



## The Contribution of Agriculture to Hawai'i's Economy: 2005

PingSun Leung<sup>a</sup> and Matthew K. Loke<sup>b</sup>

<sup>a</sup>CTAHR Department of Molecular Biosciences and Bioengineering, <sup>b</sup>Hawai'i Department of Agriculture

This sequel to two previous CTAHR publications, EI-2 and EI-3, provides an update to the estimates of agriculture's contribution to Hawai'i's economy.<sup>1</sup> As mentioned in the earlier publications, estimates of agriculture's contributions vary depending on what is defined as "agriculture" and on the methodology used to develop those estimates. Agriculture as defined in this current publication uses the latest industry classification based on the North American Industry Classification System (NAICS) including crop and animal production; forestry, fishing, and related activities; and food (including beverage and tobacco) product manufacturing<sup>2</sup> (Table 1).

As discussed in the earlier publications, the most comprehensive measure of the contribution of an in-

dustry is the value added or industry's gross domestic product<sup>3</sup> (GDP), as it avoids possible double-counting. For example, consider the product poi, which goes through three stages in the economy before reaching the final consumers. First, poi taro is grown, harvested, and sold to the poi factory at \$3.00 by the taro farmer. If the taro farmer has to purchase intermediate inputs such as huli, fertilizer, and fuel at a cost of \$2.00, the value added by the taro farmer is \$1.00 in terms of, say, labor input. Taro (an intermediate input) is then used by the poi processor to produce poi, which is sold to the supermarket for \$5.00. Thus, the value added by the poi processor will be \$2.00 (\$5.00 – \$3.00). The supermarket provides the packaging and shelf space to display the poi for us (the final consumers) to conveniently purchase the product

---

<sup>1</sup>The views expressed in this publication are those of the authors and do not necessarily reflect the position of the College of Tropical Agriculture and Human Resources, University of Hawai'i at Mānoa, or the Hawai'i Department of Agriculture.

<sup>2</sup>This definition differs from the earlier publication EI-3 (see [www.ctahr.hawaii.edu/oc/freepubs/pdf/EI-3.pdf](http://www.ctahr.hawaii.edu/oc/freepubs/pdf/EI-3.pdf)) due to the changeover from the previous Standard Industrial Classification (SIC) system to NAICS. In particular, landscaping services and veterinary services have been reassigned to services and are no longer considered part of support activities for agriculture and forestry under NAICS. NAICS is generally considered as an improvement on SIC as an industry classification system as it "more consistently classifies business establishments into industries on the basis of similar production processes" (Robert E. Yuskavage and Mahnaz Fahim-Nader, "Gross Domestic Product by Industry for 1947–86: New Estimates Based on the North American Industry Classification System," Survey of Current Business, December 2005, pp. 70–84, Bureau of Economic Analysis).

In addition, the estimates for the food product manufacturing industry under NAICS are no longer comparable to the previous estimates under SIC due to missing source data. The NAICS estimates were generated with complete source data and are considered more reliable estimates.

---

Some may argue that the definition of agriculture chosen here is somewhat narrow and may prefer a more expanded coverage. Unfortunately, a consistent set of time series information on the key economic measure of gross domestic product is simply not available beyond the present definition. It should also be noted that other non-market values of agriculture such as the aesthetic value of green space, and government services related to agriculture are also excluded in this analysis. Thus, while an expanded definition of agriculture will certainly produce different estimates, the estimates presented here can be considered as most conservative as well as most reflective.

Furthermore, as pointed out and argued in EI-3, we feel it is more appropriate to use traditional ratio measures of an industry's value added, employment, labor income, and sales to the economy's totals in addressing the contribution question rather than application of input-output multipliers as commonly used by economists to measure the impact of a particular industry.

<sup>3</sup>GDP by industry for each state replaces the former GSP (Gross State Product) by industry reported by the U.S. Bureau of Economic Analysis.

at \$7.00. The value added by the supermarket in this case will also amount to \$2.00 ( $\$7.00 - \$5.00$ ). The total sales of the taro, poi, and packaged poi would amount to \$15.00 ( $\$3.00 + \$5.00 + \$7.00$ ), which will overstate the value of production by triple-counting the value of taro and double-counting the value of poi. In this example, the total value added is only \$5.00, including \$1.00 of added value by the taro farmer and \$2.00 each by the poi processor and the supermarket. Value added can also be calculated as the difference ( $\$15.00 - \$10.00 = \$5.00$ ) between total final sales (\$15.00) and total value of intermediate inputs for all stages of production (\$2.00 by the taro farmer, \$3.00 by the poi processor, and \$5.00 by the supermarket, totaling \$10.00). As can be seen from this simple example, value added would be an appropriate measure of the value of production in the economy.

The U.S. Bureau of Economic Analysis (BEA) tracks the gross domestic product (GDP) by industry for each state and the United States as a whole. An industry's GDP is simply the value added in production by the labor and property located within a state of that industry. It is equivalent to the value of production minus the value of intermediate goods that producers buy from other producers. It can also be defined, alternatively, as the sum of employees' compensation, property-type income (proprietors' income, net interest, rental income, profits, and depreciation), and indirect business tax and non-tax liability. Summing the value added by all the industries in an economy, within a given time period, usually a year, will give us the GDP of a state, a commonly accepted measure of the size of a state's economy. The sum of GDPs of all the states is the nation's GDP, which measures the value of the goods and services produced in the United States.

In relation to agriculture, BEA tracks the GDP of crop and animal production; forestry, fishing, and related activities; and food product manufacturing under the NAICS as described earlier.

While GDP is the most comprehensive and generally accepted measure of economic output of an industry, tracking other economic yardsticks such as employment, labor income, and sales value provides a fuller picture of the performance of an industry.

Industry sales value is probably the most common measure of economic activities. For example, the Hawai'i Department of Agriculture reports routinely the farmgate values of production agriculture. Despite its double-counting problem, sales value measures the size of economic transactions of an industry based on which

general excise and use taxes are generally levied.

Employment (number of full- and part-time wage-and-salary plus proprietors' jobs) provides another good indicator for measuring the contribution of an industry to the economy. Labor income (earnings), which primarily consists of the income received by persons from participation in production, provides yet another measure of an industry's contribution to the economy.

Against this background, the purpose of this publication is to summarize and compare the four measures described above—value added or GDP, sales value, employment, and labor income—in assessing the contribution of agriculture to Hawai'i's economy for the years 1997, 2002, and 2005.<sup>4</sup>

### **Agriculture's contribution to Gross Domestic Product (GDP)**

As mentioned above, value added by each industry provides the most precise indicator of the contribution of that industry to the economy, or each industry's contribution to GDP. Table 2 shows the trend of the contribution of Hawai'i's agriculture to GDP<sup>5</sup> since 1997. Hawai'i's economy as measured by total GDP increased at an annual rate of 3.0% from 1997 to 2002 but has since grown quite rapidly at an annual rate of 8.0%. Agriculture GDP on the other hand reveals an opposite trend, growing at an annual rate of 2.8% from 1997 to 2002 but since then decreasing at an annual rate of 0.9%. While farm production was relatively stable throughout the period 1997–2005, food product manufacturing steadily increased and forestry, fishing, and related activities decreased quite rapidly. For the entire period, agriculture increased slightly at an average annual rate of 1.4%, while the total economy grew at the faster rate of 4.8% per year. Hawai'i seems to be following the national trend, where agriculture's growth falls behind the overall growth of the economy. During the same period (1997–2005), U.S. agriculture grew only 2.5% per year, while the entire U.S. economy registered an annual growth rate of 5.2%. A similar trend

<sup>4</sup>The years 1997 and 2002 were chosen because detailed sales figures are available for many of the economic sectors only from the corresponding state input-output tables. While data for 2006 are available for some of the measures, they are generally incomplete, and many of the data are preliminary in nature. Thus, we chose to report the 2005 estimates, which are deemed more complete.

<sup>5</sup>GDP is measured in current or nominal dollars and so are labor income and sales values in this publication.

**Table 1. Sectors making up Hawai'i agriculture.**

Sector	North American Industry Classification System (NAICS)	Industry number in 2002 Hawaii State Input-Output Table
<b><i>Crop and animal production (farms)</i></b>		
Sugarcane	111 and 112 11193	1
Vegetables	1112	2
Macadamia nuts, coffee, fruits (except pineapples)	1113 except part of 1113319	3
Pineapples	part of 111339	4
Flowers and nursery products	1114	5
Other crops	Other 111	6
Animal production	112 except 1125	7
Aquaculture	1125	8
<b><i>Forestry, fishing, and related activities</i></b>		
Forestry and forest products	<b>113, 114, and 115</b> 113	9
Commercial fishing	114	10
Support activities for agriculture and forestry	115	11
<b><i>Food product manufacturing</i></b>		
Food manufacturing	<b>311 and 312</b> 311	17
Sugar processing	31131	
Pineapple processing	part of 3114	
Beverage manufacturing	3121	18

Source: U.S. Census Bureau, U.S. Department of Commerce, 2002 NAICS Codes and Titles and The 2002 Hawaii Input-Output Study

**Table 2. Agriculture's contribution to Hawai'i's gross domestic product (GDP), 1997, 2002, and 2005.**

	1997	2002	2005
<b><i>GDP (millions of current \$)</i></b>			
Crop and animal production (farms)	278	301	295
Forestry, fishing, and related activities	85	77	59
Food product manufacturing	231	304	310
Total agriculture	594	682	664
Total Hawai'i GDP	37,546	43,476	54,773
<b><i>Percent of total agriculture</i></b>			
Crop and animal production (farms)	46.8	44.1	44.4
Forestry, fishing, and related activities	14.3	11.3	8.9
Food product manufacturing	38.9	44.6	46.7
<b><i>Percent of total Hawai'i GDP</i></b>			
Total agriculture	1.58	1.57	1.21
<b><i>Average annual growth rate (%)</i></b>			
	1997–2002	2002–2005	1997–2005
Crop and animal production (Farms)	1.6	–0.7	0.7
Forestry, fishing, and related activities	–2.0	–8.5	–4.5
Food product manufacturing	5.6	0.7	3.7
Total agriculture	2.8	–0.9	1.4
Total Hawai'i GDP	3.0	8.0	4.8

Source: Bureau of Economic Analysis, U.S. Department of Commerce.

is also observed in major agricultural states. For example, California, the largest agricultural state in the nation, producing more than 13% of the total U.S. agricultural outputs, shows an agricultural GDP growth rate of 3.4% annually for the period, which also falls behind that of the total economy, which grew at an annual rate of 5.9%. The corresponding annual growth rates of the total economy and agriculture were 6.9% and 1.9% for Florida, 4.6% and 0.0% for Iowa, and 6.5% and 3.8% for Texas.

Likewise, the contribution of agriculture to Hawai'i's economy when measured as its share of GDP also exhibited a slightly declining trend during the period 1997–2005. The share of agriculture remained at about the same level of 1.6% of total GDP for 1997 and 2002 but then decreased to 1.2% in 2005. This is also true for the nation as a whole and many agricultural states, where the share of agricultural GDP to total GDP also showed a declining trend. The corresponding share for the United States as a whole is 2.4% in 2005, 2.5% for California, 1.6% for Florida, 7.9% for Iowa, and 1.9% for Texas, not very much higher than the Hawai'i share of 1.2%.

While agriculture has been a steady contributor to Hawai'i's economy, it appears that it will likely follow the national trend of slightly declining share in the future.

### **Agriculture's contribution to employment**

Table 3 shows that employment for the economy; farm production; forestry, fishing, and related activities; and food product manufacturing have also exhibited declining trends. Total employment in the state increased at an annual rate of 1.6% from 740,028 jobs in 1997 to 838,740 jobs in 2005. However, total employment in agriculture decreased at an annual rate of 1.3% from 25,809 jobs in 1997 to 23,200 jobs in 2005. The decrease can be attributed primarily to decreases in the forestry, fishing, and related activities sector, and to a lesser extent the food product manufacturing sector.

In 1997, agriculture contributed 3.5% of total employment in the state but it declined to 3.2% in 2002 and 2.8% in 2005. Although its share of employment has declined somewhat, agriculture remains a major and continual contributor to Hawai'i's employment.

### **Agriculture's contribution to labor income**

The trends of labor income for the economy; farm production; forestry, fishing, and related activities; and food product manufacturing closely follow the corresponding employment trends. As shown in Table 4, the share of

agriculture labor income to total labor income declined from 2.1% in 1997 to 1.5% in 2005. Thus, the share of labor income for agriculture would tend to be lower than its employment share, reflecting the lower income of agricultural jobs.

### **Sales of agriculture and related sectors**

As shown in Table 5, total farm production sales value increased moderately at an annual growth rate of 1.8% for the period 1997–2005. Both sugarcane and pineapple production values declined during the same period at an annual rate of 4.6% and 1.8%, respectively. The continual decrease in sugarcane and pineapple production values is largely offset by the remarkable growth of diversified agriculture (such as seed crops, coffee, macadamia nuts, fruits, vegetables, flowers, and nursery products), which increased at an annual rate of 3.9% during the 1997–2005 period. Sales value of diversified agriculture constituted over 76% of total farm production and posted record high sales of \$445 million in 2005. While sales values of fisheries and forestry increased slightly during the 1997–2005 period, sales of support activities for agriculture and forestry more than doubled from \$31 million in 1997 to \$75 million in 2005. Within the food product manufacturing sector, both sugar and pineapple processing decreased steadily at annual rates of 4.4% and 4.7% respectively for the 1997–2005 period. These large decreases are more than made up by a healthy boost in other food manufacturing, which has increased at an annual rate of 2.6%. As a result, sales values of the overall food product manufacturing sector show a gain of 1.4% annually.

Total agriculture sales (including farm production, forestry, fishing and related activities, and food product manufacturing) increased from \$1,643 million in 1997 to \$1,836 million in 2002 and further increased slightly to \$1,900 million in 2005. The share of agriculture sales as compared to the total Hawai'i sales decreased slightly from 2.8% in 1997 to 2.6% in 2002 and further decreased in 2005 to 2.1%. This is similar to the GDP trend, since agricultural sales have been increasing at a slower rate than total sales of the economy.

### **Contribution of leading agricultural commodities**

The above analysis is conducted at a fairly aggregated level due to the unavailability of detailed information on specific crops. Fortunately, the 2002 Hawaii State Input-Output Model provides a slightly more disaggregated

**Table 3. Agriculture's contribution to Hawai'i's employment, 1997, 2000, and 2005.**

	1997	2002	2005
<b>Employment (number of total jobs)</b>			
Crop and animal production (farms)	11,848	12,259	11,797
Forestry, fishing, and related activities	6,030	4,944	3,887
Food product manufacturing	7,931	7,693	7,516
Total agriculture employment	25,809	24,896	23,200
Total Hawai'i employment	740,028	770,180	838,740
<b>Percent of total agriculture employment</b>			
Crop and animal production (farms)	45.9	49.2	50.8
Forestry, fishing, and related activities	23.4	19.9	16.8
Food product manufacturing	30.7	30.9	32.4
<b>Percent of total Hawai'i employment</b>			
Total Agriculture Employment	3.49	3.23	2.77
<b>Average annual growth rate (%)</b>			
	1997–2002	2002–2005	1997–2005
Crop and animal production (farms)	0.7	-1.3	-0.1
Forestry, fishing, and related activities	-3.9	-7.7	-5.3
Food product manufacturing	-0.6	-0.8	-0.7
Total agriculture employment	-0.7	-2.3	-1.3
Total Hawai'i employment	0.8	2.9	1.6

Source: Bureau of Economic Analysis, U.S. Department of Commerce.

**Table 4. Agriculture's contribution to Hawai'i's labor income, 1997, 2002, and 2005.**

	1997	2002	2005
<b>Labor income (\$ x 1,000)</b>			
Crop and animal production (farms)	208,126	223,159	219,276
Forestry, fishing, and related activities	75,045	67,609	53,644
Food product manufacturing	221,163	243,197	268,815
Total agriculture labor income	504,334	533,965	541,735
Total Hawai'i labor income	23,955,524	28,604,887	35,473,253
<b>Percent of total agriculture labor income</b>			
Crop and animal production (farms)	41.3	41.8	40.5
Forestry, fishing, and related activities	14.9	12.7	9.9
Food product manufacturing	43.9	45.5	49.6
<b>Percent of total Hawai'i labor income</b>			
Total agriculture labor income	2.11	1.87	1.53
<b>Average annual growth rate (%)</b>			
	1997–2002	2002–2005	1997–2005
Crop and animal production (farms)	1.4	-0.6	0.7
Forestry, fishing, and related activities	-2.1	-7.4	-4.1
Food product manufacturing	1.9	3.4	2.5
Total agriculture labor income	1.1	0.5	0.9
Total Hawai'i labor income	3.6	7.4	5.0

Source: Bureau of Economic Analysis, U.S. Department of Commerce.

crop breakdown for the four economic measures of value added, employment, income, and sales values. Table 6 (p. 8) shows that pineapple production provided the highest value added or contribution to GDP in 2002, followed by flowers and nursery products, sugarcane, fruits (other than pineapple) and nuts, other crops, animal production, vegetables, and aquaculture. Pineapple production was also the leading contributor to farmgate sales values and income, while flowers and nursery products provided the most employment in 2002. Although production has been declining, sugarcane still provided 14.8% of the total value added of farm production, 12.0% of farm sales, 10.5% of farm employment, and 14.2% of farm earnings in 2002. The rankings of the eight crops for the four economic measures differ just slightly.

### Summary

The contribution of agriculture as measured in terms of sales, GDP, employment, and personal income exhibits a common trend, in that it increased moderately from 1997 to 2005. However, as in the nation as a whole and many other agricultural states, the growth of agriculture by and large falls behind the general economy. Thus the contribution share of agriculture to the total economy has exhibited a slightly declining trend. In 2005, agriculture contributed to 2.1% of total Hawai'i sales, 1.2% of total value added or GDP, 2.8% of employment, and 1.5% of labor income. When distribution margins<sup>6</sup> are included, the contribution of agriculture in Hawai'i's economy in 2005 is estimated to be 2.7% in terms of sales, 1.7% in terms of GDP, 3.4% in terms of employment, and 2.0% in terms of labor income. Despite the continuing decline of sugar and pineapple production, the growth of diversified agriculture has more than made up their declines. As a result, agriculture remains a vital and steady contributor to Hawai'i's economy by providing a diversity of products and generating jobs and incomes.

It should be mentioned again that the present estimates of the contribution of agriculture differ from previous estimates due to a slight definitional change and the methodology employed.

### The economic contribution of agriculture to Hawai'i's economy including distribution margins, 2005.

Measure	Amount	Percent of Hawai'i's economy
GDP or value added (\$ million)	928	1.7
Employment (number of jobs)	28,587	3.4
Labor income (\$ million)	707	2.0
Sales (\$ million)	2,364	2.7

Although a narrower definition of agriculture is considered in this publication, we feel that it provides a better portrayal of the contribution of locally produced agricultural products to the economy. It is understandable that the estimates of the contribution of agriculture can vary significantly depending on the definition of agriculture used and the methodology employed. However, one thing remains very clear is that agriculture has been a stable and continual contributor to the economy of Hawai'i and should not be overlooked as one of the major sectors to diversify the heavily tourism-based economy.

### Acknowledgments

The authors acknowledge and thank Mr. Clifford Woodruff of the U.S. Bureau of Economic Analysis for clarifying the differences between earlier estimates of GSP by industry based on the SIC and the current estimates of GDP by industry based on the NAICS. This publication benefited greatly from constructive comments and suggestions of Professor James Mak of the UH Mānoa Economics Department, and Drs. Eugene Tian and Khem Sharma of the Hawai'i Department of Business, Economic Development and Tourism. Responsibility for the final content rests with the authors. This study was partly funded by a grant from the Hawai'i Department of Agriculture.

<sup>6</sup>Including the distribution margins allows comparison with similar estimates in previous publications. Distribution margins include transportation, wholesale and retail margins in delivering the agricultural products and services to the final consumers.

**Table 5. Sales of agriculture and related sectors, 1997, 2002, and 2005.**

	1997	2002	2005
<b>Sales (million \$)</b>			
<i>Crop and animal production (farms)</i>			
Sugarcane	86	64	59
Pineapple	92	101	79
Diversified agriculture	327	375	445
Subtotal farm production	505	540	583
<i>Forestry, fishing, and related activities</i>			
Fisheries and forestry	61	53	71
Support activities for agriculture and forestry	31	64	75
Subtotal forestry, fishing, and related activities	93	117	146
<i>Food product manufacturing</i>			
Sugar processing	133	100	92
Pineapple processing	73	71	50
Other food manufacturing	841	1,009	1,029 <sup>e</sup>
Subtotal food product manufacturing	1,046	1,180	1,171
<i>Total agriculture</i>	1,643	1,836	1,900
<i>Total sales</i>	58,868 <sup>a</sup>	70,618 <sup>a</sup>	88,968 <sup>e</sup>
<b>Percent of total agriculture sales</b>			
<i>Crop and animal production (farms)</i>			
Sugarcane	5.2	3.5	3.1
Pineapple	5.6	5.5	4.2
Diversified agriculture	19.9	20.4	23.4
Subtotal farm production	30.7	29.4	30.7
<i>Forestry, fishing, and related activities</i>			
Fisheries and forestry	3.7	2.9	3.8
Support activities for agriculture and forestry	1.9	3.5	3.9
Subtotal forestry, fishing, and related activities	5.6	6.4	7.7
<i>Food product manufacturing</i>			
Sugar processing	8.1	5.5	4.9
Pineapple processing	4.4	3.9	2.6
Other food manufacturing	51.1	54.9	54.1
Subtotal food product manufacturing	63.7	64.3	61.6
<b>Percent of total sales</b>			
<i>Total agriculture</i>	2.79	2.60	2.14
<b>Average annual growth rate (%)</b>			
<i>Crop and animal production (farms)</i>			
Sugarcane	-5.5	-2.9	-4.6
Pineapple	1.9	-7.6	-1.8
Diversified agriculture	2.7	5.4	3.9
Subtotal farm production	1.3	2.2	1.8
<i>Forestry, fishing, and related activities</i>			
Fisheries and forestry	-2.9	10.6	2.0
Support activities for agriculture and forestry	15.2	5.5	11.5
Subtotal forestry, fishing, and related activities	4.7	7.8	5.9
<i>Food product manufacturing</i>			
Sugar processing	-5.4	-2.7	-4.4
Pineapple processing	-0.6	-11.2	-4.7
Other food manufacturing	3.7	0.7	2.6
Subtotal food product manufacturing	2.4	-0.3	1.4
<i>Total agriculture</i>	2.2	1.0	1.8
<i>Total sales</i>	3.7	8.0	5.3

Source: Hawaii Agricultural Statistics; Hawai'i Dept. of Business, Economic Development and Tourism, The State of Hawaii Data Book, The 1997 Hawaii Input-Output Study, and The 2002 Hawaii Input-Output Study.

<sup>e</sup>denotes authors' estimates. <sup>a</sup>Total outputs from the 1992 and 2002 Hawaii State Input-Output Tables are used to represent total sales.

**Table 6. Contribution to value added, sales, employment, and labor income of leading agricultural commodities based on the 2002 Hawaii Input-Output Study.**

Industry	Value added			Sales (output)			Employment (jobs)			Labor income		
	(million \$)	%	Rank	(million \$)	%	Rank	(no.)	%	Rank	(million \$)	%	Rank
Sugarcane	42.85	14.8	3	64.30	12.0	4	1,304	10.5	5	27.05	14.2	4
Vegetables	21.84	7.5	7	61.66	11.5	5	1,174	9.5	6	14.86	7.8	7
Macadamia nuts, coffee, and fruits	42.13	14.5	4	78.10	14.6	3	2,048	16.5	3	27.60	14.5	3
Pineapple	64.05	22.1	1	100.62	18.8	1	2,363	19.1	2	43.26	22.7	1
Flowers and nursery products	49.75	17.2	2	92.07	17.2	2	2,856	23.1	1	33.01	17.3	2
Other crops	34.87	12.0	5	52.74	9.9	7	1,307	10.5	4	22.07	11.6	5
Animal production	25.82	8.9	6	60.14	11.2	6	1,073	8.7	7	17.11	9.0	6
Aquaculture	8.42	2.9	8	25.18	4.7	8	265	2.1	8	5.53	2.9	8
Subtotal farm production	290			535			12,389			190		
Diversified agriculture	182.84	63.1		369.89	69.2		8,722.68	70.4		120.18	63.1	
Total economy	43,807			70,618			773,751			23,792		

Source: The 2002 Hawaii Input-Output Study.