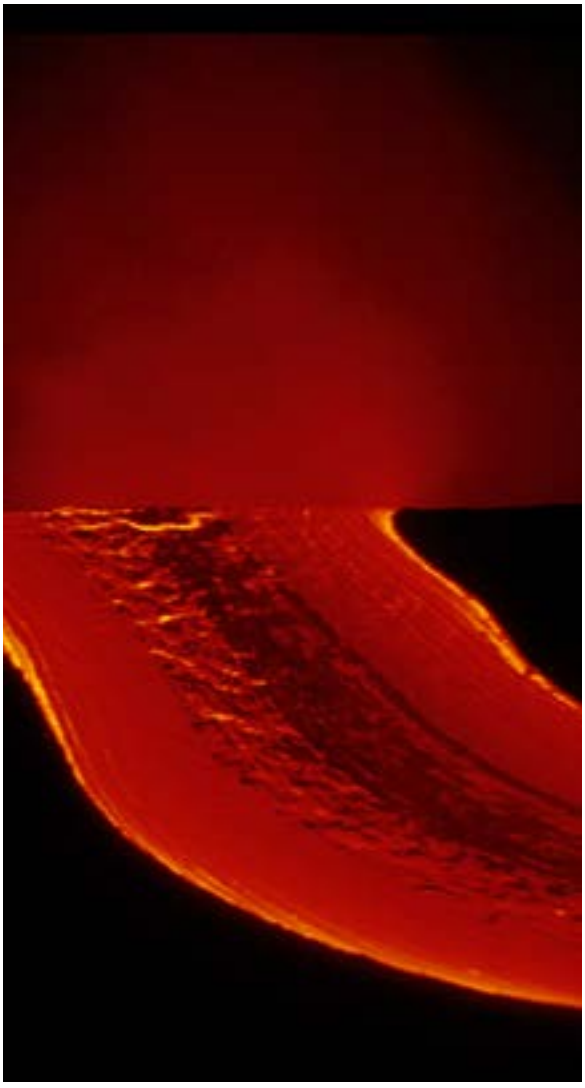
UHERO

THE ECONOMIC RESEARCH ORGANIZATION
AT THE UNIVERSITY OF HAWAIʻI

Recent Trends in Hawaiʻi's Green Economy:

Agriculture, Energy, and Natural Resource Management

JANUARY 2016



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RECENT TRENDS IN HAWAI'I'S GREEN ECONOMY

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Recent Trends in Hawai'i's Green Economy: Agriculture, Energy, and Natural Resource Management

Update to the 2012 report titled "Foundations for Hawai'i's Green Economy: Economic Trends in Hawai'i Agriculture, Energy, and Natural Resource Management"

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1. Executive Summary

This report provides an update to the 2012 "Foundations for Hawai'i's Green Economy: Economic Trends in Hawai'i Agriculture, Energy, and Natural Resource Management." Although economic information has long been collected for many sectors in Hawai'i, including agriculture and energy, the 2012 project was the first to collect indicators specifically for the natural resource management (NRM) sector. With financial support from Hau'oli Mau Loa Foundation and research assistance from The Nature Conservancy, the University of Hawai'i Economic Research Organization was tasked with collecting and analyzing information from three sectors that are key to future sustainability in Hawai'i - energy, agriculture and natural resource management. Major findings across these sectors are:

- Hawai'i's NRM sector currently provides at least 3,543 jobs, an 8% increase from FTE reported in 2012, which is equivalent to an annual growth rate of close to 2.6%. This is partly due to the fact that the number of survey respondents was 15% higher in 2015. When focusing only on respondents who participated in both survey years, jobs declined by 3%, or roughly 1% per year.

- Hawai'i's NRM sector spends at least $541 million, roughly 16% higher than expenditures reported in 2012. When focusing only on respondents who participated in both survey years, expenditures increased by an even higher 26%, which is likely a good indication that the sector is continuing to grow as a whole.

- Total Hawai'i agriculture expenditures were $684 million in 2012, up from $530 million in 2010. The total number of farms decreased from 7,500 in 2007 to 7,000 in 2012, but the average farm production expenses per acre increased over that same period from $499 to $606. All indicators point to a continuing trend of conversion to small diversified farms. Promotion of "buying and eating local" and assistance programs for local small-scale farmers may strengthen this essential sector.

- Hawai'i's energy sector continues its steady expansion, supporting the NRM and agricultural sectors, as well as the rest of Hawai'i's economy. Unfortunately, statistics on the rapidly growing renewable energy sub-sector are not yet available for a meaningful analysis of its performance.

Though preliminary, these findings can help inform policy and decision-makers of the current contribution and future potential of these sectors. In particular, they suggest opportunities to strengthen Hawai'i's economy and sustainability at the same time:

- Develop or expand local training and education programs to match anticipated "green job" growth, especially in natural resource management.

- Encourage pursuit of the most desirable college majors for NRM careers: natural resource management, biology, environmental studies, ecology, and botany. Hawaiian studies just missed the top five, which is likely an indication that NRM agencies prioritize the importance of cultural values and practices tied to natural resources in Hawai‘i.

- Stimulate interest in post-baccalaureate degrees in NRM-related fields. Higher levels of education are becoming desirable in the NRM sector for all job types.

- Include appropriate economic indicators for the natural resource management sector in economic reports and projections of green growth and green jobs prepared by State and other government agencies.

- Invest in valuation of the State's natural capital to help policy makers, business leaders, and the public understand their value and make appropriate investments in maintaining or improving the State's natural resource assets.

- Identify and track basic economic indicators for all key "sustainability sectors" in Hawai‘i to focus public attention on progress toward a green economy. In particular, more data is needed to understand the trends in consumption of local agriculture and Hawai‘i's expanding renewable energy sub-sector.

2. Background

In 2012, The University of Hawai‘i Economic Research Organization (UHERO), in cooperation with The Nature Conservancy and Hau‘oli Mau Loa Foundation, published a report (hereafter referred to as the "2012 report") characterizing the natural resource management (NRM) sector in Hawai‘i. The analysis was conducted using survey data on basic economic indicators that was collected from agencies identified as being part of the NRM sector in FY2011. The need for this work became clear through discussions regarding the types of information currently available for the NRM sector; previous studies have estimated values of Hawai‘i's natural resources—e.g., $7.4-14 billion for the Ko‘olau watershed (Kaiser et al., 1999) and $10 billion for the state's coral reefs (Cesar and van Beukering, 2004)—but less is known about the agencies charged with protecting and managing those important resources. Because natural resources are a key component of Hawai‘i's culture and economy, quantifying trends in the NRM sector would help to fill a current information gap and facilitate an integrated policymaking approach. The survey was distributed again in 2014, and the responses were collected and analyzed in this report (hereafter referred to as the "2015" report).

3. Methods

This report describes various trends in Hawai'i's NRM, agriculture and energy sectors, including four key indicators: total expenditures, employment, salaries, and education levels.[1] Trends in agriculture and energy were constructed from publicly available federal and state data sources (Table 3-1),[2] so not all metrics were available for each sector. Prior to the 2012 UHERO report, no indicators were available to quantify the size and economic importance of natural resource management in Hawai'i. Therefore, results from an online survey provided the baseline for the NRM sector. In 2014, the survey (see the Appendix) was disseminated for the second time to 182 organizations engaged in one or more aspects of natural resource management in Hawai'i. Approximately 53 percent or 97 out of the contacted organizations responded to 11 questions related to NRM expenditures, employment, employee characteristics, and salaries.[3] The updated survey included one additional question pertaining to the types of college majors NRM organizations look for when considering potential employees. While the 2015 results are emphasized in this report, some of the 2012 results are included for comparison.

Table 3-1.
Data sources for economic metrics by sector

Sector	Expenditures	Employment	Salary	Education
Agriculture	NASS (2012)	Schmitt (1977), DLIR (2014)	BLS (2013)	ERS (2013)
Energy	EIA (2012)	BLS (2013)	N.A.	N.A.
NRM	This report	This report	This report	This report

N.A. = not available | NASS = USDA National Agricultural Statistical Service | EIA = US Energy Information Administration
DLIR = Hawaii Department of Labor and Industrial Relations | BLS = US Bureau of Labor Statistics
ERS = USDA Economic Research Service

The trends highlighted in this report complement two recent reports entitled "Hawai'i's Green Workforce: A Baseline Assessment" (DLIR, 2010) and "Innovation and Technology in Hawai'i: An Economic Workforce Profile" (CREC, 2008). The DLIR study focused on the private sector and used a much broader definition for their job count:

1 GDP —the net value of production for a given sector, i.e., the total sales after subtracting purchases from all other sectors—is often viewed as one of the most comprehensive measures of a particular sector in the economy. However such a metric, which requires dollar values of produced goods or services, is not particularly amenable to characterizing the NRM sector because the ecosystem services and goods generated or protected by NRM efforts are typically not traded in conventional markets.

2 Data on expenditures and salaries was adjusted to 2014 dollars using an inflation calculator available online at: http://www.bls.gov/cpi/cpicalc.htm.

3 While this is not necessarily a representative sample, we feel that 53% is an acceptable response-rate.

jobs that "make a positive impact on the environment or energy sustainability". The CREC report, on the other hand, calculated job counts by compiling data for selected NAICS-coded industries related to renewable energy and environmental remediation and consulting services. These industries included jobs in environmental consulting, specialized engineering, and architectural design, many of which would not necessarily be classified as part of the NRM sector according to the definition used in the current report. If it were possible to avoid double-counting, aggregating results from the DLIR, CREC and the current report would provide the most complete picture of the "green" workforce in Hawai'i. That being said, we want to emphasize that the objective of the current report is to analyze trends in the NRM sector specifically, which may be viewed as a subset of the State's "green" economy.

4. Natural resource management sector overview

In this report, natural resource management (NRM) refers to the activities and employees that support and care for natural lands, air, freshwater and marine systems in Hawai'i. Support of these ecosystems includes fieldwork, science, research, regulation, planning, protection, management, hazard mitigation, communications, outreach, decision-making, policy, education, training, and administrative support. Ecosystem goods include the physical components of an ecosystem such as all living organisms, air, soil, water, and sunlight, while ecosystem services are functions provided by these systems, such as carbon sequestration, nutrient dispersal and cycling, and air and water purification.

4.1. Employment in the NRM sector

NRM jobs totaled 3,543 or 36.5 jobs on average per organization, with a standard deviation of 126.2. Averages for each category are indicated in the parentheses. Total FTE employees ranged from a low of 17 (4.3) for county agencies to a high of 1,138 (189.7) for state agencies. Total and average jobs for each sub-category are detailed in Table 4-1. For the entire NRM sector, 264.7 FTE positions were gained in the past 3 years, equivalent to a 2.62% annual (3-yr) growth rate. This is more than ten times the 0.17% growth rate predicted by survey respondents in the 2012 report. Looking forward, survey respondents expect a modest growth rate of 0.28% over the next five years, equivalent to 48.9 FTE positions.

Respondents were also asked which of 20 NRM job categories were included within their respective employee groups. The most selected categories included administrative support (71), field technicians (55), communications/outreach (58), natural resource managers (54), grants managers (66), GIS/data managers (48), and scientists (50). The top five jobs reported in the 2012 report remained in the top five in 2015, with some reordering. Survey participants were also allowed to submit "other" job types not captured by the suggested categories. Other job types included teacher/instructor, horticulturalist/arborist, engineer, climate change adaptation expert, wildlife rehabilitator, wildlife emergency response professional, project/program manager, entomologist, botanist, PR consultant, permit specialist, archaeologist, and architect. While 80% of the organizations offer paid or unpaid internships, only 41% offer longer-term fellowships. The complete data set on job types, internships, and fellowships is summarized in Table 4-2 and illustrated in Figure 4-1.

Table 4-1.
Employment (FTE) in the natural resource management sector, 2015

Category	Respondents	Total	Mean	St. Dev.
Entire NRM sector	97	3,543.4	36.5	126.2
New Jobs Past 3-yr FTE Growth [%/year]	-	264.7 [2.62%]	-	-
Expected 5-yr FTE Growth [%/year]	-	48.9 [0.28%]	-	-
State	6	1,138.0	189.7	308.1
Academic	15	1,105.5	73.7	234.2
Federal	18	744.0	43.8	52.6
Nonprofit	23	268.5	12.2	29.2
Partnership	14	137.8	9.8	7.0
Private	17	132.7	7.8	13.2
County	4	17.0	4.3	2.2

The FTE estimate for The National Park Service was obtained from the NPS Fiscal Year 2015 Budget Justification Document (http://www.nps.gov/aboutus/upload/FY-2015-Greenbook-Linked.pdf). The total includes positions funded from park base operating dollars and does not include numbers for the World War II Valor in the Pacific National Monument.

Table 4-2.
Job types, internships, and fellowships in the NRM sector, 2015

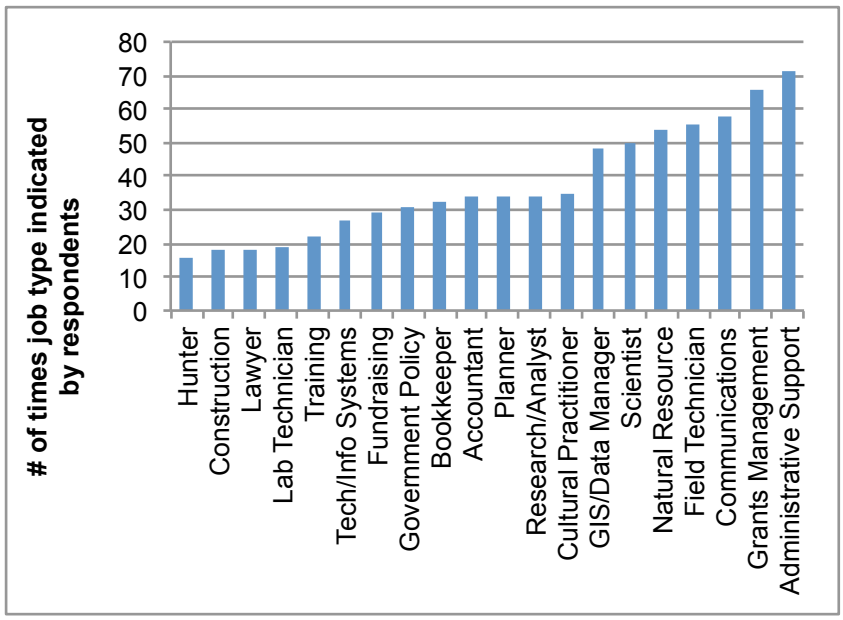
Job Types - # of times job categories indicated by respondents (2012 values in parentheses)*					
Scientist	50 (44)	Tech. Info. Sys.	27 (20)	Comm./ Outreach	58 (58)
Field Tech.	55 (59)	Bookkeeper	32 (33)	Lawyer	18 (18)
Hunter	16 (17)	Accountant	34 (24)	Planner	34 (30)
Nat. Res. Manager	54 (52)	Grants Mgmt.	66 (51)	Research/Analyst	34 (24)
Cultural	35 (30)	Fundraising	29 (22)	Training	22 (21)
Construction	18 (17)	Govt. Policy	31 (32)	Lab Tech.	19 (12)
GIS/data manager	48 (44)	Admin. Support	71 (65)	Other	-
Internships - # of times internship types indicated by respondents†					
Paid	47 (38)	Unpaid	43 (43)	None	20 (28)
Fellowships - # of times fellowship types indicated by respondents‡					
Paid	21 (16)	Unpaid	13 (11)	None	57 (65)

**These are self-reported descriptions of the types of NRM positions currently filled in the respondent's organization. In some cases, a single FTE position falls into multiple categories.*

†Internships are defined as short term (1-6 mos.) educational opportunities.

‡Fellowships are defined as medium term (>6 mos.) professional development opportunities.

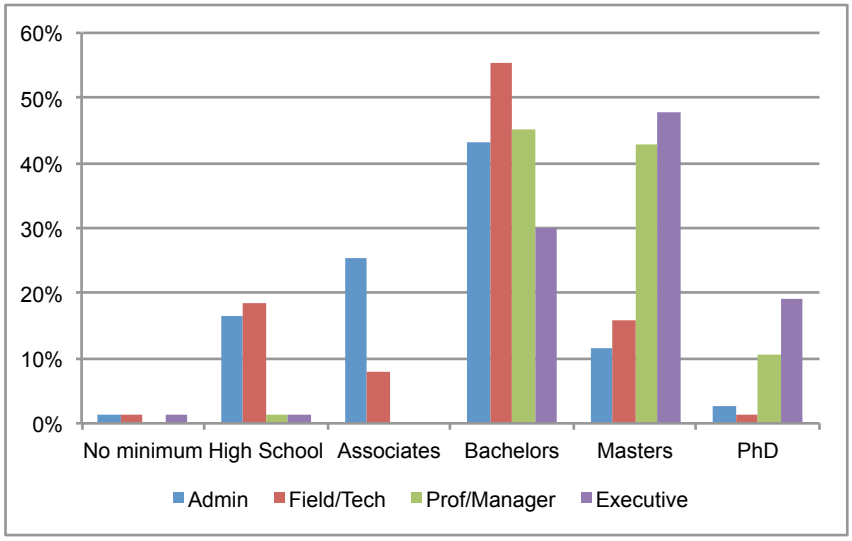
Figure 4-1.
Job types in the NRM sector, 2015



4.2. Education in the NRM sector

Survey participants were asked about the average education level for each of the following job categories: administrative, field or technical, professional or managerial, and executive. Figure 4-2 illustrates the frequency of responses for each job category. Of the employees who perform administrative tasks, 86% hold at most a bachelor's degree. Field technicians have a similar distribution, with 83% completing four years or less of postsecondary education. Meanwhile, 54% of managers and 67% of executives have completed a master's degree or higher. Compared to the numbers reported in 2012, the distribution for each category is shifted to the right, an indication that higher levels of education are becoming desirable in the NRM sector for all job types.

Figure 4-2.
Average education level by job type in the NRM sector, 2015



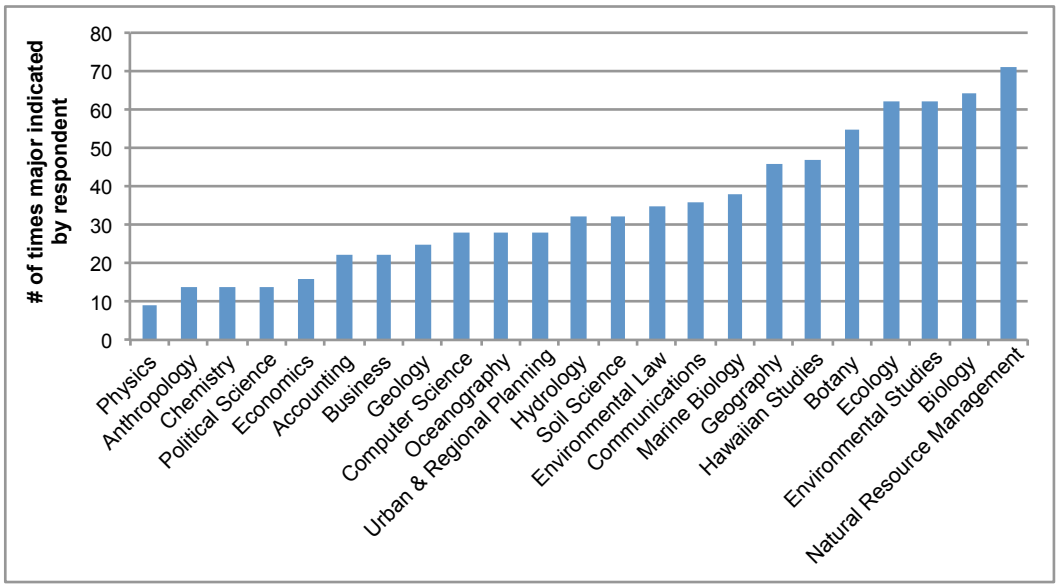
The updated survey included a new question pertaining to the types of college majors NRM organizations look for when considering potential employees. The top five spots are dominated by natural sciences: natural resource management, biology, environmental studies, ecology, and botany. Hawaiian studies just missed the top five, which is likely an indication that NRM agencies prioritize the importance of cultural values and practices tied to natural resources in Hawai'i. Results are summarized in Table 4-3 and Figure 4-3.

Table 4-3.
Desirable college majors in the NRM sector

Major (# of times major indicated by respondents)					
Accounting	22	Ecology	62	Marine Biology	38
Anthropology	14	Economics	16	Natural Resource Management	71
Biology	64	Environmental Law	35	Oceanography	28
Botany	55	Environmental Studies	62	Political Science	14
Business	22	Geography	46	Physics	9
Chemistry	14	Geology	25	Soil Science	32
Communications	36	Hawaiian Studies	47	Urban and Regional Planning	28
Computer Science	28	Hydrology	32		

Figure 4-3.

Desirable college majors in the NRM sector, 2015

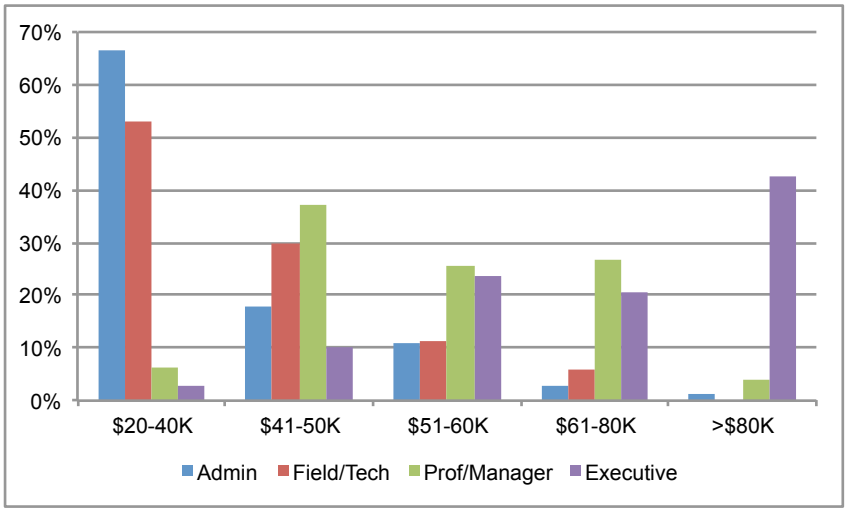


4.3. Salaries in the NRM sector

Figure 4-4 depicts a histogram for salary by job category. While 53% of field technicians and 67% of administrative support employees start in the $20,000 to $40,000 range, a larger percentage of field technicians than administrative support employees (17% versus 15%) make between $51,000 and $80,000 per annum. As expected, most of the managerial and executive positions fall into higher salary categories, with 43% of executives starting at over $80,000. The distribution for each category in 2015 is very similar to that of 2012, but recall that the distribution of education level has shifted to the right. This may be an indication that more qualified employees are competing for jobs that are not necessarily paying a significantly higher salary than in the past, although it is difficult to say for sure without more precise salary data (i.e. exact amounts rather than ranges).

Figure 4-4.

Average starting salary by job type in the NRM sector, 2015



4.4. Expenditures in the NRM sector

There are a variety of public agencies and private organizations involved in natural resource management. In total, NRM expenditures[4] amounted to $540.5 million or $8.4 million per organization on average. The $21 million standard deviation suggests, however, that the average is being inflated by large government agencies. When organizations are separated into sub-categories, average expenditures range from a low of $0.4 million for private organizations to a high of $47.9 million for state government agencies. Total and average expenditures for each sub-category are detailed in Table 4-4.

4 Survey participants were asked to estimate NRM expenditures using the most recent year/fiscal year for which data was available. In a large majority of cases, it is expected that this corresponds to the 2014 fiscal year.

Table 4-4.
Expenditures* in the NRM sector (millions of 2014 dollars)

Category	Respondents	Total	Mean	St. Dev.
Entire NRM sector	97	540.5	8.4	21.0
State	6	287.6	47.9	68.5
Federal	18	88.6	5.5	5.8
County	4	61.7	20.6	34.6
Academic	15	56.2	3.7	9.9
Nonprofit	23	29.8	1.4	3.0
Partnership	14	10.6	0.8	0.4
Private	17	6.2	0.4	0.6

**Expenditures included any expenses falling into the following categories: salaries and wages; fringe benefits; grants, contracts and "pass through" to other entities; capital improvement projects; and other. To avoid double counting, expenditures on grants, contracts and "pass through" were subtracted from the total to derive final expenditure values.*

The expenditures estimate for The National Park Service was obtained from the NPS Fiscal Year 2015 Budget Justification Document (http://www.nps.gov/aboutus/upload/FY-2015-Greenbook-Linked.pdf). The total does not include numbers for the World War II Valor in the Pacific National Monument and is not adjusted for passthrough.

The expenditures estimate for the State Department of Health was obtained from the State Executive Biennium Budget (http://budget.hawaii.gov/wp-content/uploads/2012/12/18.-Department-of-Health-FB13-15-PFP.pdf). Passthrough for 2014 is extrapolated based on the 2011 survey response.

4.5. Discussion of the NRM sector analysis

The overall numbers suggest that both expenditures and FTE increased in the NRM sector over the past three years. However, this is partly due to the fact that the number of survey respondents increased (Table 4-5).

Table 4-5.
Change in expenditures and FTE (2012-2015)

	Respondents	Expenditures	FTE
The 2012 Report	84	465.6	3,278.7
The 2015 Report	97	540.5	3,543.4
Percentage Change	15%	16%	8%

If we focus on organizations that responded in both years, the result is a panel that can be tracked over time. In that case, aggregate changes would not be confounded by a higher or lower response rate in a given year. However,

this approach is not without drawbacks. If we focus only on the agencies that responded in both years, the number of observations falls from 97 to 64 (Table 4-6). Moreover by definition, the panel requires that all included agencies were respondents to the first survey, thus precluding the possibility of adding new agencies as the sector expands.

Table 4-6.
Change in expenditures and FTE for panel (2012-2015)

	Respondents	Expenditures	FTE
The 2012 Report	64	387.6	2,429.6
The 2015 Report	64	452.0	2,161.5
Percentage Change		17%	-11%

The proportional change in expenditures remains almost the same as for the non-panel data but the change in FTE appears to fall drastically from 8% to -11%. Much of this difference is due to the data provided by a single state agency, however. The large difference may be due to a discrepancy between budgeted FTE and filled FTE positions in a given year. Because the same person did not complete the survey in both years, we cannot be certain that FTE was counted in the same way. If we omit the outlier, the results change dramatically; the change in expenditures increases to 26%, while the decline in FTE falls to -3.32%, which is equivalent to an approximately 1% decline annually over the past three years.

Based on results from this and the 2012 report, we have several recommendations moving forward. First, given the significance of the NRM sector in terms of jobs, expenditures, and growth potential, we want to reemphasize our previous suggestion that some form of the survey implemented for this report should be included in the Hawai‘i DLIR’s annual data collection program to ensure consistent and comparable data across relevant sectors.

Second, analysis of the collected data suggests that promising future NRM job opportunities exist for Hawai‘i’s youth. Over 20 different job types were reported, covering a wide variety of skill sets. Survey respondents also indicated the need for a variety of college majors in the physical sciences, social sciences, and business fields, among others. Hawai‘i’s students should therefore be encouraged, through outreach efforts, to pursue education in fields related to natural resource management.

Third, we want to reiterate the need for further development of public-private partnerships in the NRM sector, given the success of existing partnerships. The Hawai‘i Association of Watershed Partnerships, for example, comprises eleven partnerships that work with over 70 public and private partners seeking to manage approximately 2.2 million acres of watershed lands. The benefits realized by collaborative management include, but are not limited to, the ability to address large landscapes and threats affecting multiple habitats and species, leveraging limited dollars for maximum benefits, allowing the pooling of resources and expertise to reduce redundancy, and providing education and jobs.

Lastly, we encourage investment in further research on the valuation of the ecosystem services being protected by natural resource management. Quantifying the benefits generated from NRM activities will bring more comparable metrics into the sector, and will help policy makers, business leaders, and the public better understand the value of efforts to protect the state’s natural resources. While most of the general public would agree that ecosystem services are important for a variety of reasons, directly comparing the value of investing in watershed protection versus, say

highway infrastructure, is difficult without a dollar value attributed to the benefits of the former. A better quantitative understanding will inform future decisions to allocate limited budgets for the maintenance or increased restoration of Hawai'i's ecosystems.

5. Agriculture sector overview

Hawai'i's agriculture sector has experienced a significant decline since 1970 due to competition from places with lower production costs, shifting consumer preferences and limited access to affordable land and water. The state's farm production-expenditures decreased by roughly two-thirds between 1969 and 2012, and the amount of harvested cropland was nearly halved (NASS, 2012). Production expenses per acre have steadily increased, however, since the mid-1990s, and the total number of farms has more than doubled since 1974. Consequently, a larger number of smaller farmers continue to face increasing real production expenses in recent years. Nevertheless, the upward trend in the total number of farms may be viewed as a positive sign for the industry.

Farming as an occupation decreased from over 3.68% of total state employment in 1970 to a little over 1% in 2011, although most of the decline occurred in the decades leading up to the 1990s. Thereafter, farming as a percentage of total employment hovered between 1 and 1.5 percent, and actually increased from 2008 to 2011. The total number of agricultural jobs similarly followed a general downward trend over the past 40 years, with a slight rebound since 2008.

This section combines historic U.S. Census Bureau data (Schmitt, 1977) with more recent data from the USDA's state-level agriculture censuses, the Bureau of Economic Analysis, and the Bureau of Labor Statistics to give an overview of trends in expenditures, employment and salaries in Hawai'i's agriculture sector.

5.1. Employment in agriculture

Over the period 1900 to 2010, the number of agricultural workers in Hawai'i fell from 56,000 or 62% of the workforce to 6,300 or 1% of the workforce (Table 5-1), reflecting a shift in the economy from resource-based to service-based. The proportion of agricultural workers relative to the rest of the state's economy declined most significantly between 1940 and 1960 (Figure 5-1), due mainly to the end of the plantation era. Figure 5-2 provides a more detailed picture of the decline in agricultural jobs from 1972 to 2011. Although the general trend is downward, the total number of agricultural jobs in Hawai'i has been slowly increasing since 2008.

5.2. Education in agriculture

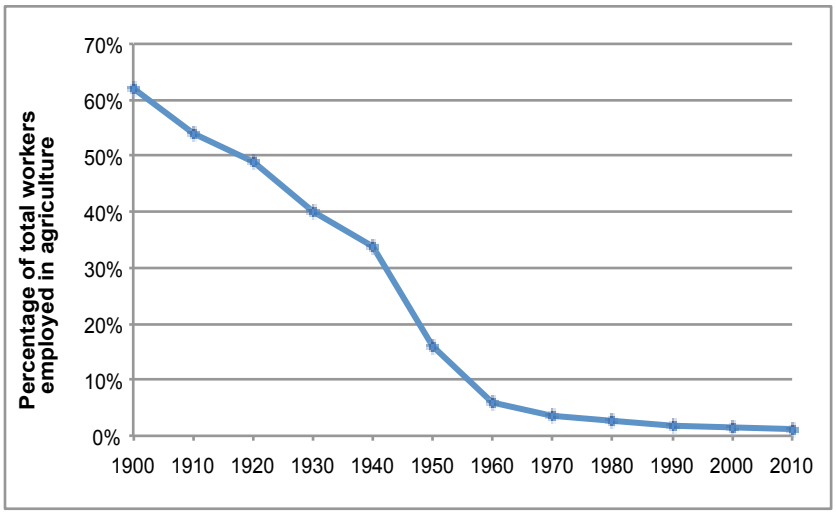
Statistics on education levels for farm workers are available only at the national level. According to the USDA Economic Research Service (ERS, 2013), 27% of all hired farm workers had less than a 9th grade education, compared with 3% of all U.S. wage and salary workers in 2012. Twenty-five percent of farm workers had some college education, up from twenty percent in the previous year. There is still a lot of ground to be gained, however, when considering that 64% of all U.S. wage and salary workers in 2012 had some form of college education.

Table 5-1.
Agricultural employment, 1900-2010

Year	Number of agricultural workers[5]	Total number of workers	Farming as % of total
1900	55,931	90,172	62.03%
1910	54,742	101,194	54.10%
1920	54,803	111,882	48.98%
1930	61,811	154,262	40.07%
1940	52,391	155,531	33.69%
1950	27,235	170,075	16.01%
1960	13,790	228,050	6.05%
1970	12,170	330,790	3.68%
1980	10,800	404,100	2.67%
1990	9,500	528,400	1.80%
2000	7,900	551,400	1.43%
2010	6,300	586,900	1.07%

Source: Schmitt (1977), DLIR (2014)

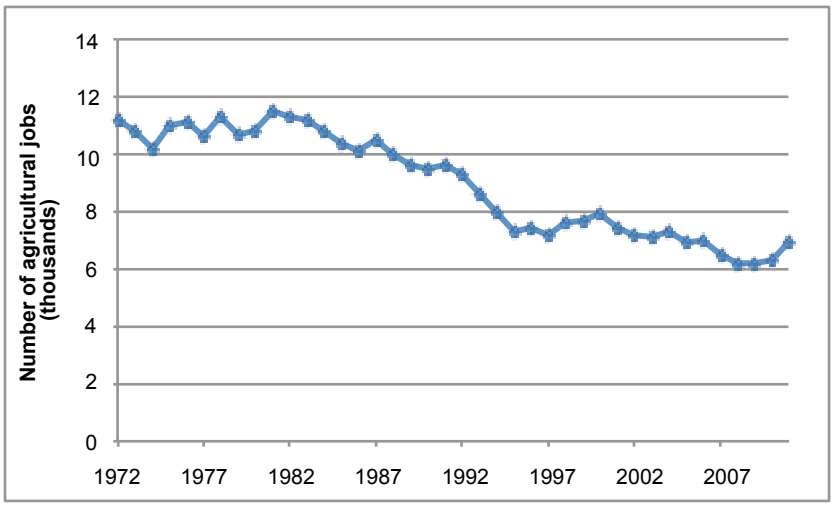
Figure 5-1.
Farming as a percentage of total employment, 1900-2010



Source: Schmitt (1977), DLIR (2014)

5 Agricultural workers are defined in this section according to the U.S. Census Bureau as workers in the industry "Agriculture, forestry and fisheries".

Figure 5-2.
Number of agricultural jobs, 1972-2011



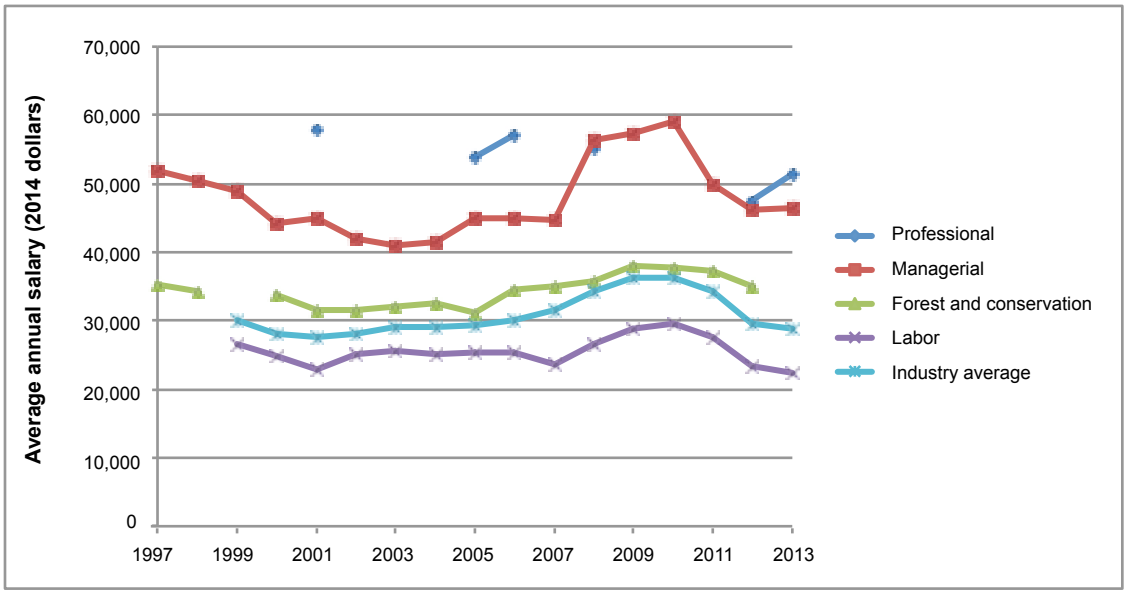
Source: DLIR (2014)

5.3. Salaries in agriculture

The Bureau of Labor Statistics publishes Occupational Employment Statistics (OES) annually for all occupations in the state (BLS, 2013).[6] We document salary trends for the following representative farming occupations over the period 1997-2013: first-line supervisors and managers (managerial); agricultural inspectors (professional); farmworkers and laborers, crop, nursery, and greenhouse (labor); and forest and conservation workers (field technician). As Figure 5-3 illustrates, salaries for all occupation types increased between 2001 and 2010, with the exception of agricultural inspectors (professional), but have trended downward since. The average salary for all occupations in the "Farming, Fishing and Forestry" industry decreased slightly from $30,032 in 1999 to $28,749 in 2013.

6 Semi-annual survey, most current data available online at: http://www.bls.gov/oes/current/oes_hi.htm#45-0000. Previous years back to 1997 are available in print form.

Figure 5-3.
Average salaries for farming occupations, 1997-2013

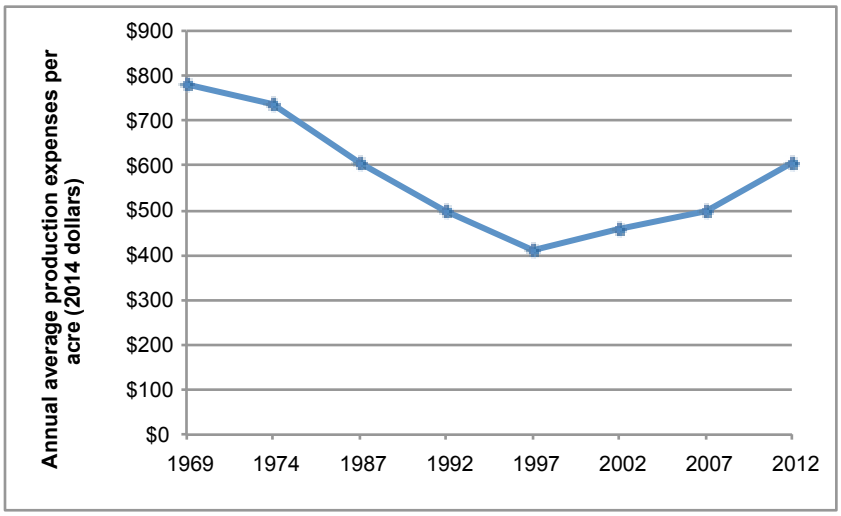


Source: BLS (2013) Broken lines are due to missing salary data in some of the categories

5.4. Expenditures in agriculture

Data on farm production expenses—livestock and poultry purchased, feed for livestock and poultry, commercial fertilizer, petroleum products, hired farm labor, interest expenses, and agricultural chemicals—have been collected in the U.S. Department of Agriculture's (USDA) state agriculture census every three to five years since 1969. Total farm production expenses declined from $1.6 billion in 1969 to $592 million in 1997, then remained relatively stable through 2007, before increasing to $684 million in 2012. During the same time period, the number of farms with harvested cropland increased from 2,750 to 5,293, suggesting a transition from large plantation style agriculture to the smaller diversified agriculture common throughout the state today. As will be seen in the next section, the total land in farms has declined more rapidly than total farm expenses since 1997. Consequently, annual average farm production expenses per acre have experienced a slow but steady increase over that period (Figure 5-4). Combined with the fact that the total number of farms throughout the state has been rapidly increasing, these trends suggest that there is an increasing number of smaller farms with smaller total expenses per farm but larger expenses per acre of farmland.

Figure 5-4.
Farm production expenses per acre, 1969-2012

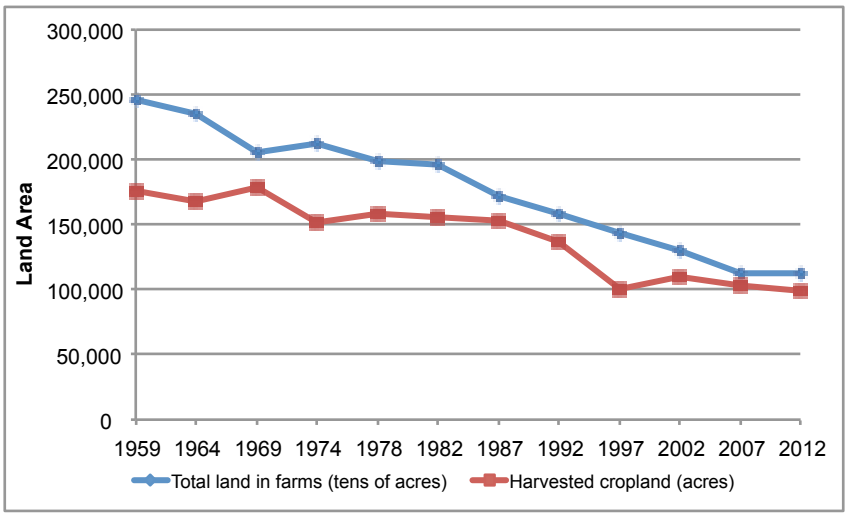


Source: NASS (2012)

5.5. Agricultural acreage and total number of farms

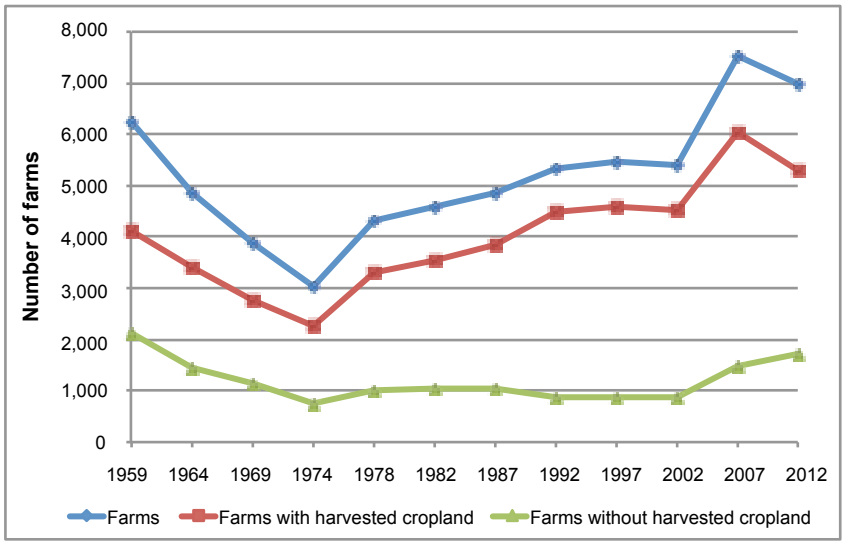
Since 1959, the amount of land in farms has declined from nearly 2.5 million to roughly 1.1 million acres (Figure 5-5), while the total number of farms declined from 6,242 in 1959 to a low of roughly 3,000 in 1974, before increasing to 7,000 in 2012 (Figure 5-6). Those numbers translate to a decline in average farm size from 394 acres in 1959 to 161 acres in 2012 (Figure 5-7). Together, these trends suggest that the sector has been steadily shifting from large plantation-style agriculture to a larger number of smaller farms with diversified products including for example flower and nursery products, cattle, aquaculture, and macadamia nuts.

Figure 5-5.
Land in farms, 1959-2012



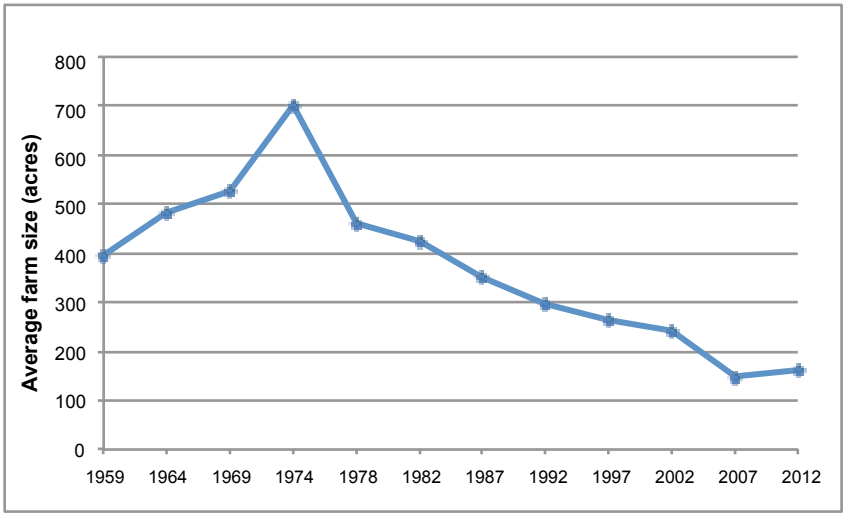
Source: NASS (2012)

Figure 5-6.
Number of farms, 1959-2012



Source: NASS (2012)

Figure 5-7.
Average farm size, 1959-2012



Source: NASS (2012)

5.6. Consumption of locally produced agricultural goods

With interest in food self-sufficiency on the rise (e.g. HDOA, 2008; Leung and Loke, 2008), efforts at marketing the idea of "buying and eating local" have increased in recent years. Results from a survey commissioned by Ulupono Initiative and conducted by OmniTrak Group Inc. (2011) suggest that a majority of shoppers on O'ahu believe that buying local is important: 81% of participants believe that the amount of food grown in Hawai'i is too little and 74% believe that it is very important that Hawai'i grow its own local foods. While the perception of locally produced agricultural goods may be changing, actual spending and consumption habits are more difficult to identify. Over the period 2004-2008, the value of agricultural exports decreased, while the value of locally grown and consumed agricultural goods increased (NASS, 2010). Although not definitive, such trends may be an indication that demand for locally produced food is on the rise.

5.7. Discussion of the agriculture sector analysis

To better understand food security in Hawai'i, we recommend tracking data on local food production and consumption. If collecting data on "production for local consumption" is not feasible, it can be approximated by the difference between total production and total exports. An important question is how this should be measured (e.g. weight, farm gate value) and in what level of detail (e.g. by major crop category, by more detailed sub-categories). Some but not all of this information is currently available in the USDA census.

If data on production for local consumption can be collected from individual farmers, then more detailed trends may emerge. For example, the data may show that most of the production from smaller farms is consumed locally,

while a few big farms are doing the majority of the exporting.

Consumption data should also be tracked separately to get an idea of how much food consumed locally is provided by local farmers. Although consumer surveys (e.g. OmniTrak 2011) provide stated preferences toward buying local or supporting local farm production, actual spending and consumption behavior would also be useful measures for the potential to expand and promote locally-produced food. For example, the average consumer may prefer locally produced food all else equal, but may end up choosing the imported alternative if the price difference is beyond a certain threshold.

6. Energy sector overview

Energy serves as a key input to the production of various goods and services in Hawai'i, including those provided by the agriculture and natural resource management sectors. Jobs in the energy sector have quadrupled over the past half a century and employment has increased by 25% in the past decade alone. While we would like to further separate the energy sector data into nonrenewable and renewable energy subsectors, disaggregating publicly available expenditures and job count data in its current form is not feasible. This section draws upon data from the Federal Energy Information Administration (EIA) and the Bureau of Labor Statistics (BLS) Quarterly Census of Employment and Wages.

6.1. Employment in energy

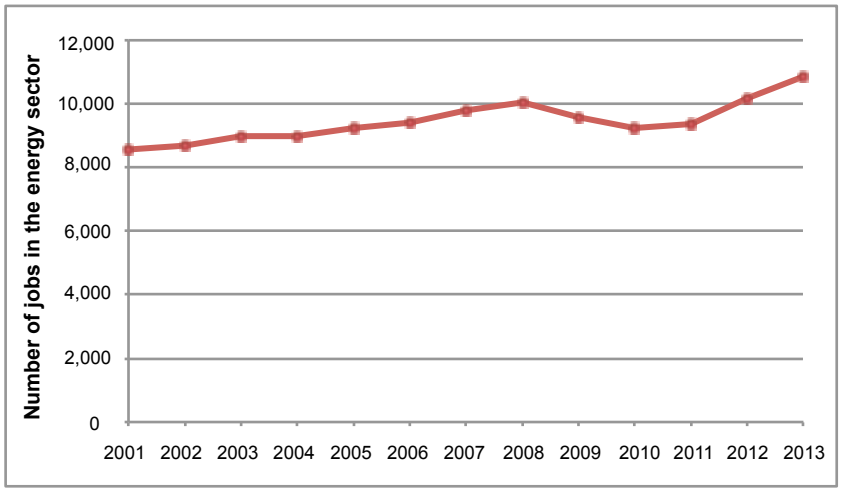
Job counts for Hawai'i's energy sector were compiled from the following industries (NAICS codes in parentheses): power generation and supply (2211), oil and gas pipeline construction (23712), power and communication system construction (23713), electrical contractors (23821), petroleum (4247), and gasoline stations (447).[7] By this measure, the energy sector provided almost 11,000 jobs in 2013 or 1.8% of total nonfarm jobs in the state. The electrical contractors industry has provided the most energy sector jobs since 2003 and accounted for nearly 40% of the total in 2013. The second largest category is power generation and supply, which accounted for almost 3,200 jobs (29%) in 2013. From 2001 to 2013, energy sector jobs increased by 27%, equivalent to an average annual increase of 1.8% per year (Figure 6-1).

Although some of the industries included in our definition of the energy sector capture renewable energy jobs, the total count is an underestimate because it does not include jobs related to renewable energy construction or renewable energy research and development (NAICS codes are not available for these "sub-industries"). DBEDT (2011) recently conducted an analysis of the energy sector and found that jobs in renewable energy construction and research grew more rapidly from 2002 to 2010 (19.5% per year) than all other jobs in the energy sector, although the size of the

7 Following DBEDT (2011), roughly 75% of jobs in the power and communication system construction industry were attributed to the energy sector. Jobs for some relevant industries (e.g. natural gas distribution) were deemed "not disclosable" by the BLS because they did not meet BLS or State agency disclosure standards.

renewable energy sub-sector is still relatively small—roughly 9% of the total energy sector in 2010. Growth is likely to increase, however, as more renewable energy projects move from stages of planning and development to construction and operation to meet the goals of the 2030 Hawai'i Clean Energy Initiative.

Figure 6-1.
Energy sector employment in Hawai'i, 2001-2013



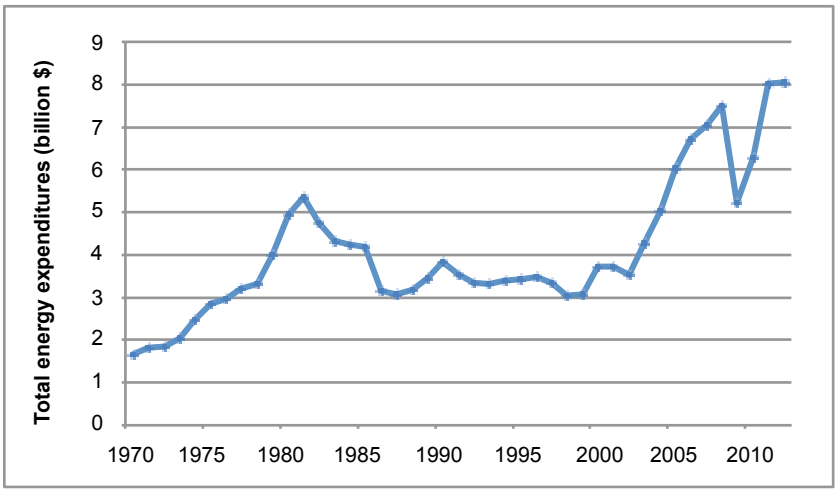
Source: Bureau of Labor Statistics Quarterly Census of Employment and Wages

6.2. Expenditures in energy

Hawai'i's primary energy expenditures[8] increased steadily from 1970 to 1981, more than doubling from $1.7 billion to over $5 billion. Expenditures then declined to $3 billion in 1987, after which they stagnated for the next decade and a half. More recently, expenditures have been on the rise again, with the exception of the two years following the 2008 financial crisis. In 2012, expenditures were up to $8 billion, an all-time high. For comparison, the state's total GDP in 2012 was $72.5 billion. Figure 6-2 illustrates the trend in energy sector expenditures over the period 1970-2012.

8 EIA calculates expenditures by multiplying price estimates by consumption estimates, after adjusting for process fuel, intermediate petroleum products, electricity exports, and other consumption that has no direct fuel costs, i.e. hydroelectric, geothermal, wind, solar, and photovoltaic energy sources, and some wood and waste.

Figure 6-2.
Energy expenditures, 1970-2012



Source: U.S. Energy Information Administration – State Profiles and Energy Estimates

6.3. Discussion of the energy sector analysis

Collection of data on job counts and expenditures by the BLS and EIA respectively will likely continue in the future, which is encouraging from a long run perspective. Some of the biggest challenges in analyzing the energy sector going forward include defining the renewable energy sub-sector and disentangling job and expenditure data across various industries. The 2011 DBEDT report provided a good starting point, but it is unclear whether their analysis will be updated in the future or if the methodology will be made clearer to allow for reproduction using newer data. The latter may be challenging, given that the proportion of spending and jobs in various industries attributable to the renewable energy sub-sector may fluctuate over time as various projects are started/completed to attain the goals laid out in the 2030 Hawai'i Clean Energy Initiative.

7. Recommendations

Going forward, we recommend that similar metrics be tracked for all three of these economic sectors, such as expenditures, numbers of jobs, types of jobs, job growth, education, salaries and wages. A job and expenditure survey like that done for the NRM sector would be particularly useful for the renewable energy sector, given that publicly available datasets do not define renewable energy as a sub-sector within the larger energy industry. Although job and expenditure data are publicly available for the agriculture sector, it would be useful to track local production for local consumption, given growing interest in "buying and eating local." Finally, since the NRM dataset used in this report is only the second of its kind in Hawai'i to our knowledge, we recommend continued efforts to collect the same type of

data in the future in order to build the kind of time-series information that can be tracked and meaningfully compared to other important sectors of the green economy.

8. Acknowledgements

Funding for this report was generously provided by Hauʻoli Mau Loa Foundation. We are grateful to Ken Kakesako (Hawaiʻi Department of Agriculture) and Earl Yamamoto (Hawaiʻi Department of Agriculture) for pointing us to new agriculture sector data and for their insights regarding local food consumption. We also appreciate all of the efforts made by Mark Fox (The Nature Conservancy), Brant Chillingworth (Hauʻoli Mau Loa Foundation), and Janis Reischmann (Hauʻoli Mau Loa Foundation) to encourage survey participation by various NRM organizations. However, any errors in the report are our own.

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10. Appendix: Natural Resource Management Sector Survey

The Nature Conservancy (TNC), Hauʻoli Mau Loa Foundation, and the University of Hawaiʻi Economic Research Organization (UHERO) are again conducting this survey of organizations in Hawaiʻi engaged in one or more aspects of natural resource management. This is the second time this survey has been conducted in Hawaiʻi, in order to quantify the size and economic importance of the state's natural resource management sector. This survey is an important part of documenting the significance of the natural resource management sector in Hawaiʻi's economy.

Please answer questions 1 through 3 to provide critical data for assessing the size of Hawaiʻi's natural resource management sector. Though questions 4 through 11 are optional, we would greatly appreciate your responses that will provide greater depth to this research. Please complete this survey by November 30, 2014.

All individual responses will be kept strictly confidential. Summarized findings that do not identify individual organizations will be available to all survey participants and may be shared with policy makers, others in natural resource management, the media, and the general public. While types or names of organizations may be identified as survey participants, no individual responses or data will be released.

If you have any questions please feel free to contact Kimberly Burnett at UHERO at (808) 956-8068 or kburnett@hawaii.edu.

FOR THE PURPOSES OF THIS SURVEY, NATURAL RESOURCE MANAGEMENT IS DEFINED AS:

Activities and employees that support and care for natural lands, air, freshwater and marine systems in Hawaiʻi. This includes fieldwork, science, research, regulation, planning, protection, management, hazard mitigation, communications, outreach, decision-making, policy, education, training, and administrative support.

1. Please provide your contact information so that we can reach you with any questions about your responses. Your individual responses will be kept confidential.

Name: _____

Company/Organization: _____

Email Address: _____

Phone Number: _____

2. Please complete the following chart with information on your organization's approximate annual expenditures for natural resource management in Hawaiʻi. You may use the most recent year/fiscal year for which you have data. *Note: Individual responses will be kept strictly confidential.

Category of Expense	Amount
Salaries and wages	
Fringe benefits (may be expressed in dollars or as a percentage of salaries and wages)	
Grants, contracts, and "pass through" to other entities	
Capital improvement projects (e.g., buildings, roads, fences, etc.)	
All other expenditures	
TOTAL	

3. How many full-time (FT) or full-time equivalent (FTE) natural resource management employees currently work in your organization in Hawai'i?

_____

4. Please identify the kinds of jobs in your organization that support your natural resource management work in Hawai'i. (Check all that apply)

- ☐ Scientist
- ☐ Field Technician
- ☐ Hunter
- ☐ Natural resource manager
- ☐ Cultural Practitioner
- ☐ Construction personnel
- ☐ GIS/data manager
- ☐ Technical information systems
- ☐ Bookkeeper
- ☐ Accountant
- ☐ Grants management
- ☐ Fundraiser
- ☐ Government policy
- ☐ Administrative support
- ☐ Communications and outreach
- ☐ Lawyer
- ☐ Planner
- ☐ Research/Analyst
- ☐ Training
- ☐ Lab technician
- ☐ Other (please describe)

5. Please identify the kinds of undergraduate college majors that your organization looks for in their employees to support your natural resource management work in Hawai'i. (Check all that apply)

- ☐ Accounting
- ☐ Anthropology
- ☐ Biology
- ☐ Botany
- ☐ Business
- ☐ Chemistry
- ☐ Communications
- ☐ Computer science
- ☐ Ecology
- ☐ Economics
- ☐ Environmental law
- ☐ Environmental studies
- ☐ Geography
- ☐ Geology
- ☐ Hawaiian studies
- ☐ Hydrology
- ☐ Marine biology
- ☐ Natural resource management
- ☐ Oceanography
- ☐ Political science
- ☐ Physics
- ☐ Soil science/agronomy
- ☐ Urban and regional planning
- ☐ Other (please describe)

6. What is the approximate average education level for the following categories of natural resource management employees in your organization in Hawai'i? (check only one box in each row)

	No minimum	HS Diploma	2-year Associates	4-year Bachelors	Masters	PhD
Administrative						
Field/Technical						
Professional/Managerial						
Executive						

7. What is the approximate average starting salary for the following categories of natural resource management employees in your organization in Hawai‘i? (check only one box in each row)

	$20-40K	$41-50K	$51-60K	$61-80K	>$80K
Administrative					
Field/Technical					
Professional/Managerial					
Executive					

8. Does your organization currently offer natural resource management internships in Hawai‘i, i.e., paid or unpaid short term (1-6 mos.) educational opportunities? (check all that apply)

- ☐ Yes, we offer paid internships
- ☐ Yes, we offer unpaid internships
- ☐ No, we don’t offer internships
- ☐ Other (text box)

9. Does your organization currently offer natural resource management fellowships in Hawai‘i, i.e., paid or unpaid medium term (>6 mos.) professional development opportunities? (check all that apply)

- ☐ Yes, we offer paid fellowships
- ☐ Yes, we offer unpaid fellowships
- ☐ No, we don’t offer fellowships
- ☐ Other (text box)

10. Approximately how many full-time (FT) or full-time equivalent (FTE) natural resource management positions has your organization lost or gained in Hawai‘i in the last 3-5 years? You may express your answer as a percentage or a number of positions, e.g., 15% loss or lost 3 jobs. Please specify loss or gain (+ or -) in your response.

_____

11. Approximately how many full-time (FT) or full-time equivalent (FTE) natural resource management positions does your organization expect to lose or gain in Hawai‘i in the next 3-5 years? You may express your answer as a percentage or a number of positions, e.g., 5% gain or gain 1 job. Please specify loss or gain (+ or -) in your response.

_____