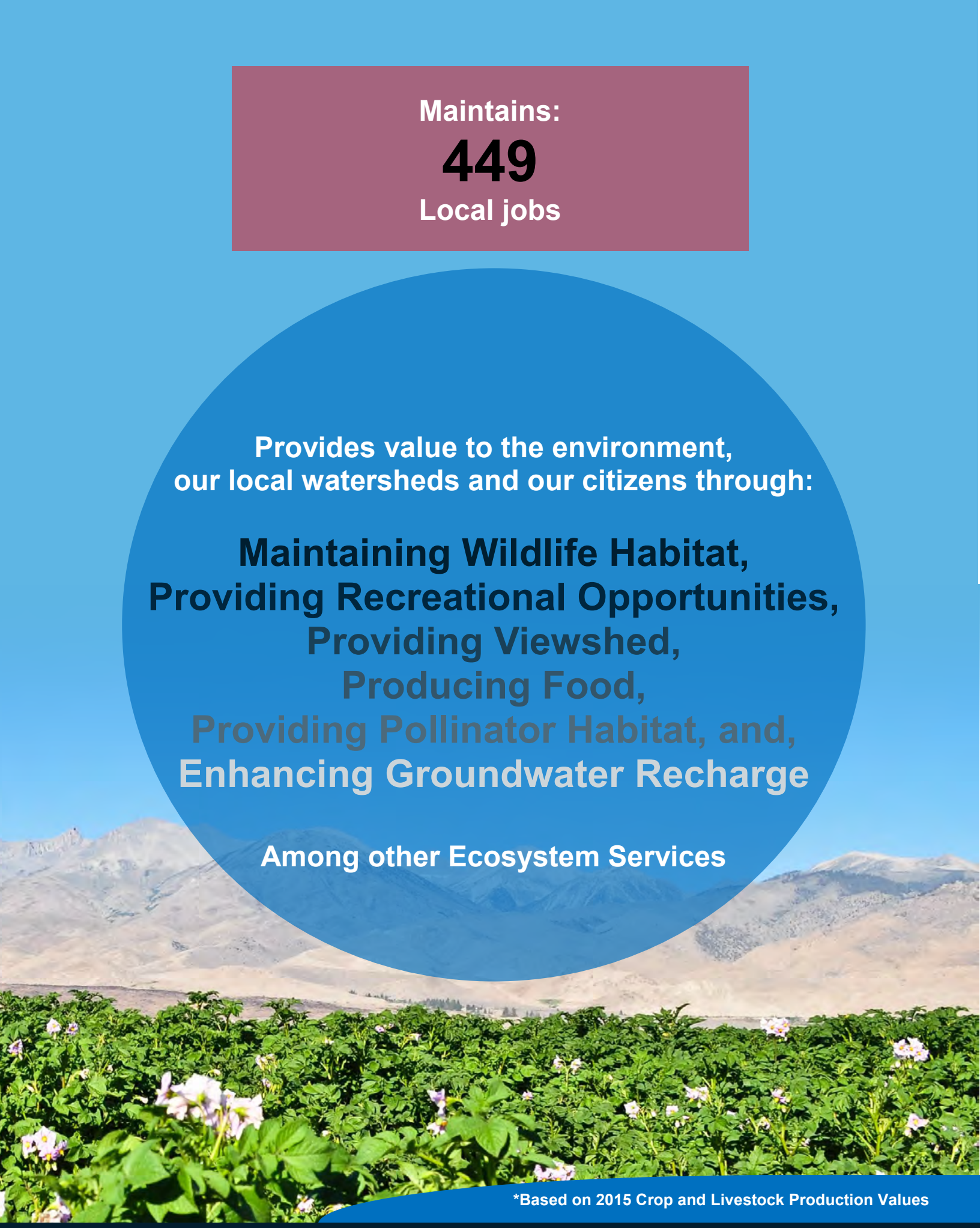
449

Local jobs

Provides value to the environment, our local watersheds and our citizens through:

Maintaining Wildlife Habitat,
Providing Recreational Opportunities,
Providing Viewshed,
Producing Food,
Providing Pollinator Habitat, and,
Enhancing Groundwater Recharge

Among other Ecosystem Services



*Based on 2015 Crop and Livestock Production Values

Agriculture in Inyo & Mono Counties: An Economic Profile

Executive Summary

For more than a century, agriculture has provided a vital link between Inyo and Mono Counties' cultural past and economic future. Although the counties' annual *Crop and Livestock Report* documents production values across various categories, it does not attempt to capture agriculture's larger economic profile. This report helps fill part of that knowledge gap. Drawing from multiple sources, it examines agriculture's broader economic implications.

The analysis supports ten main conclusions, in particular:

#1. **Direct production value.** For 2015, agriculture produced a combined total of $49.7 million across both counties, including $18.5 million from Inyo and $31.2 million from Mono. "Livestock & Livestock Products" was the largest category, contributing 48.3% of the counties' combined total.

#2. **Steady, overall growth.** Despite recent dips and variations across counties and categories, total farm production values have shown steady, long-term growth. From 2000 to 2015, the combined total output for both counties rose $14.1 million (39.6%). This growth outpaced inflation by 3.9%.

#3. Multiplier effects. Agricultural production creates ripples in the local economy. For example, every dollar's worth of economic output from Inyo "Livestock & Livestock Products" creates an extra 64 cents in purchases from suppliers and spending by agricultural employees.

#4. Total economic output. Agriculture's multiplier effects totaled $9.0 million in Inyo and $19.9 million in Mono, for a combined total of $28.9 million. When added to the $49.7 million in direct output mentioned above, agriculture's combined total economic output rises to $78.6 million.

#5. Ownership of agricultural lands. Across both counties combined, federal agencies own most of agricultural land (88.7%) and rangeland pasture is the most common use (97.2% of total area). Among field crops, private lands contributed the highest dollar output (63.8% of the total), mostly through alfalfa hay production (66.6% of all output).

#6. Employment and taxes. Across both counties combined, agriculture provided 239 direct jobs plus an additional 210 from multiplier effects, for a total of 449 jobs. Total combined tax payments across local, state, and federal levels were $6,287,128.

#7. Cross-county interdependencies. Seasonal movement of cattle herds across county lines creates complex economic interdependencies. For example, an acre of Mono County irrigated pasture accounts for $1,657 in production combined across both counties. Alfalfa contributes $10,525.

#8. Significant non-market values. Agricultural lands provide society with wildlife habitat, scenic beauty, carbon storage, and many other "ecosystem services." Established methodologies exist for quantifying the economic value of these contributions.

#9. Economic diversity within agriculture. Combined across the two counties, the agricultural industry has an economic diversity index score of 1.75. While low, the number has remained stable over the past decade, unlike many California counties that have seen declines.

#10. Expansion through diversification. Agriculture faces expansion opportunities through five diversification strategies. In terms of specific diversification focal areas, local meat processing remains an especially promising area, along with agritourism, cannabis and wineries.

Overall, the results provide an especially detailed look at agriculture's economic role, as well as key information gaps to fill in the future. The findings should be of use to a wide ranges of stakeholders. Individual producers, for example, can understand how their operations fit into larger context. Public agency and non-profit staff can better understand agriculture's current and potential future role in sustaining a healthy economy.

Acknowledgments

Agricultural Impact Associates LLC (www.ag-impact.com) produced this report under contract to the Inyo & Mono Counties Department of Agriculture, Weights & Measures. The Mono County Community Development Department provided additional funding. Lead authors were Dr. Jeff Langholz (jeff@ag-impact.com) and Dr. Fernando DePaolis (fernando@ag-impact.com). Nathan Reade supervised the project on behalf of Inyo & Mono Counties. We thank several local agricultural experts for sharing their expertise during development of this report. Photos are courtesy of Inyo & Mono Counties Department of Agriculture, Weights & Measures.

Agricultural Impact Associates

"Quantifying the value of California agriculture"

List of Figures and Tables

Figures

Tables

INTRODUCTION

Residents and visitors alike know and value the rural character of Inyo and Mono Counties. Cattle graze in vast pastures and alfalfa fields green the valley floors. Farmers markets overflow with fresh produce and community spirit. Clearly, agriculture plays a key role in sustaining a healthy local economy. What's not so clear, however, is the true size of that role. How much money does agriculture pump into the local economy? How many jobs does agriculture support? What other economic implications does agriculture have?

This report sheds light on these and related questions. Using multiple data sources and advanced economic modeling techniques, it analyzes economic aspects of Inyo and Mono Counties' agriculture. The report focuses on ten questions shown in the box below.

Ten Research Questions

1) What is the total direct economic value of agriculture?
2) How has the total direct value of agriculture changed over time?
3) What economic "multiplier effects" does agriculture create?
4) What is agriculture's total economic contribution considering direct and multiplier effects?
5) How do agriculture's economic contributions vary by land ownership type?
6) What contributions does agriculture make through local employment and taxes?
7) What economic relationships exist within agriculture that straddle both counties?
8) What "ecosystem services" do agricultural lands provide to society?
9) How economically diverse is agriculture?
10) What options exist to add economic value to local agricultural production?

Although the report does not attempt to cover every aspect of agriculture's economics, it represents the most detailed analysis to date. The findings should be of interest to a wide range of stakeholders, including policy makers, growers, ranchers, and all others who value a vibrant local economy.

METHODS

Primary data collection took place in late 2016 and early 2017. To maximize accuracy, we used a hybrid approach that combined multiple methods, researchers, and sources. Please consult the authors for additional details on the methods used.

We sourced quantitative data from local experts, annual *Crop and Livestock Report*s, and a widely used economic modeling program called IMPLAN. Using econometric modeling, IMPLAN converts data from more than a dozen federal government sources into local values for every U.S. county and zip code, as well as for each of 536 industry sectors. Except where otherwise noted, all figures are from the year

2015, the most recent IMPLAN dataset available. For additional details on IMPLAN, please see the sections below and www.IMPLAN.com.

Qualitative data collection consisted of three methods. First, we conducted personal interviews with local experts from public and private sector organizations. These experts provided highly informed perspectives into local agriculture. Second, we collected and reviewed a wide range of key documents. These documents included written policies, program evaluations, annual reports, financial statements, business plans, newspaper articles, scholarly studies, and others. Third, we drew from direct observations, having spent ample time in both counties over the course of many years.

Our analysis emphasizes agriculture's economic contributions. To understand agriculture's full economic impact, one would also need to assess agricultural-related costs to society, for example net impacts on water and other natural resources. While important, these impacts lie beyond the scope of this study.

1. WHAT IS THE TOTAL DIRECT VALUE OF AGRICULTURE?

This section focuses on the simplest measures of economic output: production. It describes total farm production across various production categories.

Table 1 shows the various categories that make up Inyo and Mono Counties' farm production value. "Livestock & Livestock Products" was the single largest production category by dollar value, comprising $24.0 million and 48.3% of the counties' combined total. "Cattle & Calves" dominated this category, consisting of $9.6 million for Inyo and $10.2 million for Mono. The remaining $4.3 million (17.9%) of the "Livestock and Livestock Products" category includes sheep, lambs, wool, eggs, and miscellaneous other livestock products. At $23.4 million, "Field Crops" was the second largest category (47.1%). "Field Crops" consisted mostly of three sub-categories: 1) "Alfalfa Hay" at $13.2 million and 56.4%; 2) "Pasture (Irrigated)" at $4.0 million and 17.0%; and 3) "Pasture (Rangeland)" at $2.7 million and 11.6%. The remainder includes garlic, grain hay, sudangrass, and other miscellaneous field crops accounting for $3.5 million and 15.0%.

Together, these two major categories contributed $47.5 million (95.5%) of the counties' combined, direct farm production values. For 2015, that combined, total farm production value was $49.7 million. This gross value does not reflect net profit or loss experienced by individual growers or by the industry as a whole. Interested readers are encouraged to consult the annual *Crop and Livestock Report* for additional details.

Table 1: Distribution of Inyo and Mono Counties' Agriculture by Production Value

	INYO County		MONO County		COMBINED	
Production Category	$ Value	%	$ Value	%	$ Value	%
Livestock / Livestock Products	$10,114,000	54.7%	$13,930,000	44.6%	$24,044,000	48.3%
Field Crops	$6,192,000	33.5%	$17,239,000	55.2%	$23,431,000	47.1%
Nursery Products	$1,620,000	8.8%	-	-	$1,620,000	3.3%
Fruit & Nut Crops	$203,000	1.1%	$38,800	0.1%	$241,800	0.5%
Apiary Production	$315,000	1.7%	-	-	$315,000	0.6%
Vegetable Crops	$45,000	0.2%	-	-	$45,000	0.1%
Forest Products	-	-	$34,400	0.1%	$34,400	0.1%
TOTALS:	**$18,489,000**	100%	**$31,242,200**	100%	**$49,731,200**	100%

Source: 2015 Crop and Livestock Report

2. How has the total direct value of agriculture changed over time?

How has agriculture's direct economic output changed over time? **Figure 1** shows long-term production trends. For Inyo County, total growth in agricultural production from 2000 to 2015 was $4.0 million (+27.7%). Mono agriculture grew $10.1 million (+47.7%). Combined, the two counties grew $14.1 million (39.6%).

Inflation averaged 2.2% during this period and totaled 35.7%. **Figure 1** does not reflect this increase. Thus, in "real" (inflation adjusted) terms, Inyo lost 8.0% over the sixteen-year period while Mono gained 12.0%. Combined, the counties gained 3.9%.

Figure 1 highlights three additional patterns. First, the dominant trend has been one of slow, steady growth. Notwithstanding inflation-adjusted results and recent dips, total production value tends to climb over time. The "steady growth" pattern goes back at least thirty years, as a graphic in the 2014 *Crop and Livestock Report* showed.

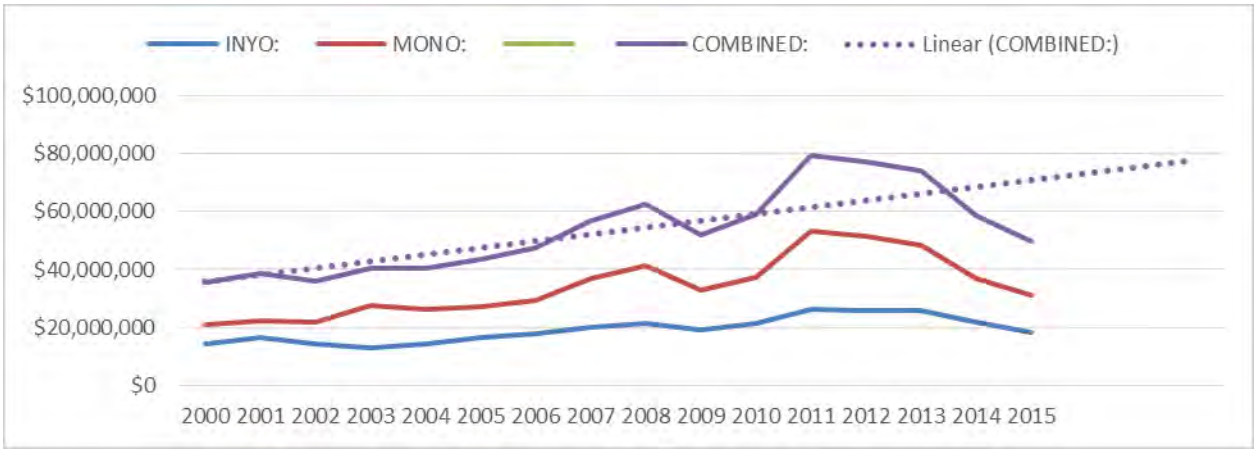
Second, the two counties tend to move in tandem. This might indicate similar production patterns, vulnerabilities to external economic forces, and/or significant inter-county relationships such as those described in Section #7.

Third, recent fluctuations represent a variation from the usual pattern. The long-term trend has not only been one of growth, but also of little variation. The sharp rise starting in 2011, followed by the steep decline of 2014 and 2015, stand in stark contrast to the long-term growth trend.

Figure 1 includes a linear trend line. This dashed line shows what one would expect to happen in 2016, 2017, and 2018 based on sixteen previous data points. Note that the predicted trend continues upward, despite recent declines.

Only time will tell if production values return to their long-term trend. One working hypothesis is that the big drop during 2014 and 2015 was simply a "correction" to above-average growth during the preceding three years, i.e. from 2011 to 2013. A deep drought may have exacerbated the correction. An alternative hypothesis is that something has fundamentally changed and the decades-long growth story is ending. The next few years should shed light on which explanation seems most valid, especially considering the wet winter of 2016-2017.

Figure 1: Long-term Trends in Production Value



3. What economic "multiplier effect" does agriculture create?

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

It is appropriate to calculate *multiplier effects* when analyzing what economists call a *basic industry*. A *basic industry* is one that sells most of its products beyond the local area and thus brings outside money into local communities. Agriculture is a basic industry in Inyo and Mono Counties. For example, nearly all of the cattle go to other counties for processing into meat products. Thus, this report includes *multiplier effects* when describing agriculture's total economic contribution.

Economic ripples take two forms: *indirect effects* and *induced effects*. The first consist of "business to business" supplier purchases. For example, when a rancher buys vehicles, fuel, insurance, feed, medicine, banking services, veterinary services, and other inputs, this creates *indirect effects*.

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

Economists calculate *indirect* and *induced* effects by using multipliers. Multipliers are numbers that when applied to direct economic output values, quantify the ripple effect. **Table 2** shows economic multipliers for major production categories. We used IMPLAN multipliers as a starting point, then customized them to reflect local production and benchmark data from other California counties.

For example, Inyo County "Livestock & Livestock Products" has an *indirect effects* multiplier of 0.4940. This means that each dollar's worth of direct output generates an extra 49 cents in supplier purchases. The 0.1424 *induced effects* multiplier means that each dollar's worth of direct economic output also generates an extra 14 cents in consumption spending by agriculture owners and employees.

Table 2. Economic Output Multipliers

	INYO Output		MONO Output	
	Indirect Effects Multiplier	Induced Effects Multiplier	Indirect Effects Multiplier	Induced Effects Multiplier
Livestock / Livestock Products	0.4940	0.1424	0.5112	0.3728
Field Crops	0.1264	0.1725	0.1220	0.3139
Nursery Products	0.0587	0.2392	n/a	n/a
Fruit & Nut Crops	0.0757	0.2562	0.0609	0.6098
Apiary Production	0.1639	0.2724	n/a	n/a
Vegetable Crops	0.0830	0.2600	n/a	n/a
Forest Products	n/a	n/a	0.0489	0.2689

** Note: "n/a" indicates zero production value for a given category, thus no multiplier effect*

Note that individual production sectors all have different multipliers for induced and indirect output. For example, the indirect effect multiplier for Mono County "Livestock & Livestock Products" is nearly seven times higher than for "Fruit & Nut Crops." The induced effect multiplier for Mono County "Livestock & Livestock Products," however, is lower than for all other production categories. Multipliers also vary across counties, reflecting where and how much agricultural companies and their employees can and do spend money.

4. What is agriculture's total economic contribution, including multiplier effects?

The previous sections have provided key pieces to an economic puzzle. This section combines those puzzle pieces into a fuller picture showing the larger economic output effect of Inyo and Mono Counties' agriculture.

Applying economic multipliers from the previous section, **Table 3** shows agriculture's direct, indirect, and induced economic effects for major production categories in Inyo County. The total economic contribution was $27.5 million. This consisted of $18.5 million in direct output from production, plus $9.0 million in multiplier effects.

Table 3. Overall Economic Effect of Inyo County Agriculture

	Output for INYO County			
	Direct Output	Indirect Effects Output	Induced Effects Output	Total Output (Direct + Indirect + Induced)
Livestock & Livestock Products	$10,114,000	$4,996,588	$1,440,010	$16,550,598
Field Crops	$6,192,000	$782,511	$1,068,405	$8,042,916
Nursery Products	$1,620,000	$95,015	$387,473	$2,102,488
Apiary Production	$315,000	$51,623	$85,815	$452,438
Fruit & Nut Crops	$203,000	$15,371	$52,013	$270,384
Vegetable Crops	$45,000	$3,736	$11,698	$60,435
TOTALS:	**$18,489,000**	**$5,944,845**	**$3,045,414**	**$27,479,259**

Table 4 shows agriculture's direct, indirect, and induced economic effects for major production categories in Mono County. The total economic contribution was $51.1 million. This consisted of $31.2 million in direct output from production, plus $19.9 million in multiplier effects.

Table 4. Overall Economic Effect of Mono County Agriculture

	Output for MONO County			
	Direct Output	Indirect Effects Output	Induced Effects Output	Total Output (Direct + Indirect + Induced)
Livestock & Livestock Products	$13,930,000	$7,120,346	$5,193,787	$26,244,133
Field Crops	$17,239,000	$2,102,914	$5,411,529	$24,753,444
Fruit & Nut Crops	$38,800	$2,364	$23,661	$64,825
Forest Products	$34,400	$1,681	$9,250	$45,331
TOTALS:	**$31,242,200**	**$9,227,306**	**$10,638,228**	**$51,107,733**

Table 5 combines both counties into a single snapshot of agriculture's total economic effect. Including all seven major production categories, the total economic contribution was $78.6 million. This consisted of $49.7 million in direct output from production, plus $28.9 million in multiplier effects. These totals capture economic contributions beyond what the annual *Crop and Livestock Report* is designed to reflect.

Table 5. Overall Economic Effect of Both Counties Combined

	Output for Inyo & Mono Counties Combined			
	Direct Output	Indirect Effects Output	Induced Effects Output	Total Output (Direct + Indirect + Induced)
Livestock & Livestock Products	$24,044,000	$12,116,934	$6,633,797	$42,794,731
Field Crops	$23,431,000	$2,885,425	$6,479,935	$32,796,360
Nursery Products	$1,620,000	$95,015	$387,473	$2,102,488
Fruit & Nut Crops	$241,800	$17,735	$75,674	$335,209
Apiary Production	$315,000	$51,623	$85,815	$452,438
Vegetable Crops	$45,000	$3,736	$11,698	$60,435
Forest Products	$34,400	$1,681	$9,250	$45,331
TOTALS:	**$49,731,200**	**$15,172,151**	**$13,683,642**	**$78,586,992**

5. How do agriculture's economic contributions vary by land ownership type?

So far, we have shown agriculture's economic contributions from direct production and multiplier effects across major production categories. This section adds a new variable: land ownership.

As the 2015 *Crop and Livestock Report* and other sources indicate, private land ownership is rare in Inyo and Mono Counties. Privately owned lands comprise only 1.7% of Inyo County and 6.5% of Mono. Thus, agricultural production depends to a large extent on leasing lands owned by other entities. This dependency, in turn, makes agriculture vulnerable to changes in leasing policies.

To better understand this phenomenon, this section examines the nexus of land ownership and agricultural production. The first part briefly describes major land ownership categories most relevant to agriculture. The second part estimates total economic contributions attributable to each land ownership type, including direct output and multiplier effects.

Four Main Land Ownership Types

Based on publicly available data and on consultations with local experts, we focused on four major land ownership types. Although other land ownership types exist, most agriculture occurs under these four categories:

Federal: U.S. Bureau of Land Management (BLM). Part of the U.S. Department of the Interior, the BLM manages 245 million acres of land in the United States, including 1.4 million Inyo County acres and 524,000 Mono County acres. The agency's multi-use mission combines energy development, livestock grazing, recreation, timber harvesting and other production types with protection of natural, cultural, and historical resources.

Federal: U.S. Forest Service (USFS). Part of the U.S. Department of Agriculture, the USFS manages 193 million acres million acres of land in the USA, including 776,000 in Inyo County and 1,219,489 in Mono County. The agency works to sustain the health, diversity, and productivity of the nation's forests and grasslands for current and future generations. Like BLM, USFS leases many of its lands to private, for-profit businesses for grazing, logging, and other extractive purposes.

City of Los Angeles, Department of Water and Power (LADWP). As a result of a long, complex, and contentious history, the City of Los Angeles has extensive holdings in Inyo and Mono Counties. LADWP uses these lands to supply water to Los Angeles via aqueducts. Total acreage varies across information sources. Based on county government sources such as General Plans and Crop and Livestock Reports, LADWP owns around 253,000 Inyo County acres (3.9% of the county) and 64,000 acres of Mono County (3.2% of the county), for a total of 317,000 acres.

At the time of writing, LADWP noted owning roughly 320,000 acres in Inyo and Mono Counties, with 240,000 of these acres leased to ranchers for grazing. Leased lands include 18,000 irrigated acres, 2,000 of them allocated for alfalfa production. On its website, LADWP notes that, "Grazing and recreation are compatible with watershed protection, and are an important part of a land management program that provides viable business opportunities while satisfying the goal of water quality protection" (see www.LADWP.com).

Private Ownership. As noted earlier, private land ownership is rare in Inyo and Mono Counties. At the time of writing, an estimated 121,200 Inyo County acres were in private ownership (1.9%), and 130,291 Mono County acres (6.5%). Private land occurs mostly in community areas. The low rates of private land ownership extend into agricultural production, making agriculture small and highly dependent on leasing lands from other owners.

Although most agriculture occurs within these four categories, two others warrant mention. First, the State of California owns land managed by its Department of Fish and Wildlife (DFW). Examples include the 991-acre Pickel Wildlife Area and the 1,400-acre East Walker River Wildlife Area, both in Mono County. DFW also owns the 181-acre Fish Slough Ecological Reserve near the Inyo-Mono border. Any occasional use of these lands by ranchers is for moving stock rather than grazing. The other exception is the County of Mono, which owns 770 acres.

Economic Effect Attributable to Each Land Ownership Type

Now that we understand the major land ownership types under which agriculture occurs, we can determine the amount of economic output attributable to each land ownership type. We can also allocate output across common production categories. The following three figures show results for Inyo and Mono Counties individually, then combined.

Table 6 shows Inyo County agriculture's direct, indirect, and induced effects based on land ownership

and use. It focuses on three main land uses: alfalfa hay, irrigated pasture, and rangeland pasture. Key findings include:

- Ownership: With 777,401 acres under agricultural production, BLM by far owns the most agricultural land (65%). Private ownership accounts for the smallest portion, with just 388 acres (3%).

- Uses: Of the 1,204,077 acres used for production, 98.7% of them (1,187,859 acres) are used as rangeland pasture. Only tiny portions go toward alfalfa hay (2,018 acres) and irrigated pasture (14,200 acres).

- Output. Including direct and multiplier effects, agricultural lands produced $6.97 million across the three product categories. LADWP lands accounted for most of this output (68.6%), at $4.8 million. Among the three land uses, alfalfa hay accounted for the most economic output (57.7% and $4.0 million), even though less than one percent of the total acres were in alfalfa hay (0.17%).

Table 6. Inyo County Economic Effect by Land Ownership & Use

	Federal (BLM)	Federal (USFS)	City (L.A.)	Private Owner	TOTALS:
Alfalfa Hay					
# of Acres:	-	-	1,630	388	2,018
% of Total:	0%	0%	81%	19%	100%
Direct Value:	$0	$0	$2,503,964	$596,036	$3,100,000
Indirect Value:	$0	$0	$316,437	$75,324	$391,761
Induced Value:	$0	$0	$432,049	$102,844	$534,893
Total Value:	**$0**	**$0**	**$3,252,451**	**$774,203**	**$4,026,654**
Pasture (Irrigated)					
# of Acres:	-	-	14,200	-	14,200
% of Total:	0%	0%	100%	0%	100%
Direct Value:	$0	$0	$980,000	$0	$980,000
Indirect Value:	$0	$0	$123,847	$0	$123,847
Induced Value:	$0	$0	$169,095	$0	$169,095
Total Value:	**$0**	**$0**	**$1,272,942**	**$0**	**$1,272,942**
Pasture (Rangeland)					
# of Acres:	777,401	225,057	185,401	-	1,187,859
% of Total:	65%	19%	16%	0%	100%
Direct Value:	$842,939	$244,030	$201,031	$0	$1,288,000
Indirect Value:	$106,526	$30,839	$25,405	$0	$162,770
Induced Value:	$145,446	$42,106	$34,687	$0	$222,239
Total Value:	**$1,094,911**	**$316,976**	**$261,123**	**$0**	**$1,673,010**
Total Values Across All 3 Uses					
# of Acres:	777,401	225,057	201,231	388	1,204,077
% of Total:	65%	19%	17%	0.03%	100%
Direct Value:	$842,939	$244,030	$3,684,995	$596,036	$5,368,000
Indirect Value:	$106,526	$30,839	$465,689	$75,324	$678,378
Induced Value:	$145,446	$42,106	$635,832	$102,844	$926,227
GRAND TOTAL:	**$1,094,911**	**$316,976**	**$4,786,516**	**$774,203**	**$6,972,606**

Table 7. Mono County Economic Effect by Land Ownership & Use

	Federal (BLM)	Federal (USFS)	City (L.A.)	Private Owner	TOTALS:
Alfalfa Hay					
# of Acres:	-	-	-	9,200	9,200
% of Total:	0%	0%	0%	100%	100%
Direct Value:	$0	$0	$0	$10,120,000	$10,120,000
Indirect Value:	$0	$0	$0	$1,234,497	$1,234,497
Induced Value:	$0	$0	$0	$3,176,790	$3,176,790
Total Value:	**$0**	**$0**	**$0**	**$14,531,287**	**$14,531,287**
Pasture (Irrigated)					
# of Acres:	4,509	5,977	6,500	23,067	40,053
% of Total:	11%	15%	16%	58%	100%
Direct Value:	$338,853	$449,174	$488,478	$1,733,495	$3,010,000
Indirect Value:	$41,335	$54,793	$59,587	$211,462	$367,177
Induced Value:	$106,370	$141,001	$153,339	$544,165	$944,875
Total Value:	**$486,559**	**$644,968**	**$701,404**	**$2,489,122**	**$4,322,053**
Pasture (Rangeland)					
# of Acres:	498,696	539,579	21,563	-	1,059,838
% of Total:	47%	51%	2%	0%	100%
Direct Value:	$670,049	$724,979	$28,972	$0	$1,424,000
Indirect Value:	$81,736	$88,437	$3,534	$0	$173,708
Induced Value:	$210,336	$227,580	$9,095	$0	$447,011
Total Value:	**$962,122**	**$1,040,996**	**$41,601**	**$0**	**$2,044,719**
Total Values Across All 3 Uses					
# of Acres:	503,205	545,556	28,063	32,267	1,109,091
% of Total:	45%	49%	3%	3%	100%
Direct Value:	$1,008,902	$1,174,153	$517,450	$11,853,495	$14,554,000
Indirect Value:	$123,072	$143,230	$63,122	$1,445,959	$1,775,382
Induced Value:	$316,706	$368,581	$162,434	$3,720,955	$4,568,676
GRAND TOTAL:	**$1,448,680**	**$1,685,964**	**$743,005**	**$17,020,408**	**$20,898,058**

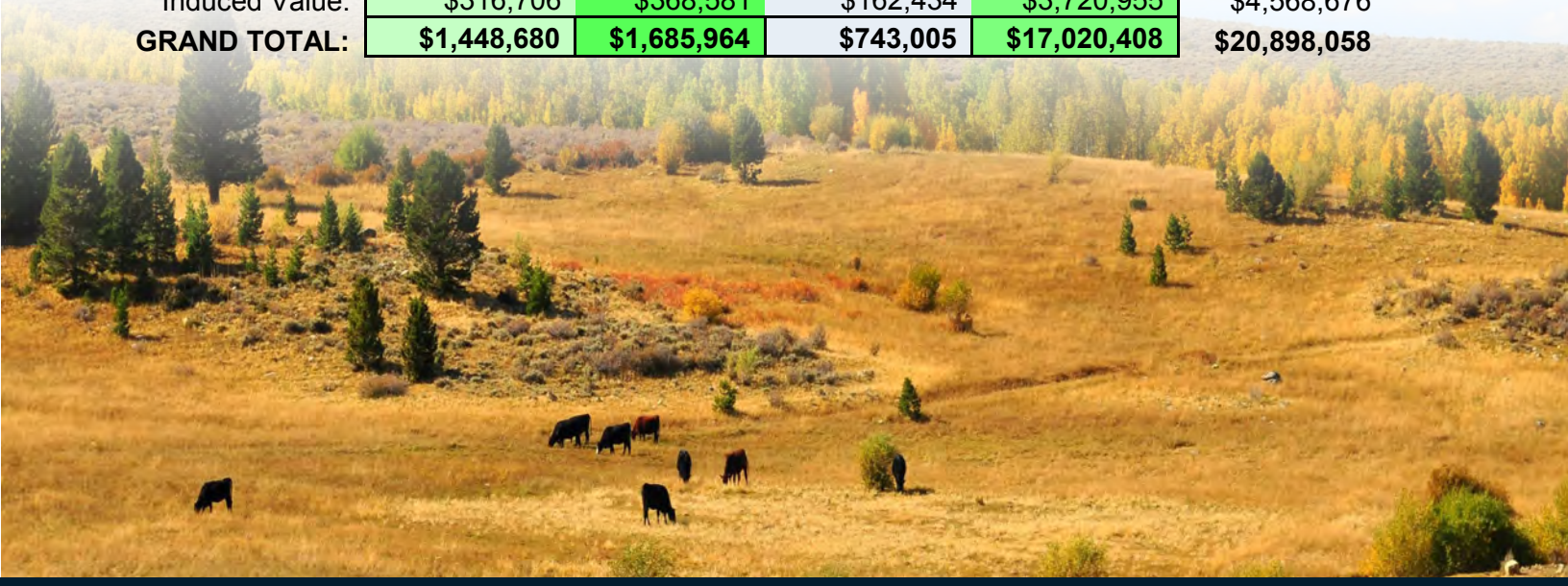


Table 7 shows Mono County agriculture's direct, indirect, and induced effects based on land ownership and use. Key findings include:

- Ownership: With 503,205 and 545,556 acres in production respectively, BLM and USFS are the biggest two agricultural land owners. Private landowners and LADWP own the remaining 6%, in nearly equal proportions.

- Uses: Similar to Inyo County, the overwhelming majority of agricultural land is rangeland pasture. Rangelands account for 1,059,838 acres (95.6%) of the total 1,109,091 acres under production. Relatively small areas go toward alfalfa hay (9,200 acres) and irrigated pasture (40,053 acres).

- Output. Including direct and multiplier effects, agricultural lands accounted for $20.9 million across the three production categories. At $17.0 million, private lands accounted for the overwhelming majority of this total (81.4%), despite having just 32,267 acres in production. Similar to Inyo County, alfalfa hay accounted for more economic output ($14.5 million and 69.5%) than irrigated pasture or rangeland pasture despite covering less than one percent of total area used for agriculture (0.83%).

Table 8 combines the data for both counties. Key findings include:

- Ownership: With 1,280,606 and 770,613 acres in production respectively, BLM and USFS are the biggest two agricultural land owners by area (88.7%). LADWP is next with 9.9%, followed by private landowners at 1.4%.

- Uses: As was the case with each individual county, rangeland pasture accounts for the vast majority of agricultural acres. Rangelands cover 2,247,697 acres (97.2%) of the counties' combined 2,313,168 acres under production. Relatively small areas go to irrigated pasture (54,253 acres, 2.3%) and alfalfa hay (11,218 acres, 0.5%).

- Output. Combining direct and multiplier effects across both counties, agricultural lands accounted for $27.9 million across the three production categories. Despite only 32,655 acres in production, private lands accounted for the overwhelming majority of this total ($17,794,611, 63.8%). Similar for each county individually, alfalfa hay accounted for more economic output ($18,557,940 and 66.6%) than irrigated pasture or rangeland pasture, even though less than one percent of total acres were in alfalfa hay (0.5%).

This long section has explored the nexus of land ownership, production type, and economic output. At the risk of oversimplifying the rich story told by more than 360 numbers, we offer the following four key findings:

1. Alfalfa hay is the most economically significant production use, by far. Alfalfa accounts for less than half a percent of all acres in production but contributes 66.6% of the total economic output.

2. The federal government owns the overwhelming majority of land used for agricultural production (88.7%), but these lands are nearly all low value rangeland that contribute just 16.3% of agriculture's overall economic output.

3. Private landowners do not own rangeland, but rather focus solely on higher value alfalfa and irrigated pasture. For this reason, private lands account for 63.5% of all economic output despite comprising just 1.4% of the agricultural land.

4. LADWP lands play a critical, disproportionate role in agricultural economic output. LADWP owns just 9.9% of agricultural acres but 19.8% of agriculture's direct and indirect economic output occurs there. Thus, any changes in LADWP leasing policies would have significant consequences for agricultural economic output.

Table 8. Inyo and Mono Counties' Economic Effect by Land Ownership & Use

	Federal (BLM)	Federal (USFS)	City (L.A.)	Private Owner	TOTALS:
Alfalfa Hay					
# of Acres:	-	-	1,630	9,588	11,218
% of Total:	0%	0%	15%	85%	100%
Direct Value:	$0	$0	$2,503,964	$10,716,036	$13,220,000
Indirect Value:	$0	$0	$316,437	$1,309,821	$1,626,258
Induced Value:	$0	$0	$432,049	$3,279,633	$3,711,682
Total Value:	$0	$0	$3,252,451	$15,305,490	**$18,557,940**
Pasture (Irrigated)					
# of Acres:	4,509	5,977	20,700	23,067	54,253
% of Total:	8%	11%	38%	43%	100%
Direct Value:	$338,853	$449,174	$1,468,478	$1,733,495	$3,990,000
Indirect Value:	$41,335	$54,793	$183,434	$211,462	$491,024
Induced Value:	$106,370	$141,001	$322,434	$544,165	$1,113,970
Total Value:	$486,559	$644,968	$1,974,346	$2,489,122	**$5,594,995**
Pasture (Rangeland)					
# of Acres:	1,276,097	764,636	206,964	-	2,247,697
% of Total:	57%	34%	9%	0%	100%
Direct Value:	$1,512,988	$969,009	$230,003	$0	$2,712,000
Indirect Value:	$188,262	$119,276	$28,939	$0	$336,478
Induced Value:	$355,782	$269,686	$43,782	$0	$669,250
Total Value:	$2,057,032	$1,357,972	$302,724	$0	**$3,717,728**
Total Values Across All 3 Uses					
# of Acres:	1,280,606	770,613	229,294	32,655	2,313,168
% of Total:	55%	33%	10%	1%	100%
Direct Value:	$1,851,841	$1,418,183	$4,202,445	$12,449,531	$19,922,000
Indirect Value:	$229,598	$174,069	$528,811	$1,521,283	$2,453,761
Induced Value:	$462,152	$410,687	$798,265	$3,823,798	$5,494,903
GRAND TOTAL:	$2,543,591	$2,002,940	$5,529,521	$17,794,611	**$27,870,664**

6. What contributions does agriculture make through local employment and taxes?

In addition to economic output, agriculture also contributes to the local economy through employment and taxes. How many jobs does agriculture directly and indirectly support? What effect does agriculture have on tax revenues?

Employment

The tables below detail employment. They include induced and indirect jobs, calculated using IMPLAN's employment multipliers which differ across counties and production sectors. For Inyo County (**Table 9**), agriculture supported 140 direct jobs plus an additional 65 from multiplier effects, for a total of 205 jobs. These numbers encompasses a wide range of production-related jobs, including not just growing and harvesting, but also sales, marketing and many other roles.

Table 9. Employment Effect of Inyo County Agriculture

	INYO Agricultural Employment			
	DIRECT Effects Employment	INDIRECT Effects Employment	INDUCED Effects Employment	TOTAL Employment Effect
Livestock & Livestock Products	46	29	13	88
Field Crops	55	8	9	72
Nursery Products	4	1	3	9
Apiary Production	8	0	1	9
Fruit & Nut Crops	12	0	0	12
Vegetable Crops	14	0	0	15
	140	**38**	**27**	**205**

For Mono County (**Table 10**), agriculture supported 99 direct jobs and an additional 144 from multiplier effects, for a total of 244 jobs.

Table 10. Employment Effect of Mono County Agriculture

	MONO Agricultural Employment			
	DIRECT Effects Employment	INDIRECT Effects Employment	INDUCED Effects Employment	TOTAL Employment Effect
Livestock & Livestock Products	4.8	38	41	84
Field Crops	73.5	23	43	139
Fruit & Nut Crops	0.7	0	0	1
Forest Products	20.0	0	0	20
	99	**60**	**84**	**244**

For both counties combined (**Table 11**), agriculture supported 239 direct jobs and an additional 210 from multiplier effects, for a total of 449 jobs.

Table 11. Employment Effect of Inyo & Mono Counties Combined

	COMBINED Agricultural Employment			
	DIRECT Effects Employment	INDIRECT Effects Employment	INDUCED Effects Employment	TOTAL Employment Effect
Livestock & Livestock Products	51	67	54	172
Field Crops	128	31	52	211
Nursery Products	4	1	3	9
Fruit & Nut Crops	13	0	1	13
Apiary Production	8	0	1	9
Vegetable Crops	14	0	0	15
Forest Products	20	0	0	20
TOTALS:	**239**	**99**	**111**	**449**

Taxes

Economic output has powerful implications for tax revenues. In general, the greater the economic output, the more money local, state, and federal governments have available to fund various public services. Using U.S. Bureau of Economic Analysis data as its foundation, IMPLAN calculates net taxes paid by individual sectors based on direct and multiplier output. **Table 12** shows estimated tax revenues attributable to Inyo County agriculture. With $100,064 in State & Local taxes and $1,586,167 in Federal taxes, Inyo agriculture accounted for a total of $1,686,231 in tax payments.

Table 12. Tax Base Effect of Inyo County Agriculture

LOCAL & STATE TAXES PAID	by HOUSEHOLDS	by BUSINESSES	TOTAL
Social Security	$7,296	$14,741	$22,037
Tax on Production and Imports		($399,181)	($399,181)
Personal Taxes	$465,230		$465,230
Corporate profits and dividends		$11,978	$11,978
Total Local & State	**$472,526**	**($372,462)**	**$100,064**

FEDERAL TAXES PAID	by HOUSEHOLDS	by BUSINESSES	TOTAL
Social Security	$471,634	$168,697	$640,331
Tax on Production and Imports		($56,278)	($56,278)
Personal Taxes	**$928,039**		**$928,039**
Corporate profits and dividends		$74,075	$74,075
Total Federal	**$1,399,673**	**$186,494**	**$1,586,167**

Table 12 introduces several tax concepts that might be new to some readers. For example, “Social Security” taxes are those that employees and employers make into the social insurance system. “Tax on Production and Imports” refers to property taxes, fees, tariffs, and other business taxes. “Personal Taxes” consist mostly of income tax. Please consult the authors for additional details.

Table 13 shows estimated tax revenues attributable to Mono County agriculture. With $1,234,008 in State & Local taxes and $3,617,601 in Federal taxes, Mono agriculture accounted for a total of $4,851,609 in tax payments.

Table 13. Tax Base Effect of Mono County Agriculture

LOCAL & STATE TAXES PAID	by HOUSEHOLDS	by BUSINESSES	TOTAL
Social Security	$5,293	$10,694	$15,987
Tax on Production and Imports		($101,661)	($101,661)
Personal Taxes	$1,454,502		$1,454,502
Corporate profits and dividends		($134,820)	($134,820)
Total Local & State	**$1,459,795**	**($225,787)**	**$1,234,008**

FEDERAL TAXES PAID	by HOUSEHOLDS	by BUSINESSES	TOTAL
Social Security	$1,425,460	$199,722	$1,625,182
Tax on Production and Imports		($6,736)	($6,736)
Personal Taxes	$2,834,931		$2,834,931
Corporate profits and dividends		($835,776)	($835,776)
Total Federal	**$4,260,391**	**($642,790)**	**$3,617,601**

Table 14 shows estimated tax revenues attributable to Inyo and Mono agriculture combined. With $1,147,816 in State & Local taxes and $5,139,312 in Federal taxes, Inyo and Mono agriculture accounted for a total of $6,287,128 in tax payments.

Table 14. Tax Base Effect of Inyo & Mono Counties Combined

LOCAL & STATE TAXES PAID	by HOUSEHOLDS	by BUSINESSES	TOTAL
Social Security	$15,985	$32,297	$48,282
Tax on Production and Imports		($554,129)	($554,129)
Personal Taxes	$1,704,976		$1,704,976
Corporate profits and dividends		($51,313)	($51,313)
Total Local & State	**$1,720,961**	**($573,145)**	**$1,147,816**

FEDERAL TAXES PAID	by HOUSEHOLDS	by BUSINESSES	TOTAL
Social Security	$1,699,506	$445,265	$2,144,771
Tax on Production and Imports		($55,762)	($55,762)
Personal Taxes	$3,368,017		$3,368,017
Corporate profits and dividends		($317,714)	($317,714)
Total Federal	**$5,067,523**	**$71,789**	**$5,139,312**

7. What economic relationships exist within agriculture that straddle both counties?

Inyo and Mono Counties look separate on a map but their economies have invisible connections. Just as tourists, wildlife, and other things flow across the boundary, so too do economic goods and services. We are not aware of any rigorous attempts to document cross-county economic linkages involving agriculture. This section helps fill part of that knowledge gap and focuses on cattle grazing. We use two approaches: 1) a straightforward, linear analysis based on numbers of acres, level of inter-county livestock production, and their economic values; and 2) an integrated, input-output model of livestock-related connections between the two counties.

Why is this important? Cross-county interdependencies raise the stakes for any policy changes. What occurs in Mono can affect Inyo, and vice versa. Previous sections have shown the livestock industry's high dependency on leasing grazing lands from USFS and LADWP. If one of these entities pulls land out of production in one county, and that land was used by one of the region's 19 cross-border ranching operations, then it would create ripple effects in the other county. The operator might no longer move the herd to the other county, which in turn could create cascading effects of various kinds within and beyond the ranching industry. The rancher may incur greater costs for supplemental feed, straining already thin margins. Indeed, some ranchers have reduced herd size or even moved herds out of state due to limited availability of grazing lands. The key point is that pulling an acre of pasture out of production can affect operations in both counties and removes not just the value of not just the field crop, but also the livestock that depend on it.

Linear Approach

Quantifying the economic value of cross-county interdependencies is not an exact science. One way to do it is to assume a straight, linear effect. Calculating the economic impact in this manner entails creating a long formula that combines 36 separate variables.

- The direct $ value of economic output attributable to an acre of each of three kinds of field crops (alfalfa hay, irrigated pasture, rangeland), in each county (6 variables).
- The $ value of two multiplier effect types (induced and indirect) attributable to an acre of each of three field crops (alfalfa hay, irrigated pasture, rangeland), in each county (12 variables).
- The per acre direct production value for the cattle from each county that depend on each of the three field crop types (alfalfa hay, irrigated pasture, rangeland) on that particular land, for at least part of the year, plus induced and indirect multiplier effects (18 variables).

The calculations are complicated and time-consuming, and performing them for every combination of crop and land ownership lies beyond our scope here. Nevertheless, they allow us to say things like the following:

- LADWP owns an estimated 1,630 acres of alfalfa in Inyo County. If LADWP were to remove part of that land from production, then it would create combined losses for the two counties totaling $10,525 per acre removed from production. Inyo County agriculture would lose $6,748 per acre in direct output plus $3,776 in multiplier effects for a total of $10,525 per acre. No losses would occur in Mono County, since cattle there do not normally use LADWP's alfalfa acres in Inyo County.

- LADWP owns an estimated 14,200 acres of irrigated pasture in Inyo County. If LADWP were to remove part of that land from production, then it would create combined losses for the two counties totaling $1,657 per acre removed from production. Inyo County agriculture would lose $767 per acre in direct output plus $465 in multiplier effects for a total of $1,232 per acre. Based on the extent to which Mono cattle depend on LADWP's irrigated pasture lands in Inyo, Mono County livestock production would lose $226 per acre in direct output plus $199 per acre in multiplier effects for a total loss of $425 per acre of irrigated pasture removed from production.

Holistic Approach

The section explores production of field crops as if each comprises its own micro-economy consisting of just one product with isolated effects. This section takes a more integrated approach. It analyzes "livestock production" as a whole rather than by its individual components like alfalfa, irrigated pasture, and rangeland. This process entails sophisticated modeling that accounts for complex economic interactions and effects.

Economists use the term "negative shock" to describe events like the significant reduction in livestock production that we model here. Such shocks can and do occur in a wide range of industries. They take many forms in agriculture. Examples include weather-related events such as droughts and floods, foodborne illness outbreaks, game-changing technological advances, influxes of lower cost imports, or major policy changes. These and many other events can create rapid, dramatic changes in economic output. For our purposes here, we focus on a reduction in livestock production due to fewer acres of grazing land available for ranchers to lease.

When such events occur, consequences ripple beyond the industry in which they originated. For example, a negative shock to pasture and livestock could make farmers and ranchers less able to make payments to their employees, suppliers, contractors, and lenders, who in turn, might pass those ripples onto others. This, in turn, can strain those other industries. The nature and extent of these complex effects depends on economic interdependencies and spillover effects across sectors.
Fortunately, IMPLAN's powerful software makes such modelling possible. In order to simulate a negative shock to Inyo and Mono grazing and livestock, we built an input-output model to represent their combined economy. The model includes 536 economic sectors from IMPLAN. To "shock" the system, we impacted the model with a $1.0 million reduction in the value of economic output from livestock in each county, for a total of $2.0 million. We put this "shock" into IMPLAN's sector #11 ("Beef cattle ranching..") then let it ripple through the other 535 economic sectors.

According to the model, a combined $2.0 million shock to livestock production (e.g., through non-renewal of grazing leases) would cost $3,381,060 (including direct, indirect and induced effects) in lost economic output and 17 jobs across various economic sectors within the two counties. It would also cost $113,998 in lost tax revenues as affected industries such as retail, banking, insurance, and other sectors engage in slightly lower levels of taxable business activity.

The results scale in proportion to the shock. For example, if we simulate a $10.0 million shock instead of just $2.0 million, representing nearly 50% of the two counties' combined annual livestock production value, then the losses would rise to $16,905,300 in output and 85 jobs, plus $569,990 in foregone tax revenues.

Regardless which approach one uses, linear or holistic, economic connections between the two counties mean that what happens to agricultural lands in one will reverberate through the other as well.

8. What "ecosystem services" do agricultural lands provide to society?

So far, we have discussed "market" values of Inyo and Mono County agricultural lands, i.e. goods and services that people can easily buy or sell. Agricultural lands also produce "non-market" services, i.e. things that we do not normally buy or sell but nevertheless have significant value. This section explores a category of non-market values called ecosystem services. If does three things: 1) introduce the concept and its overall use; 2) describe types of ecosystem services likely to occur on Inyo and Mono agricultural lands; 3) provide a suggested methodology for quantifying the dollar value of ecosystem services provided by Inyo and Mono agricultural lands. On the whole, section takes an initial step toward greater recognition of the myriad non-market economic contributions that agriculture makes to society.

Introduction to Ecosystem Services

Several definitions exist but we focus here on the one used by the California Department of Food and Agriculture (CDFA), in particular its Environmental Farming Act Science Advisory Panel. CDFA defines ecosystem services as "the multiple benefits we gain from farming and ranching including crop and livestock production." This definition acknowledges that management decisions and conservation practices by farmers and ranchers provide open space, wildlife habitat, recreational opportunities, and many other benefits to society that often go uncounted.

Recognizing the importance of ecosystem services in agriculture, the U.S. Department of Agriculture (USDA) has launched multiple initiatives to elevate our understanding of these functions. These include designing and testing new markets for greenhouse gases, water quality, biodiversity, and habitats. A key priority (and Farm Bill requirement) is to create a system for quantifying, registering, and verifying environmental benefits produced by land management activities. USDA believes such a system could lead to multiple benefits, including becoming a new economic driver for rural America.

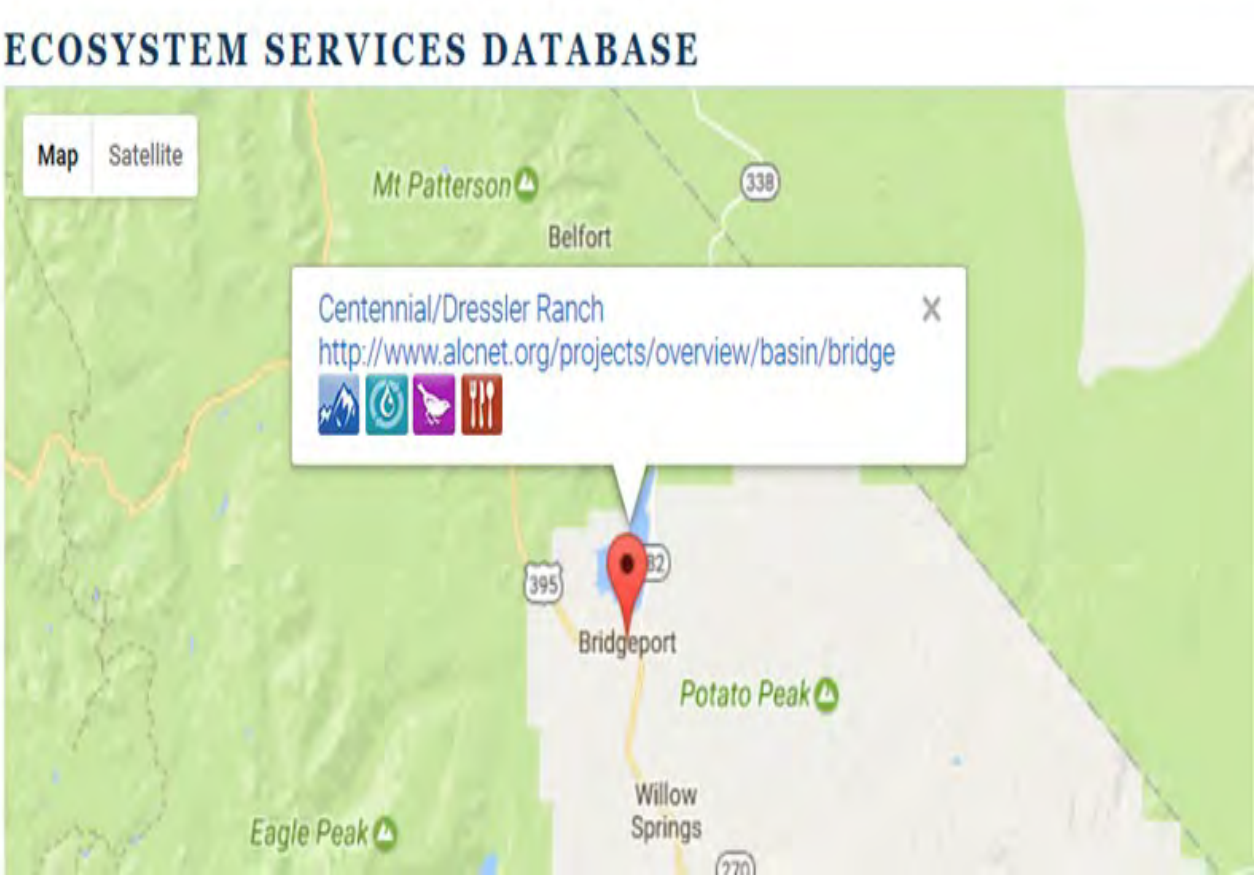
California is on the forefront of supporting and valuing ecosystem services on agricultural lands. In August 2011, the California Department of Food and Agriculture (CDFA) created the Environmental Farming Act Science Advisory Panel (EFA-SAP). The panel exists to document, study, recognize and incentivize environmental stewardship efforts on farms and ranches. For example, the panel has developed a Qualitative Assessment Model (QAM) to identify ecosystem services provided by various farming practices. The QAM illustrates the net environmental benefits from management practices implemented by growers and ranchers to enhance the environment. This in turn, can help CDFA educate a wide audience about net social, economic and environment benefits (and tradeoffs) of on-farm management practices.

In 2013, CDFA announced what is believed to be the nation's first ecosystem services database for agriculture. The CDFA Ecosystem Services Database documents and communicates the many social and environmental benefits offered by growers and ranchers in California, including food production. One on hand, the new database helps CDFA discuss multiple benefits provided by California agriculture. On the other hand, it assists growers, ranchers and others who want to learn more about ecosystem services.

Information in the database comes from farm and ranch websites, growers who voluntarily enter their farm details via the website, and online case studies. Users can search the database by key word and categories as well as through the interactive map. The database then identifies different benefits from the farm management practices, such as, food, fiber, fuel, nutrient cycling and water quality for each farm. An interactive map allows users to view where the services are taking place throughout California.

At the time of writing, the database contained only one example from Inyo or Mono: the 6,350-acre Dressler Ranch (**Figure 2**). Located in Bridgeport Valley on the east slope of the Central Sierra Nevada, the historic Centennial/Dressler Ranch provides several ecosystem services, including wetland habitat and miles of riparian areas along waterways such as the East Walker River.

Figure 2. Samples Ranch in the CSFA Ecosystems Services Database



NOTE: At the time of writing, CDFA's Ecosystem Services database had 400 California farms but only one in Mono County and none in Inyo County. CDFA encourages growers and ranchers to visit the website, enter their farm details, and gain recognition for their ecosystem service

SOURCE: https://apps1.cdfa.ca.gov/EcosystemServices/

Ecosystem Services in Inyo and Mono Counties Agriculture

The discussion so far has provided a general overview of ecosystem services and how federal and state agencies support them. This section drills down to the deeper level. Based on CDFA's categories, it describes specific types of ecosystem services that agricultural lands provide in Inyo and Mono Counties.

Figure 3. Ecosystem Services Provided by Inyo and Mono Counties' Agricultural Lands

Each category contains many sub-elements. In a specific example, Inyo and Mono agricultural lands help with air quality by abating dust. Also, many of the categories above consist of multiple, smaller categories. The box below, for example, describes nine different kinds of "Recreation & Cultural" services that Inyo and Mono Counties agricultural lands provide.

BOX: Specific Examples of "Recreation & Cultural" Ecosystem Services

Cultural Diversity. Local agricultural diversity supports rich cultural diversity rooted in ranching, farming, and other cultures.

Spiritual and Religious Values. Many residents have a profound relationship with the land that includes a powerful spiritual or religious component.

Educational Value. Schools and local communities explore and study the county's agricultural landscapes, using them as living laboratories.

Local Historical Value. Generations of growers and ranchers working the land have provided valuable local knowledge that is not written in books, but rather passed down.

Inspiration. The county's striking agricultural landscapes provide a rich source of inspiration for art, folklore, architecture, music & advertising.

Recreation and Ecotourism. Agricultural lands help support ranch stays, horseback riding, bike rides, and other leisure activities.

Aesthetic Values. Beautiful agricultural landscapes provide critical "open space" for the community, even to the point of affecting where people decide to live.

Sense of Place. Many residents value the "sense of place" associated with the county's striking landscape, including its beautiful agricultural lands.

Assigning Dollar Values to Ecosystem Services

Economists have attempted with varying success to assign monetary values to benefits from ecosystem services. Studies have quantified the value of recreation, impact on property values, natural water filtration, aesthetic values and other many other benefits. The total value of all ecosystem services worldwide is estimated to surpass $33 trillion per year.

This raises an important question: what is the annual dollar value of ecosystem services provided by agricultural lands in Inyo and Mono Counties? No one has yet attempted to answer this question. Collecting primary data on every ecosystem service type would require considerable time and effort. Fortunately, economists have developed a cost-effective approach that takes full advantage of existing research. Called the Benefit Transfer Methodology, the approach estimates economic values by transferring existing benefit estimates from studies already completed for another location or issue.

For example, if several studies have already quantified the per acre value of ecosystem services on cattle ranches in Nevada, Wyoming, Arizona, or elsewhere in California, then perhaps some findings may transfer to Inyo and Mono cattle ranches, given reasonable changes in the weightings based on differences among the cattle ranches.

Applying the Benefit Transfer Methodology in Inyo and Mono Counties would entail three steps. First, researchers would document types and amounts of ecosystem services provided by the county's agricultural lands. How much carbon sequestration takes place? How many tourists visit local farms and ranches? What's the dollar value of helping keep dust on the ground instead of blowing through the air? How many people attend farmers markets and related cultural events? This step entails counting acres, species, people, events, and other things. Some of this information may already exist in the offices of local non-profit organizations, university researchers, and government agencies.

The second step would entail reviewing existing literature to determine dollar amounts typically attributed to each ecosystem service. This requires locating and reviewing a large number of studies, perhaps as many as several hundred scholarly publications. It also involves screening each study for its relevance and quality, and determining how applicable they are to Inyo and Mono Counties. Several databases and software programs can help inform and validate estimates. Examples include InVEST (www.naturalcapitalproject.org) and ARIES (www.ariesonline.org).

The final step is to "localize" these values. This entails assigning dollar values to ecosystem services provided by the county's agricultural lands. Transferring the results of other studies to Inyo and Mono Counties requires making careful, systematic judgments regarding the relevance and credibility of specific measures from other sites and studies. It's a rigorous approach using a decision-tree that considers the quality of the study site data and the correspondence between the study site and Inyo and Mono Counties. One must check each study for data issues, site correspondence issues, temporal issues, and spatial issues.

The bottom line is that the methodology combines complexity and rigor with feasibility and cost-effectiveness. In summary, to determine what the annual dollar value is of each of the ecosystem services provided by the county's agriculture would require a significant amount of resources. The cost may range from $35,000 to $50,000 for a desk study that utilizes existing methodology and literature (Benefit Transfer Methodology), or more than $250,000 for a comprehensive study that generates primary data.

A Final Word on Ecosystem Services

This section has described several aspects of ecosystem services on agricultural lands. The four main points are:

- USDA, CDFA, and other key agencies are providing tools, momentum, and high level support for valuation of ecosystem services.

- Agricultural lands in Inyo and Mono Counties provide several types of ecosystem services to society, all of which directly support human well-being. Many residents and visitors may take these benefits for granted and have never before seen them listed as they are here.
- All these ecosystem services make an extremely large economic contribution to Inyo and Mono Counties every year, but no one has yet attempted to quantify the total dollar value of this contribution.

- We have described a rigorous, cost-effective methodology for calculating the annual dollar value of ecosystem services provided by agricultural lands.

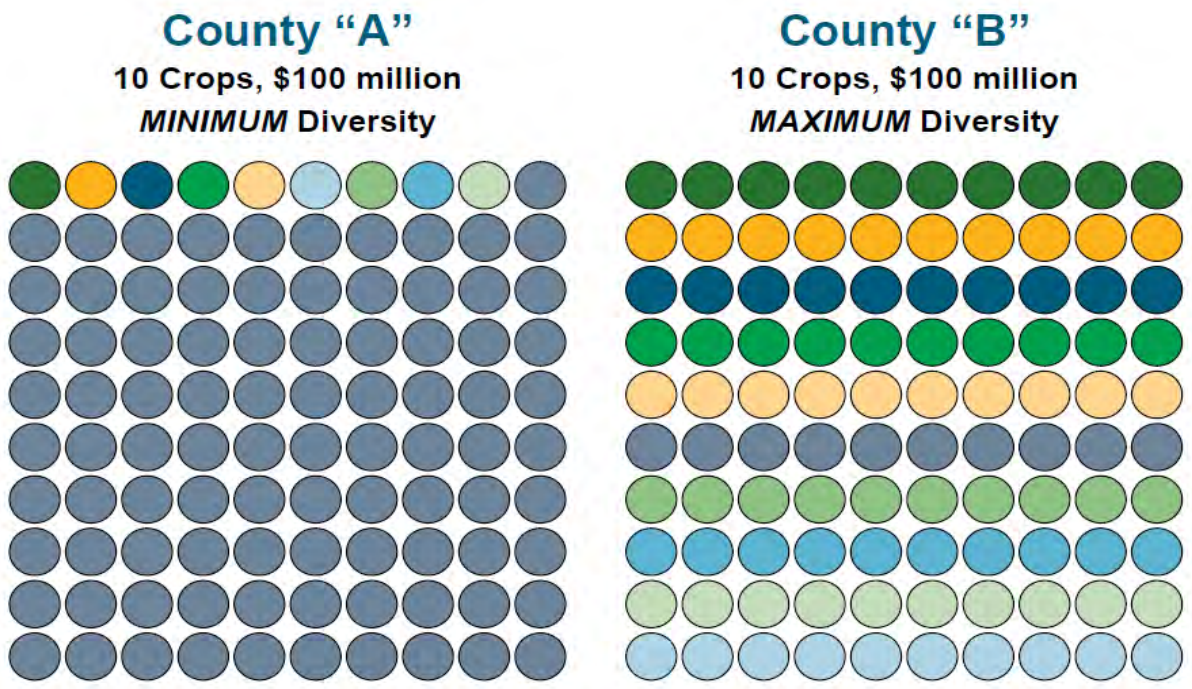
9. How economically diverse is agriculture?

Economists disagree on things but there's one thing they all can agree on: a diverse economy is a resilient economy. Any region that depends on a large number of economic sectors reduces risk of catastrophic shocks. This important economic principle applies to agricultural diversity, too. For example, a county with just one or two main crops faces higher vulnerability to shocks in the form of price drops, disease outbreaks, new regulations, new competitors, spikes in the cost of key inputs, and other unpleasant surprises. Meanwhile, a county with a diverse agricultural industry can withstand shocks to certain crops without unraveling the entire agricultural economy. Bottom line: having "all your eggs in a single basket" is never a good idea, especially when it comes to something as economically important as agriculture.

Unfortunately, robust measures of Inyo and Mono Counties' agricultural diversity do not exist, let alone the total economic value of such diversity. People see assorted crops growing in well-tended fields. They see cattle grazing and farmers markets overflowing with different kinds of food. But no one has attempted to quantify that diversity or its economic value. Part of the reason is that measuring diversity is a complex job. It requires more than just counting the different things for sale at the farmers market or listed in the annual *Crop and Livestock Report*. Measuring diversity includes the number of different crops grown as well as the assessing their economic *abundance* or *evenness*.

For example, imagine two California counties where the annual farm production value is $100 million each. Both counties grow ten different kinds of crops. In County "A," a single crop contributes 91% of the revenue and the nine other crops make up 1% each (see **Figure 4** below). In County "B" the ten crop types all contribute equally, at 10% each. *Both counties have the same number of crops and total revenues, but County "B" has much higher economic diversity*. Thus, we could expect County "B" to be much more resilient to economic shocks than County "A".

Figure 4. Agricultural Economic Diversity is More Than Just the Number of Crops



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

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

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

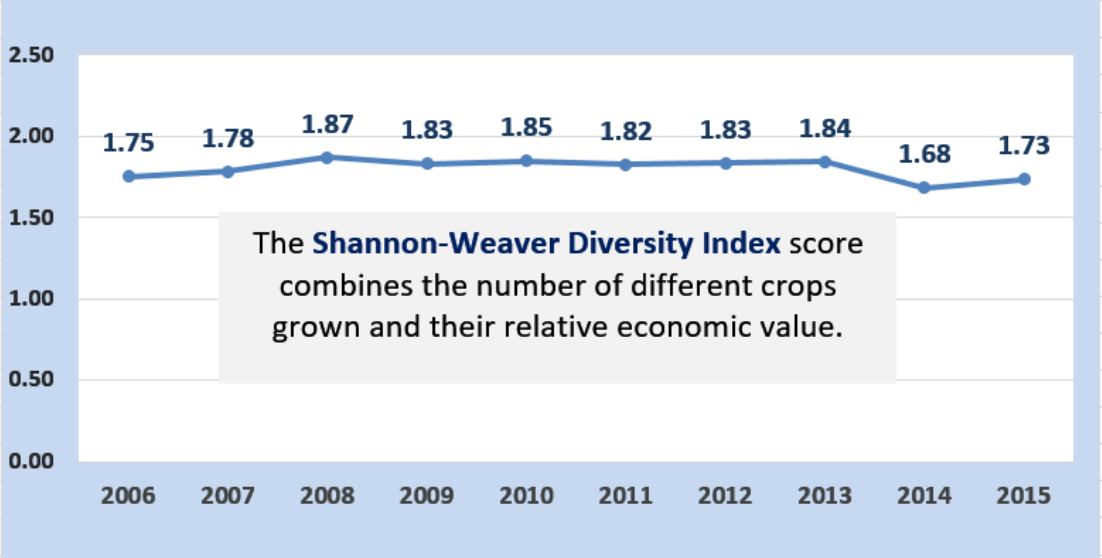
To measure agricultural diversity in Inyo and Mono Counties, we started by creating a list of specific products mentioned in the annual *Crop and Livestock Report*. We only used products for which production values were provided for the past decade, even though the total number of commercial products is certainly much larger. For example, we tracked alfalfa hay from its 2015 total ($13.2 million) all the way back to 2006 ($10.3 million), for each county individually as well as combined. Careful lumping and splitting resulted in 15 different categories consistently reported over the past decade. Next, we applied the list of products and their production values to the formula above. This resulted in a 2015 Shannon-Weaver Diversity Index score of **1.73**.

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

Speaking of earthquakes, note that formula above includes a logarithmic function ("ln"), similar to the Richter Scale for measuring earthquakes. Many Californians understand that a 7.4 earthquake releases twice the energy of a 7.2 earthquake even though the numbers are not far apart. The same principle applies to Shannon-Weaver Diversity Index scores: a tiny numeric difference represents a big change.

Figure 5 shows how the Shannon-Weaver Diversity Index score has fluctuated over time. It has remained essentially flat over the ten-year period, starting and ending near the same general level (1.75 to 1.73). This suggests a generally stable level of economic diversity within agriculture. Note that the diversity index climbed slightly from 2008 to 2013 before returning to normal levels. This does not mean that more product types were being grown at that time, but rather that existing products balanced their respective pieces of the economic pie. We have calculated scores for several California counties and rarely see such a steady overall trend. Scores for many counties have dropped over time as a small number of crops gained economic prominence, for example strawberries in several coastal counties.

Figure 5. How Economically Diverse is Agriculture in Inyo & Mono Counties?



A discussion of the Shannon-Weaver Diversity Index should include caveats and limitations. Although this index provides a useful measure of the county's agricultural diversity over time, comparisons to other counties are problematic due to different methods of reporting. Counties vary in the level of detail with which they report their agricultural products. The more economically important an agricultural product is, the greater detail with which counties tend to report it. For example, Inyo and Mono Counties lump wine grapes with other products in a single "Miscellaneous" Fruit & Nut Crops category. Major wine-producing counties such as Napa and Sonoma, however, specify production values across several different wine grape types, which raises their diversity score.

Caveats aside, the key points combine good news with not so good news. The 1.73 score is low compared to others we have seen. This means that compared to other California counties, Inyo and Mono agriculture faces high vulnerability to economic "shocks" such as those discussed earlier. On the upside, the score has remained stable over the past decade, with no sign of decline.

10. What options exist to add economic value to local agricultural production?

As Section #9 detailed, Inyo and Mono agriculture has low economic diversity, which puts the agricultural economy at risk. Droughts, recessions, and other "shocks" may inflict even worse damage than they otherwise would. Any efforts to strengthen agriculture though economic diversification could help address this challenge.

Local policy makers, agricultural producers, and other stakeholders have long expressed interest in economic diversification. Even the Mono County General Plan lists a strong and diverse economy as a top strategic direction. Mono's latest economic development strategy also calls for diversifying the economy and creating a regional food system (see www.monocounty.ca.gov). These mandates underscore the region's commitment to addressing this vulnerability.

Despite longstanding interest and high-level mandates, little agricultural diversification has occurred. Stakeholders understand the need to diversify and the exciting opportunities it presents, but conditions on the ground have not changed. Reasons vary but a lack of knowledge could be part of the problem. Few stakeholders probably know the range of diversification options already discussed and attempted in Inyo and Mono. Even fewer stakeholders might grasp the rich diversity of proven options that ranchers and farmers in

other locations have developed. In short, the current state of knowledge about diversification opportunities is anecdotal and scattered.

This section takes a step toward filling that knowledge gap and consists of three components. First, we provide background on agricultural diversification, including a typology of five main strategies. Second, we describe 21 tactics within the five broad diversification strategies – specific approaches that farmers and ranchers have successfully used. Third, where relevant we include discussion of how various tactics apply in the Inyo and Mono context. We hope the content provides a common framework and jumping off point for future discussions by local farmers, ranchers, non-profit staff, agency staff, and others interested in economic strength through diversification.

Background and Conceptual Framework

Methods: Developing this section consisted of three main methods. First, we consulted local experts from a range of public and private sector organizations. The experts represent decades of experience and deep knowledge of agriculture's past, present, and potential future. Second, we reviewed the relevant academic and gray literature. Gray literature included annual reports, evaluations, business plans, white papers, websites, government policies, and a local beef feasibility study. Within the vast academic literature, we focused mostly on agricultural diversification studies. Hundreds of publications have documented challenges faced by farms and ranches in the U.S. West and beyond, and have explored economic diversification as a potential solution. We found more than thirty articles just on ***Tactic #1*** on the following page, diversification of ***grazing systems***. If we could pick just one article for stakeholders to read, it would be a 2012 piece by Sayre *et al*. titled, "The Role of Rangelands in Diversified Farming Systems: Innovations, Obstacles, and Opportunities in the USA." We consider this review article to be the definitive piece on agricultural diversification. It emphasizes ranching but applies to farms, too. Our typology of strategies and tactics stems mostly from this article, as do many of the examples. We adjusted their typology in various places but kept it mostly intact.

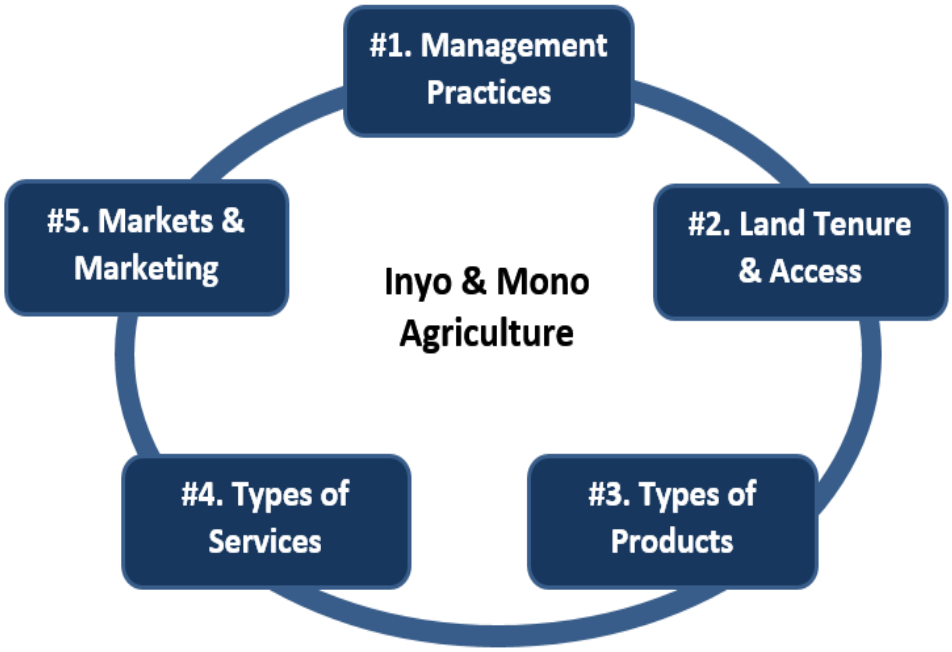
Finally, we drew from our extensive professional experience with this topic. This includes, for example, economic studies we have completed for several California counties. The studies all included a section on "locally sourced, value-added food processing." For each study, we calculated the direct economic output from a county's food processing activities, as well as employment and multiplier effects. These analyses covered diverse production types, from boutique wineries in San Diego County, to sheep and lamb processing in Solano County, to triple-washed leafy greens in Monterey County.

Our experience extends far beyond California. One co-author (Jeff) has visited ranches across the U.S. West and in over a dozen countries to document economic diversification strategies. From Kansas to Kenya, California to Costa Rica, Nebraska to Namibia, he has identified over 24 alternative revenue streams that ranchers have developed. Many of these do not appear in any published literature.

Three caveats are in order. First, this does not pretend to be an exhaustive discussion. We mention current diversification examples from Inyo and Mono but the list is not complete. The same applies to examples in the U.S. and beyond. Farmers and ranchers try new things all the time and we cannot possibly know about every project. We welcome additions to the list. Second, a rigorous analysis of local diversification opportunities lies well beyond our scope here. By design, we do not rate or rank the options, perform feasibility tests, or even make detailed recommendations. Instead, we provide the menu of diversification options for local stakeholders to consider, with a few general recommendations at the end.

Figure 6 shows the five main agricultural diversification strategies based on the Sayre *et al*. 2012 article mentioned above. These major categories provide a useful framework. We liken them to the annual *Crop and Livestock Reports* that California counties produce each year. Those reports tend to lump dozens of agricultural products into the same five or six major categories such as Fruit & Nut Crops, Vegetable Crops, Animal Products, Nursery Products, Field Crops, and so on. Doing so provides a valuable structure, common language, and shared understanding. The same principle applies here. The following five sections go through each strategy in turn.

Figure 6. Five Major Strategies for Agricultural Diversification



Source: adapted from Sayre et al. 2012. "The Role of Rangelands in Diversified Farming Systems: Innovations, Obstacles, and Opportunities in the USA." Ecology and Society 17(4): 43.

STRATEGY #1. Diversification through innovative management practices.

Focused on ranching, this strategy entails adjusting the timing, frequency, and intensity with which livestock eat, as well as the grazing location. It takes many forms in the U.S. but the various approaches tend to have a few things in common. For example, the new management approach may emphasize reducing operating costs for purchased inputs, human labor and other factors. A second common theme entails improving rangeland productivity by restoring riparian and other damaged areas. Finally, many ranchers innovate around environmental sustainability practices that generate additional income, for example ones that increase ecosystem services (Section #8) in ways that augment direct income.

- ***Tactic #1 – Grazing systems***. Ranchers move livestock around on a regular basis depending on myriad factors. Recent innovations, however, have taken movement patterns to a new level of sophistication and effectiveness. Thousands of ranchers in the U.S. and far beyond now use an approach called Holistic Management (see www.holisticmanagement.org). Also known by various other names such as regenerative agriculture and planned grazing, the concept entails grazing cattle in ways that mimic natural processes. In particular, this type of grazing mimics herds of bison, elk, wildebeest, and other wildlife that created and maintained the world's grasslands for millennia. The idea is to have dense livestock herds that move quickly from one area to the next. Animals bunch close together, mimicking protection from predators, for example bison defending themselves from wolves or wildebeest surrounded by lions. Stocking rates run four times denser than what California ranchers typically use, with significant financial implications.

  According to chief proponent Alan Savory and many scientific studies, the short duration, intensive grazing approach can increase ground cover, improve water retention, enhance soil organic matter, replenish streams, and protect biodiversity, all while increasing ranch revenues. Savory's 2013 TED talk "How to Fight Desertification and Reverse Climate Change" lays out his approach and has 3.9 million views. It is well worth the 22 minutes.

Not surprisingly, several skeptics have called Savory's bold claims into question. Only time and additional empirical studies will determine which way the scientific consensus leans. Meanwhile, our direct experience stems from time spent at three California ranches that practice holistic management: the 4,000-acre Dorrance Ranch, the 10,000-acre Paicines Ranch (www.paicinesranch.org), and the 20,000-acre Santa Lucia Preserve (www.slconservany.org). To a lesser extent, we have also observed it at the 50,000-acre Segera Ranch in Kenya (www.segera.com).

On the upside, we witnessed this grazing approach restore heavily degraded lands back to productivity. It was especially striking to see ranches with clumps of deep rooted, perennial grasses that stayed lush and green throughout California's recent drought while nearby annual grasses turned brown. Results like this have significant cost saving implications for Inyo and Mono ranchers who cut hay and supplemental feed part of the year. On the downside, the frequent movement of herds and their electric fencing requires extra labor and planning. It also takes time, effort, and patience to train the cattle when and where to move.

- ***Tactic #2 – Multispecies grazing***. Many ranchers have diversified the types of species they stock. Instead of just cattle, they add goats, sheep, and other livestock. Mixing browsers with grazers diversifies herbivory impacts and tends to mimic natural, ecological processes. Joel Salatin's "Polyface" system offers a prominent example of this mix-species approach (see www.polyfacefarms.com).

  Sheep sound fine in theory but can cause serious concerns locally. Mono sheep and lambs accounted for $2.1 million in value for 2015 but face new restrictions on grazing opportunities that could limit production after 2017. After careful deliberation, the Mono County Board of Supervisors voted in March 2017 to terminate domestic sheep grazing on the county's Conway Ranch property. The decision came based on scientific evidence that the domesticated sheep could transmit pneumonia to endangered Sierra Nevada bighorn sheep located in and around nearby Lundy Canyon.

- ***Tactic #3 – Matching livestock numbers and needs to variable forage conditions***. Although ranchers constantly adjust herd sizes and movements, this tactic entails more rigorous matching of herd size and the timing of grazing with forage quantity and quality. Forage quality varies widely across locations and years. With this approach, ranchers track the nutritional quality of rangeland then adjust stocking accordingly. The goal is to ramp grazing demand to match peak nutritional availability then dial it back down as the peak ebbs. In short, this tactic is a more concerted approach to the forage balancing act that ranchers already do. Many ranchers are subscribe to "Herd Quitter," a popular newsletter on the topic by rancher Kit Pharo (see www.pharocattle.com).

STRATEGY #2. Diversification of land access and tenure arrangements.

This strategy entails diversifying beyond simple fee ownership of land, embracing a wide range of land rights that create flexibility and stability. Ranchers in the western U.S. rarely own enough land to support their herds throughout the year and that is especially the case in Inyo and Mono. As Section #5 noted, private ownership accounts for just 1.9% of all Inyo County acres 6.5% of Mono. By necessity, local ranchers rely on multiple tenure arrangements that combine public and private lands, ownership and leases. These allow them to use different elevations and vegetation types according to seasons and weather patterns. Although ranchers already use tenure diversity to a certain extent, others options exist.

- ***Tactic #4 – Conservation easements.*** A conservation easement is a voluntary agreement between a landowner and a qualified land trust, conservation group or government agency regarding the future uses of private property. A rancher or farmer who grants a conservation easement gives up development rights but keeps full ownership of the property as well as rights to live there, produce crops and livestock, and other activities. Among other things, locking up the development rights lowers the appraised value of the property, creating significant property tax benefits for the landowner. Thousands of farmers and ranchers in California and elsewhere have secured conservation easements through the Rangeland Trust (www.rangelandtrust.org) and many other organizations, including ones specializing in Agricultural Conservation Easements (ACE) for farmlands. In Mono County, the 6,350-acre Centennial / Dressler Ranch featured in Section 9 (**Figure 2**) provides an example of a local ranch under a conservation easement.

- ***Tactic #5 – Shared or common property regimes.*** Popular overseas, common property regimes have existed for centuries but U.S. ranchers have not used them much. That is changing somewhat as more ranchers band together for the common good. Sayre *et al*. describe an association of 40 ranchers that jointly leases grazing allotments on federal lands. They run their stock together, using less labor than what they would need to do so individually. When the grazing season ends, they sort the cattle move them home or to other pastures.

  For more than a century, a group of Wyoming ranchers has jointly moved its cattle 58 miles from spring pasture on the desert to summer pasture in the forest. The collaborative approach by the Upper Green River Cattle Association ranchers allows them to move cattle across lands under a range of jurisdictions, including lands owned by BLM, National Forest Service, State of Wyoming, and private landowners (see www.greenriverdrift.org).

- ***Tactic #6 – Grassbanks.*** A grassbank is an area of rangeland set aside by a public agency or conservation organization that ranchers can use under certain conditions. Just as a bank might lend money, a grassbank "lends" forage to ranchers. They do so at below market rates in exchange for ranchers agreeing to support certain conservation practices on their own properties. The Nature Conservancy pioneered the concept in 2002 on its 60,000-acre Matador Ranch in Montana. Local ranchers pay discounted fees to graze cattle on the Matador. In return, they implement wildlife-friendly practices on their own operations. As ranchers implement more conservation practices at home, their cost to lease the Matador grazing lands drops proportionally.

- ***Tactic #7 – Ownership partnership***. This tactic entails a farmer or rancher engaging an organizational partner in ownership of the property. Common partners include government agencies at the federal, state, or local level, tribal authorities, and colleges or universities. The key advantage is that an ownership partner can bring significant financial, intellectual, and other resources that help reduce the rancher's costs and strengthen revenues. Ranchers and farmers continue to live on the land, producing livestock and crops as they always have. But they incur fewer costs for upkeep, taxes, and other common expenses. They also enjoy greater opportunities through research, education, and other compatible activities that the partner organization implements on-site.

STRATEGY #3. Diversification of products.

This strategy consists of farmers and ranchers resisting long-term trends and market pressures that favor sale of a single commodity of uniform size, shape, color. Instead, they produce a diverse range of plant and animal products.

- ***Tactic #8 – Mixed or minor breed cattle and crops***. Rather than produce genetically similar calves destined for feedlots, as most U.S. rangeland ranching does, this tactic uses mixed or minor breed cattle such as Murray Gray, Belted Galloway, and Laola. Ranchers in the American Criollo Beef Association, for example, produce the hardy, desert-adapted Criollo breed of cattle, which is originally from Andalusia, Spain and first brought New World by Christopher Columbus (see www.leanandtenderbeef.com). Ranchers also create locally adapted herds of conventional breeds, for example by culling for smaller animals that fare better with limited forage or during droughts. Overseas, we have seen this with Nguni cattle in Swaziland and other southern Africa countries, a local breed resistant to drought and disease.

  In crop production, many farmers have shifted to heirloom and other traditional varieties that appeal to consumers who prefer a more traditional, often tastier, product. In Inyo County, the Bishop Paiute Tribe has been encouraging members to save traditional plant seeds that help preserve culture and could fill future niche markets.

- ***Tactic #9 – Multiple livestock species***. This tactic moves beyond traditional livestock such as cattle, goats, and sheep (Tactic #2) to include many exotic ones. Ranchers and farmers add hogs, bison, chickens, and others, in some cases herds of bison and elk. Under certain circumstances, these unusual products can increase incomes, sustain ecological resources, and reduce risk.

For example, a report we recently completed on the economics of Solano County agriculture noted a boutique goat farm that produces a wide range of cosmetics made from goat milk. The product line started with goat milk soap. Over the years, it has grown to include other goat milk products such as bath powders, body butters, salves, and lotions. Two other ranches produce and sell their own alpaca fiber, yarn, roving, and related products from alpacas. We have seen ostrich farms in California and southern Africa, and even a 400-acre Costa Rica ranch that produces large, tree-climbing iguanas for local restaurants and direct consumer sales.

- ***Tactic #10 – Breeding stock***. This tactic entails ranchers entering the market earlier in the animal lifecycle by selling breeding stock to other producers. Pharo Cattle Company, for example, has North America's largest selection of grass-based genetics. Semen from these animals can help ranchers reduce frame size, increase thickness, and improve calving ease, which in turn lower costs and increase profits (see www.pharocattle.com). An emphasis on breeding creates interesting hybridization opportunities. For example, the owners of Matheson Farms have crossed a bull from their Himalayan yak herd with a beef cow and now sell individually wrapped cuts of Yak Beef and ground Yak Beef (see www.mathesonfarms.com).

- ***Tactic #11 – Value-added animal products***. Few ranchers finish their own animals, but those who do can diversify into value-added animal products such as meat, pet food, bacon, and sausage. For example, the Sun Ranch north of San Francisco cuts, wraps, and sells a vast array of beef, poultry, pork, products, including specialty items such as pepperoni, jerky, and uncured hot dogs (see www.marinsunfarms.com). In Inyo and Mono, a few small, local markets will process meat for 4-H and FFA animals but no significant, commercial processing occurs. The Environmental Health Department confirmed that no meat processors are currently registered and permitted.

  Local meat processing is an especially promising area for Inyo and Mono. Ranchers currently send cattle to Harris Ranch in the Central Valley or to the Walker River Meat Processing plant in Yerrington, Nevada. Many sales, if not most, now occur via video auction. As one local expert told us, "Our livestock go everywhere but here…"

  In 2009, Inyo County commissioned a study to explore the feasibility of local meat processing. The resulting "Natural Livestock Feasibility Study" by Jeff Schahczenski is available online in PDF (see: https://attra.ncat.org/attra-pub/summaries/summary.php?pub=202). Despite the small sample size of just ten ranchers, the study offers interesting insights into capturing greater value through new products and markets, especially through sale of grass-fed, natural, and organic beef. For example, ranchers surveyed for the study preferred slaughtering services over marketing assistance. They also preferred a stationary processing facility over a mobile one. The 21 merchants that completed a survey indicated a preference for local meat products. A large ski resort in Mammoth, for example, expressed desire to purchase all local beef. It was unclear, however, if the price local merchants were willing to pay would justify the costs of a processing facility. A mobile facility could cost $250,000, a stationary one $300,000 to $1.5 million. Overall, the study concluded that an initiative focusing on local, sustainable meat processing was not feasible at that time, but future research and educational efforts could change that.

- ***Tactic #12 – Value-added plant products.*** Farmers in many parts of California and elsewhere have ample experience adding value to their raw plant products. Our economic analysis of agriculture in other California counties has documented a wide range of value-added products. Popular examples include baked goods, jams, jellies, trail mix blends, fruit and nut gift baskets, walnut oil, olive oil, popsicles, dog treats, salsas, "craft" beers brewed with local hops, and many others. A few growers even sell stevia and cactus products.

  Similar to meat processing, hardly any processing of local fruits, vegetables, and other plant products occurs in Inyo and Mono. We located only minor, small-scale operations. For example, a producer near Death Valley packages and sells dates through retail outlets. The area's honey producer does his own packaging and sells retail, but on a small scale. One grower produces hops, some of which supply the region's micro-breweries. Regarding beer, the annual June Lake Autumn Beer Festival hosts breweries and visitors from across California, reinforcing the economic role that local, craft brewing can play.

Despite the dearth of local food processing, significant potential certainly exists. In fact, nearly every crop listed in the Inyo and Mono annual *Crop and Livestock Report* has value-added potential. In other California counties, we have seen examples of local producers adding value to crops listed for Inyo and Mono, in particular: almonds, apples, apricots, blackberries, cherries, figs, grapes, nectarines, peaches, pears, pecans, persimmons, plums, pomegranates, raspberries, strawberries, walnuts, garlic, herbs, leafy greens, pumpkins, sweet corn, tomatillos, and tomatoes.

We have even seen value-added to field crops. For example, many Central Valley growers compress hay into small squares for export to lucrative international markets, mostly Asia. Despite the potential profits, we do not recommend this for Inyo and Mono because of the already constrained hay supply. Shipping it overseas could create serious consequences for ranchers whose livestock depend on local hay.

Two crops likely present the biggest opportunity: wine grapes and cannabis. To our knowledge, the region has just one significant wine grape producer and several smaller, hobby-scale vineyards. The larger producer sells wine at a local bakery, whereas the hobbyists consume or share what they produce. Thanks to new varietals and other factors, wine grapes and wineries have expanded rapidly across California and the U.S., often into areas where no one thought wine production possible. Thus, the fact that local winemaking now occurs in Inyo and Mono bodes well, despite its current small size.

Economic studies we have done for other counties indicate that when it comes to locally sourced, value-added food processing, wineries offer an especially common and fruitful path. They create significant, direct economic output with high employment and multiplier effects. San Diego County wineries, for example, converted just $4.3 million worth of wine grapes into $70.4 million in direct winery output plus another $49.5 million in multiplier effects. In Contra Costa County, wineries converted $10.3 in grape production into $34.5 million in direct winery output, or $50.2 million including multiplier effects. Dramatic results like these occur in county after county. Part of wineries' economic value includes hosting wine tastings, weddings, and other events. Even a small wine industry in the Eastern Sierras could create large, lasting impacts.

Cannabis cultivation is poised to explode in California as new policies take effect. Now that Californian voted to legalize recreational marijuana use, growers across the state are considering entering this market due high potential profitability. No one can predict how this will play out. We are concerned that euphoria and optimism are running so high, and production ramping so fast, that it

could overshoot demand, adversely affecting smaller producers. We also have concern about a "substitution effect" whereby a large-scale shift into cannabis cultivation results in farmers growing less food due to the lower profit margins of typical food crops. This, in turn, could tighten supply and raise food prices. On the upside, a local expert in Inyo County expressed hope that profitable cannabis cultivation might motivate Inyo and Mono's aging farmers to defer retirement a while longer. It could also provide enough revenue to younger, small-sized producers that they can more comfortably afford to grow lower margin, higher nutrition food crops.

Despite these concerns, the sheer magnitude of the economic opportunity makes it hard to resist. The market for concentrates, edibles, drinkables, and other cannabis-infused products certainly creates an interesting opportunity for Inyo and Mono. Both counties voted strongly in favor of legalization, so overall receptivity is high. Only time will tell if cannabis creates net positive effects for Inyo and Mono. In the meantime, a detailed feasibility study, combined with relevant analysis of policy alternatives, could help steer the cannabis juggernaut in a positive direction.

- ***Tactic #13 – Nonagricultural products.*** A growing number of ranchers have diversified into energy production, mining, photos, and other non-agricultural products that provide significant, supplemental revenue. We have seen oil and gas wells, wind turbines, and other infrastructure situated in ways that seem compatible with livestock ranching and crop farming. One of the ranches mentioned in ***Tactic #1*** generates supplemental revenue from a telecommunications tower located high atop the ranch. Farms and ranches with agritourism enterprises (see ***Tactic #14*** below) also sell photos and other merchandise. A few of Inyo and Mono's iconic ranches have appeared in film productions, and Mono County even has a film commission to facilitate such efforts.

STRATEGY #4. Diversification of services.

- ***Tactic #14 – Agricultural tourism and recreation***. Farmers and ranchers can diversify revenue streams through hosting visitors who come for a wide range of experiences such as hiking, birdwatching, and other recreational activities. Western ranches, for example, offer 'dude ranch' experiences where visitors pay to ride horses and experience the traditional ranching lifestyle. A prominent Mono County example is Humewill Ranch. Guests at this sixth-generation Bridgeport property can ride horses for pleasure or assist with cattle work such as moving cows and calves to fresh grass, sorting cattle from a herd, or loading calves into a trailer as a timed event. Other ranches offer guided fishing, birdwatching, and natural history tours. Many farms host weddings, picnics, and various catered events, while also offering U-pick and other farm activities. We heard interest in moving beyond the traditional "pumpkin patch and apple cider" experience into "working farms" that act more like dude ranches. Overall, agritourism on ranches and farms represents a natural and promising growth area for Inyo and Mono Counties. It can help preserve local ranches and ranching culture, create economic synergies with the region's already strong tourism industry, and help diversify both the agriculture and tourism industries.

- ***Tactic #15 – Hunting and fishing***. Whether informal or formal, commercial or subsistence, ranchers and farmers can generate supplemental revenue from aquatic and terrestrial wildlife. Hunting tends to be compatible with livestock ranching and provides an incentive to manage for wildlife habitat. Many ranchers and farmers hunt wildlife for their own table but a growing number charge hunters fees based on time (i.e., daily, seasonal, annual access) or receive payments from an outfitter or broker for access. State laws and game agencies regulate hunting of wild game. Most laws treat exotic game species as if they are livestock (e.g., oryx, wildebeest, bongo, impala, eland, kudu), which gives owners greater control over the timing and extent of harvest.

  In early 2017, we analyzed the economics of bird hunting (mostly pheasant and chukar) in part of the Sacramento - San Joaquin River Delta and determined that hunting had a 0.74 multiplier on economic output. In other words, every dollar that hunting brought into the local economy also added an extra 74 cents to the local economy through supplier purchases and consumer spending. Similar effects could occur in Inyo and Mono.

- ***Tactic #16 – Ecosystem services.*** The non-market economic contributions that ranchers and farmers make through ecosystem services, as detailed in Section #8, sometimes result in revenue. Several examples exist of operators receiving payments for providing habitat for wildlife, pollinators and plants. Others receive payments for carbon storage and sequestration. Still others earn payments for ecological restoration work. Finally, some generate revenue from cultural preservation activities. The U.S. Department of Agriculture implements many of these incentive and financial assistance programs, especially through its Natural Resources Conservation Service. Instead of cash payments, some programs offer technical assistance and cost sharing for conservation projects.

- ***Tactic #17 – Miscellaneous Other Services.*** The Sayre *et al*. 2012 article lists several other tactics, which we combine here into a miscellaneous section. Examples include "horse boarding," "Education and research," and "Control of fire risk and invasive weeds." "Services for other ranchers" includes consulting, monitoring, video production and training facilities for horses and cows. We encourage interested readers to consult the article for further details.

STRATEGY #5. Diversification of markets and marketing

Whereas the previous strategy focused on creating new value, this one focuses on capturing value. It does this through new, alternative markets and conservation-friendly production practices. When a customer spends a dollar on food, the overwhelming majority of that dollar goes to processing, distribution, and marketing. This strategy helps producers increase their share of that food dollar.

- ***Tactic #18 – Third party certification and marketing***. Many third-party certification and marketing systems now exist to help ranchers and farmers capture price premiums from niche markets. Prominent examples include American Grassfed (www.americangrassfed.org), and Certified Humane (www.certifiedhumane.org), as well as wildlife-friendly and predator-friendly certifications. The U.S. Department of Agriculture has certified over 2 million acres of rangeland and pasturelands as certified organic, as well as over 15 million poultry and half a million head of cows, hogs, and sheep. Inyo and Mono seem to have negligible organic production, if any at all. Annual *Crop and Livestock Reports* do not specify certified organic crop types or acreages.

- ***Tactic #19 – Cooperatives and producer marketing boards***. Alternative marketing arrangements can benefit small-scale producers, for example through capturing more down-stream value, maintaining ownership of new technologies, and having more marketing power than they could generate individually. This can include accessing niche markets. The Oregon-based Country Natural Beef cooperative, for example, enables 120 ranches in 12 states to sell on national and international markets under a brand that adheres to a common set of sustainability and animal welfare standards. The ranches treat cattle humanely, steward the environment, avoid using hormones and antibiotics, and are all family-owned (see www.countrynaturalbeef.org). Ranchers tend to be independent-minded and self-reliant but several examples across the U.S. West confirm their willingness to collaborate for their greater economic good.

- ***Tactic #20 – Direct to consumer food marketing***. This tactic skips one or more middlemen in the supply chain so producers can capture more value. Recent years have seen proliferation of direct marketing approaches across California and nationwide. Common examples include farmers' markets, community supported agriculture (CSA), retail operations (including farm stands and roadside markets), mail order, U-pick or pick your-own, and direct sales to restaurants and various other institutions. Producers also make greater use of local produce aggregation and delivery services such as Door to Door Organics (www.doortodoororganics.com) and Blue Apron (www.blueapron.com). One of our former graduate students, Alan Lovewell even created a marine CSA. Customers receive a weekly cooler of fresh fish caught by in the Monterey Bay by local fishermen (www.realgoodfish.com).

  In Inyo and Mono, the Eastern Sierra Food System Network (ESFSN) has explored ways to strengthen ties between local producers and consumers. A collaborative of public and private sector organizations, ESFSN strives to build community gardens, food co-ops, CSAs, and farmers markets, with an emphasis on increasing low-income residents' access to affordable, nutritious food.

- ***Tactic #21 – Local and regional brands.*** With tailwinds from the local food movement, a growing number of farming and ranching communities have developed their own brands. For both crops and livestock, the brand usually specifies a geographical feature. For example, 'Lava Lake' lamb products come from Lava Lake, 'Solano Grown' products come from Solano County, and so on. The 'Southwest Grass-fed Livestock Alliance' (SWGLA) offers an especially strong example. SWGLA is a non-profit alliance of ranchers, farmers, consumers, land managers, conservationists, researchers, and local food system providers working together to support local, grass-fed livestock products (see www.grassfedlivestock.org).

  The 2009 Inyo and Mono "Natural Livestock Feasibility Study" described earlier also examined regional marketing opportunities. Local ranchers preferred 'Eastern Sierra Beef' as a potential brand name. That said, the Eastern Sierras seem to lack a large enough human population to drive sufficient demand for local meat. It might make sense to market local products as part of the greater 'Tahoe Basin' foodshed as well, with its larger population base.

This section has explored options for strengthening Inyo and Mono agriculture through economic diversification. It summarizes five main diversification strategies: diversification through new management practices, tenure arrangements, types of products, types of services, and markets & marketing. We ground the five strategies with 21 specific tactics developed and tested by farmers and ranchers in various locations. The discussion can serve as a jumping off point for local stakeholders interested in advancing this topic.

Rigorous feasibility testing and specific recommendations both lie beyond our purpose here. Nevertheless, we offer four final thoughts. First, evidence suggests that significant need and opportunity exist in Inyo and Mono to diversify into more value-added products. We encourage stakeholders to make it a priority. Second, although considerable value-added processing can occur with small-scale products, we think wine and cannabis hold particular promise for larger scale impact. Third, eight years and a major drought have passed since that last assessment of the local meat processing idea. Local meat remains a highly promising option and warrants another look. Finally, agritourism on working ranches and farms hold considerable promise, especially given its light touch on the land, cultural connection, and clear synergies with the larger tourism sector.

Conclusion

This report has focused on ten questions about Inyo and Mono agriculture. The final section summarizes key takeaways from the study and poses priority research gaps to fill in the future. Ten major results, one for each section, are:

#1. **Direct production value.** For 2015, agriculture produced a combine total of $49.7 million across both counties, including $18.5 million from Inyo and $31.2 million from Mono. "Livestock & Livestock Products" was the largest category, contributing 48.3% of the counties' combined total.

#2. **Steady, overall growth.** Despite recent dips and variations across counties and categories, total farm production values have shown steady, long-term growth. From 2000 to 2015, the combined total output for both counties rose $14.1 million (39.6%). This growth outpaced inflation by 3.9%.

#3. Multiplier effects. Agricultural production creates ripples in the local economy. For example, every dollar's worth of economic output from Inyo Livestock and Livestock Products creates an extra 64 cents in purchases from suppliers and spending by agricultural employees, and 88 cents in Mono.

#4. Total economic output. Agriculture's multiplier effects totaled $9.0 million in Inyo and $19.9 million in Mono, for a combined total of $28.9 million. When added to the $49.7 million in direct output mentioned above, agriculture's combined total economic output rises to $78.6 million.

#5. Ownership of agricultural lands. Across both counties combined, federal agencies own most of agricultural land (88.7%) and rangeland pasture is the most common use (97.2% of total area). Among field crops, private lands contributed the highest dollar output (63.8% of the total), mostly through alfalfa hay production (66.6% of all output).

#6. Employment and taxes. Across both counties combined, agriculture provided 239 direct jobs plus an additional 210 from multiplier effects, for a total of 449 jobs. Total combined tax payments across local, state, and federal levels were $6,287,128.

#7. Cross-county interdependencies. Seasonal movement of cattle herds across county lines creates complex economic interdependencies. For example, an acre of Mono County irrigated pasture accounts for a combined $1,657 in production across both counties. Alfalfa contributes for $10,525.

#8. Significant non-market values. Agricultural lands provide society with wildlife habitat, scenic beauty, carbon storage, and many other "ecosystem services." Established methodologies exist for quantifying the economic value of these contributions. We recommend the Benefit Transfer Methodology for its combination of rigor and cost effectiveness.

#9. Economic diversity within agriculture. Combined across the two counties, the agricultural industry has an economic diversity index score of 1.75. While low, the number has remained stable over the past decade, unlike many California counties that have seen declines.

#10. Expansion through diversification. Agriculture faces expansion opportunities through five diversification strategies. In terms of specific diversification focal areas, local meat processing remains an especially promising area, along with agritourism, cannabis and wineries.

Priority Information Gaps to Fill.

Although this report has presented many facts and figures, it has barely begun to fill key information gaps about agriculture's economic role. The process of developing this report has raised several additional questions that lie beyond the scope of this report but may warrant future analysis. Priority research questions include:

- **A fuller understanding of inter-county linkages.** Due to its limited scope, this study has relied on limited data regarding livestock operations that straddle both counties. What is the full extent of this phenomenon? The unique economic opportunities and risks?

- **Analysis of inter-industry relationships.** The recent drought cost the agriculture industry an estimated $35 million in lost production. What ripple effect did this create across other Inyo and Mono industries. For example, how many jobs and millions of dollars did real estate, restaurants, trucking, and other local industries experience as a result of agricultural companies and their employees having less money to spend?

- **Changes in land access.** This report has highlighted the serious economic implications of reducing the amount of land available for lease by ranchers. Exactly how much reduction has occurred in the recent past? What might the future hold, for example designations of new critical habitat for endangered species?
- **Regional integration.** What needs to happen in order for Inyo and Mono Counties to function as a more integrated, economically aligned, regional food system that supports sustainability and synergies?

- **Cannabis.** Experts predict an explosion of cannabis cultivation in response to California's legalization of recreational marijuana use. What economic opportunities and risks does this create for local agriculture? Will it decrease the amount of food that local growers produce?

- **Ecosystem services.** What is the annual dollar value of wildlife habitat, open space, scenic beauty, carbon sequestration, cultural preservation, pollination, and other "ecosystem services" that the county's agricultural lands provide to society?

- **Diversity.** How diverse are Inyo and Mono Counties' agriculture not just in terms of economic production categories, but also across farm sizes, geographical markets, organic/conventional, and operator demographics?

- **Diversification.** What new policies, programs, and other initiatives hold the most promise for strengthening agriculture through diversification into new products, services, and other means? What's required to advance this topic in a significant way?

- **Economic shocks.** The recent drought highlighted agriculture's vulnerability to large, outside forces. What other "shocks" could dramatically affect agriculture's economic results? How big a hit to economic output would they cause? What's the best way to anticipate and mitigate against them?

In conclusion, for more than a century agriculture has provided a vital link between Inyo and Mono Counties' cultural past and economic future. This report has provided an especially detailed snapshot of agriculture's current economic role. Although it is by no means a complete analysis, the study provides local stakeholders with important information for understanding local agriculture's current economic role and strengthening it for the future.

Counties of Inyo and Mono
Agricultural Commissioner's Office
207 W South Street
Bishop, CA 93514

760.873.7860