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The Impact of CBB on the Economics of Coffee Production in Hawai‘i: 2007–2012 USDA Census Analysis

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Abstract

We assess the impact of the coffee berry borer (CBB) on the Hawai‘i coffee industry shortly after the discovery of the pest in 2010. A direct comparison using 2012 Ag Census data to our baseline study based on the 2007 Ag Census (Woodill et al. 2014) shows little impact. The analysis was expanded to use an annual series starting from 1992 and augmented by a third series that began with the 2014–2015 crop season. However, all three data sets are statewide; institutional limitations do not allow a separation of information from CBB-infested versus non-infested production regions. Overall, the impact of CBB is not clear and may be masked or diluted by the data. Coffee that was harvested but not sold, presumably due to CBB, has been reported since 2014–2015. Yields were decreasing before the onset of CBB, and price increases coincide with structural changes and other factors, so the role of CBB is not separable. Declining yields indicate that the coffee root-knot nematode, *Meloidogyne konaensis*, might be a more destructive pest than CBB.

Introduction

Hawai‘i coffees are known as some of the best-tasting coffees in the world, and coffee is an important crop to Hawai‘i agriculture. However, in 2010 an invasive species called the coffee berry borer (CBB) was found on coffee farms in Kona, Hawai‘i (HDOA 2010) and subsequently infested other parts of Hawai‘i Island and spread to O‘ahu and Maui. CBB attack the coffee bean by burrowing through the coffee cherry, eating the bean as a food source, and laying eggs inside of the cherry, where the offspring then feed on the bean. CBB damages the yield and quality of coffee, and producers incur additional costs to manage CBB in the crop and for sorting out damaged beans. By some accounts, in 2010 Kona farmers reported CBB infestation levels of up to 80–90% of their harvested crop. Many coffee farmers in Hawai‘i operate on small margins (Woodill et al. 2014), so with the discovery of CBB, we expected to find that farmers would incur substantial losses and even shut down as costs of control increased and production decreased.

Coffee and seed corn are the largest individual crops in Hawai‘i, yet official data beyond select statewide variables are limited. The lack of data makes it difficult to evaluate region-specific events such as the arrival of CBB. Therefore, any analysis is severely constrained by the limitations of the data released. While considerable effort and resources are expended on the USDA Agriculture Census and other data series, results are limited, and some series have been discontinued or modified. We work within these constraints to provide an analysis that best describes the current state of coffee production in Hawai‘i.

In this paper, we first investigate the impact of CBB on Hawai‘i coffee through USDA National Agricultural Statistics Service (USDA-NASS) Census data for 2007 and 2012. Although infested and non-infested production areas cannot be differentiated, the data allow a limited look at non-commercial and small farms before and immediately after CBB was discovered in Hawai‘i. Given the limitations of census data, we next use NASS annual variables (1) for the past 25 years and (2) since 2012 to discuss the impact of CBB management efforts and the current state of coffee production in Hawai‘i. These data are also limited to the entire state, i.e., for CBB-infested and non-infested areas combined. Finally, we discuss the implications of these results and provide an economic outlook for the industry.

2007 and 2012 USDA Census Analysis

We previously analyzed the 2007 USDA Census Survey to look at the coffee industry before CBB (Woodill et al. 2014). We now discuss the differences in 2012, soon after the identification of CBB, and ideally would later assess the impacts of CBB management efforts using subsequent census surveys. The analysis focuses on understanding how farmers adjusted between 2007 and 2012 and the possible implications of the advent of CBB.

The Census of Agriculture, which is administered every five years, is a complete count of farms and ranches for every county in the U.S. The data are collected through individual mail surveys that include questions on land use and ownership, operator characteristics, production practices, income, and expenditures.

According to the census, Hawai‘i had 1,521 coffee farms comprising 7,891 acres in 2007 and 1,577 farms comprising 9,872 acres in 2012 (USDA-NASS 2014). For this study, USDA-NASS provided certain data for a subset of coffee farms with sales and acreage greater than zero in 2007 and 2012. Further, we select those farms that were either noncommercial farms—those making less than $10,000—or small farms—those earning between $10,000 and $250,000 (Hoppe 2010). The majority of coffee farms in Hawai‘i fall into one of these two categories; however, our sample does not include all farms in Hawai‘i or region-specific data, as for Kona, Hawai‘i. We are unable to report on large farms ($250,000–$1,000,000 in sales) and extra-large farms (more than $1 million in sales) due to the small number of farms in the subset and NASS disclosure rules, which protect the confidentiality of individual farms. The samples each contain 200–250 farms and seek to identify changes in coffee sales, profitability, cost of production, and labor usage.

Summary of Acreage, Sales, and Profitability

Acreage, sales, and profitability for noncommercial farms were the only variables that had statistically significant changes between 2007 and the next census year, 2012. Other variables for noncommercial farms (Table 1) and all variables for small farms (Table 2) exhibited no statistically significant differences in means; thus, there appeared to be no changes with the introduction of CBB. Concerning profitability, we utilize five measures to look at how efficient farms were and how they operated in the short and long run. Output–input ratio (OIR) measures the level of sales from a dollar of expenditure and return-on-assets (ROA) measures the return for each dollar invested. Both OIR and ROA provide a measure of a farm’s efficiency; in general, a higher value indicates more efficiency, i.e., that resources are put to better use. Gross profit per acre (before income tax) includes variable costs and excludes fixed costs; it details how a farm operates in the short run. A negative value indicates that farm revenues are not covering day-to-day operating expenses, much less any fixed costs. Net profit per acre (before income tax) accounts for both variable and fixed costs and the ability to operate in the long run. With negative net profit but positive gross profit, the farm is covering operating expenses and some of the fixed costs but is losing money over time. The operation is financially in bad shape if both gross and net profits are negative. The last measure, “% profitable,” is the percentage of farms that have net profits greater than zero.

Noncommercial farms are typically managed by a single operator or a family and operate on small margins (see Table 1). From 2007 to 2012, these farms appear to have sustained or improved their sales. Average sales saw an increase of $547 to $4,246, with improved output–input ratios and the percentage of profitable farms increasing from 36% to 54%. Total costs, gross and net profits per acre, and return on assets were unchanged; on the average, total costs remained higher than sales, so gross profits were close to zero and net profits were negative. However, the average acreage declined by a quarter acre, from 1.29 to 1.06. The decrease in acreage is likely a result of the decrease from 237 farms in 2007

Table 1: Noncommercial Farms Acres, Sales, and Profitability (2007–2012)

Variable	2012 Mean (s.d.)	2007 Mean (s.d.)	Mean Difference (t-stat)
Sample Size	228	237	228/237
Average Acres	1.06 (1.17)	1.29 (1.32)	-0.23* (-1.99)
Average Sales	4,246 (3,163)	3,699 (3,081)	547* (-2.08)
Total Costs	5,707 (10,792)	7,037 (12,019)	-1,330 (-1.26)
Output–Input Ratio	1.98 (4.51)	1.26 (2.07)	0.72* (2.20)
Return-on-Assets	-0.01 (0.12)	-0.02 (0.15)	0.01 (0.45)
Gross Profit per Acre	130 (8,688)	-30 (4,698)	160 (0.25)
Net Profit per Acre	-1,698 (12,404)	-1,986 (7,211)	284 (0.3)
% Profitable	54%	36%	18%

* Statistically significant at 95%. Source: USDA Census of Agriculture (2007 and 2012)

Table 2: Small Farms Acres, Sales, and Profitability (2007–2012)

Variable	2012 Mean (s.d.)	2007 Mean (s.d.)	Mean Difference (t-stat)
Farms	232	203	232/203
Average Acres	4.42 (4.77)	4.29 (3.99)	0.13 (0.31)
Average Sales	29,872 (37,252)	32,390 (35,225)	-2,518 (-0.72)
Total Costs	26,438 (51,467)	32,054 (87,058)	-5,616 (-0.80)
Output–Input Ratio	2.81 (7.33)	2.13 (2.42)	0.68 (1.33)
Return-on-Assets	0.03 (0.28)	0.01 (0.16)	0.02 (0.84)
Gross Profit per Acre	1,993 (6,919)	1,908 (7,965)	85 (0.12)
Net Profit per Acre	649 (8,087)	524 (8,695)	125 (0.15)
% Profitable	66%	69%	-3%

Source: USDA Census of Agriculture (2007 and 2012)

to 228 farms in 2012. The change may be because some larger noncommercial farms dropped out of the industry or, more likely, because price increases for coffee meant that their sales increased above $10,000 in 2012, moving them into the small farm category. These variables do not account for the within-farm change—we track the difference in the mean for the entire group, but not the changes for individual farms.[1]

Small farms operate on better margins and can take advantage of improvements in returns to scale, as discussed in our previous paper (Woodill et al. 2014). As mentioned earlier, there was an increase in the number of small farms in 2012, possibly due to the movement of some noncommercial farms into the small farms group. The results from 2012 were statistically unchanged from 2007; average acres were 4.42, with average sales of $29,872 and total costs of $26,438 (see Table 2). The majority of farms were profitable, with 66% of all farms having positive gross ($1,993) and net per-acre ($649) values. Small farms also had a positive return on assets (3%) and an output–input ratio of 2.81.

The differences in acres, sales, and profitability between noncommercial and small farms are especially large (see Table 3). For 2012, while the difference in average acres between the two groups is only around 3 acres, the average sales show close to a 7-fold increase from noncommercial farms to small farms ($4,247 versus $29,872). In terms of total costs, the difference is around a 5-fold increase ($5,707 versus $26,438). These results suggest that small farmers, as compared to noncommercial farmers, can take advantage of returns to scale and vertical integration, where costs increase 5-fold and sales increase 7-fold, with a smaller 3-fold increase in acreage.

While some variables appear to show improvements, it is important to point out again that only average acres, average sales, and OIR for noncommercial farms have statistically significant changes between 2012 and 2007. All other differences are statistically insignificant, which means we cannot rule out the possibility that there may have been no change between the years. Therefore, most of the variables show no differences from before CBB was established to after CBB.

Summary of Production Costs

We now turn to production costs and labor for noncommercial and small farms (see Table 4 and Figure 1 for breakdowns and Appendix Table 1 for values). Tables 1 and 2 show that there were no significant changes in total costs for noncommercial and small farms. Labor remains the highest cost of production due to the labor-intensive nature of coffee farming and high costs of labor in Hawai‘i. For noncommercial farms, fertilizer and chemicals are next highest, then utility and fuel or maintenance and custom work. These are all associated with maintaining the farm and the high cost of labor. Noncommercial farms have higher interest and taxes because they have proportionately more capital assets such as buildings and equipment relative to producing acreage, thus will pay more interest and taxes relative to other costs of production on their farms.

For small farms, labor and operator labor are the highest, then fertilizer and chemicals, followed by maintenance and custom work, and then utility and fuel. As in noncommercial farms, a small farm's primary cost of production is labor for harvesting and maintaining the farm.

Between noncommercial and small farms, it is the differences in labor that are the most pronounced. Although operator labor is similar, the differences in labor are driven by the need for more workers to maintain coffee fields and especially for picking cherry. With noncommercial farms, operators take up the majority of the work, but as acreage increases the need for labor increases (see discussion below).

Summary of Labor

We now break down labor for noncommercial and small farms in 2012 (see Table 5). In 2012, noncommercial farms reported an average operator labor per farm of 0.94 worker. Hired and contract labor was reported at 0.28 worker. When including operators, hired, and contract workers, the average reported was 1.19 workers per farm. As mentioned earlier, noncommercial farms are usually run by a single operator and/or family, so the majority of labor comes from operators.

[1]We originally envisioned and designed a sample of individual farms in both 2007 and 2012 census years. This sample provided changes for individual farms (within-farm differences), which would have allowed us to track how those individual farm variables changed between census years. Unfortunately, due to technical issues, the results cannot be used.

Table 3: Noncommercial and Small Farms Acres, Sales, and Profitability

Variable	2012 Mean (s.d.)	2007 Mean (s.d.)	2012 Mean (s.d.)	2007 Mean (s.d.)
	Noncommercial		Small	
Farms	228	237	232	203
Average Acres	1.06 (1.17)	1.29 (1.32)	4.42 (4.77)	4.29 (3.99)
Average Sales	4,247 (3,163)	3,699 (3,081)	29,872 (37,252)	32,390 (35,225)
Total Costs	5,707 (10,792)	7,037 (12,019)	26,438 (51,467)	32,054 (87,058)
Output–Input Ratio	1.98 (4.51)	1.26 (2.07)	2.81 (7.33)	2.13 (2.42)
Return-on-Assets	-0.01 (0.12)	-0.02 (0.15)	0.03 (0.28)	0.01 (0.16)
Gross Profit per Acre	130 (8,688)	-30 (4,698)	1,993 (6,919)	1,908 (7,965)
Net Profit per Acre	-1,698 (12,404)	-1,986 (7,211)	649 (8,087)	524 (8,695)
% Profitable	54%	36%	66%	69%

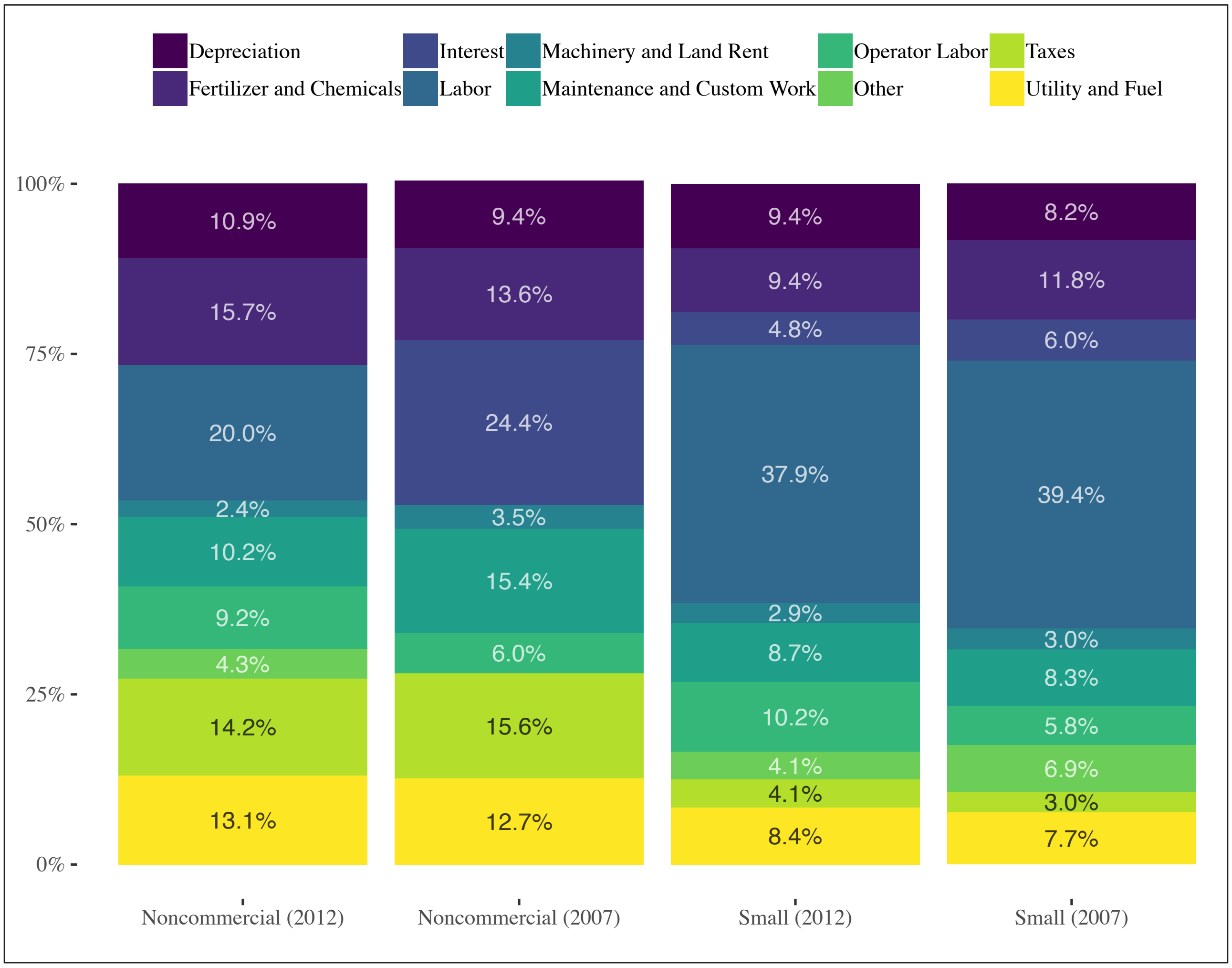
Source: USDA Census of Agriculture (2007 and 2012)

Table 4: Summary of Cost of Production (2007–2012)

Costs	Noncommercial		Small	
	2012	2007	2012	2007
Machinery and Land Rent	2.40%	3.50%	2.87%	3.03%
Utility and Fuel	13.09%	12.70%	8.42%	7.70%
Labor	19.96%	--	37.92%	39.43%
Operator Labor	9.25%	5.97%	10.21%	5.77%
Fertilizer and Chemicals	15.69%	13.61%	9.42%	11.77%
Maintenance and Custom Work	10.20%	15.40%	8.72%	8.30%
Interest	--	24.38%	4.80%	5.98%
Taxes	14.21%	15.55%	4.10%	2.98%
Depreciation	10.88%	9.40%	9.44%	8.16%
Other	4.35%	--	4.10%	6.90%
Net Profit per Acre	-1,698 (12,404)	-1,986 (7,211)	649 (8,087)	524 (8,695)
% Profitable	54%	36%	66%	69%

Source: USDA Census of Agriculture (2007 and 2012)

Figure 1: Changes in Cost of Production for Noncommercial and Small Farms, 2007–2012



Compared to noncommercial farms, small farms have slightly higher average operators per farm, at 1.03, and large increases in hired and contract labor, at 1.22 workers. The increase suggests that small farms are hiring laborers to maintain farms, likely through hiring pickers during harvest to ensure ripe cherries are harvested. There were no statistically significant changes in labor between 2007 and 2012 for noncommercial or small farms.

Overall, small farms have proportionately more labor per farm than noncommercial farms, but fewer workers per acre (1.12 versus 0.50). One explanation for this difference is that with fewer acres to maintain and harvest, noncommercial farms can support their labor requirements with operator and family labor. However, the lower labor per acre suggests that small farms are more likely to have labor-related issues, such as the inability to hire pickers at peak times of coffee cherry harvest. We suspect, as reported previously (Woodill et al. 2014), that farms in the large to extra-large category will see increases in total workers but fewer workers per acre, due to mechanization and economies of scale.

NASS-HASS Annual Statistics of Hawai‘i Coffee Production, 1992–2017

Hawai‘i coffee production is small compared to world production (0.14% of the total coffee produced in 2016); however, in 2016 it was the second most valuable crop in

Table 5: Summary of Labor (2007–2012)

	Noncommercial			Small		
	2012 Mean (s.d.)	2007 Mean (s.d.)	Mean Difference (t-stat)	2012 Mean (s.d.)	2007 Mean (s.d.)	Mean Difference (t-stat)
Farms	228	237	---	232	203	---
Average labor (operators)	0.94 (0.66)	0.87 (0.55)	0.07 (1.24)	1.03 (0.68)	1 (0.60)	0.03 (0.49)
Average labor (hired and contract)	0.28 (1.06)	0.51 (1.88)	-0.23 (-1.63)	1.22 (2.68)	1.43 (3.23)	-0.21 (-0.73)
Average labor (operators, hired, and contract)	1.19 (1.15)	1.34 (1.9)	-0.15 (-1.03)	2.21 (2.65)	2.31 (3.19)	-0.1 (-0.35)
Labor/acre (operators, hired, and contract)	1.12	1.04	---	0.50	0.54	---

Source: USDA Census of Agriculture (2007 and 2012)

Hawai‘i after seed crops, with a total production value of over $48 million (USDA 2016). According to USDA NASS data, while production value continues to increase, Hawai‘i coffee production and yield have been declining.

Figure 2 provides five data series from 1992 to 2017 for parchment coffee in the entire state of Hawai‘i, where the vertical line represents the arrival of CBB in 2010. Acres harvested had been increasing, with the growth of the Ka‘ū area as well as large mechanically harvested farms, until 2014 and 2015. Aggregated data prevents us from confirming the specific reasons for declines, but the subsequent decline suggests one reason could be abandoned farms due to CBB, or it might be an adjustment as growers shift to rotational block pruning, or some other reason.

Production, measured in pounds of parchment, saw an increase from 1992 after Hurricane ‘Iniki until 1999 and has been declining since. This decline continued with the arrival of CBB in 2010, most recently to levels similar to 1995. Yield followed a similar pattern as production, with a gradual decline since the late 1990s. While CBB is known to affect yields and total production, aggregate state data prevents the ability to discern direct impacts.

Although production has faltered, Hawai‘i coffee has sustained value due to increases in price per pound. Since 2010, the price for parchment coffee has increased by 66%. This price increase coincides with arrival and establishment of CBB (and declines in production and yield), but the impact of CBB's contribution is unclear. The loss in supply naturally drives up the price. Product differentiation and structural change (growth of internet sales) also are likely contributors to the price increases. As a result, the value of production for coffee has also increased by 32% since 2010. Those farmers who vertically integrate their business—produce, process, and sell coffee—are well positioned to take advantage of these effects in the market.

NASS Annual Statistics of Hawai‘i Coffee Production, 2014–Current

Unlike increasing parchment coffee prices, the price for coffee cherry has remained stable since the 2014–2015 season, when coffee cherry prices were first reported (see Table 6). Numbers for cherry that is harvested but not sold are also first published in this period. Since production has been in decline, the value of utilized production measured in cherry has also been in decline. Notably, production value declined by nearly $19

Figure 2: Hawai‘i Coffee Overview (Parchment – dried, unhulled coffee beans)

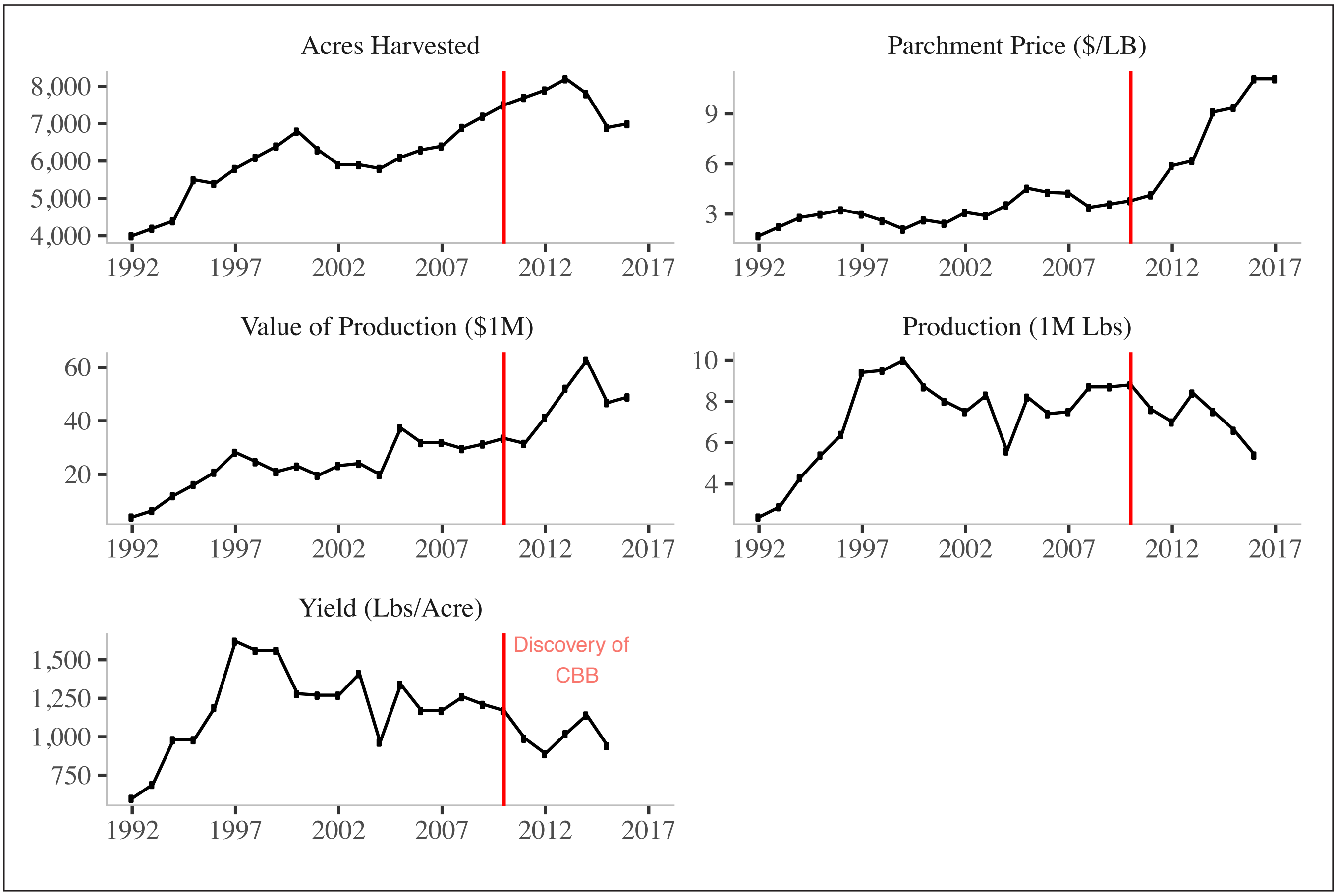


Table 6: Summary of Hawai‘i Coffee Cherry Price and Production

Season	Price per pound	Utilized production (1,000 lbs)	Value of utilized production ($1,000)	Harvested, not sold (1,000 lbs)
2014–2015	$1.72	36,816	62,622	408
2015–2016	$1.56	30,137	46,712	1,603
2016–2017	$1.71	28,571	48,856	689
2017–2018	$1.78	24,592	43,774	824

Source: USDA NASS Quick Stats

million, or by over 30%, from the 2014–2015 to the 2017–2018 season. Cherry farmers, or those who only sell cherry to a mill, have lost revenue due to the stable cherry prices combined with reductions in production and yield. The impacts on vertically integrated farms and those selling processed coffee are not clear beyond what is implied by the increase in parchment prices over the same period.

These data continue to document the declines in production and yield. CBB might be a contributing factor, as indicated by the coffee that was harvested but not sold, but these declines started before the arrival of the pest. Regional changes in the weather, such as drought or rain patterns, play a major role in the production of the coffee cherry. The ongoing volcanic events on Hawai‘i Island might also contribute. As discussed in the next section, we suspect coffee root-knot nematode to be a major factor at least on Hawai‘i Island.

Another possible reason for the decline in utilized production is a reported shortage of coffee pickers in Hawai‘i. There is a high demand for labor during the cherry-picking season, but in a strong economy with competing job opportunities, coffee-picking wages are too low to attract sufficient laborers, so farms dependent on hand picking are not able to harvest all available cherry. Unfortunately, island- and regional-level data are not available to tease out these factors, so we can only make assumptions about Hawai‘i as a whole.

Implications and Future Outlook

We cannot directly determine the impact of CBB nor of CBB management efforts, due to the inability in both the Agriculture Census and annual variables to separate infested coffee-producing regions from those free of the pest. However, we draw from additional resources in this section to discuss implications and a future outlook on the industry as a whole.

In a recent survey of farmers (Bittenbender et al. 2017), those farmers who are following Integrated Pest Management (IPM) strategies (Kawabata et al. 2017) such as field sanitation, including efficient harvesting practices, strip-picking trees, and spraying, see reductions in CBB infestation levels that mitigate damages. Of around 80 farmers surveyed in 2017, 80% said they strip-picked their farm at the end of the season, 59% said sampling was a “pretty good” or “very good” strategy for ascertaining effective spraying patterns, and 90.7% said *Beauveria bassiana*[2] sprays were effective at controlling CBB. As a result, 55% of farmers surveyed saw a decrease in CBB from previous years. These results, while anecdotal and from a sample of participants in the subsidy survey, suggest that as long as farmers follow IPM strategies, CBB infestation levels can be managed to mitigate damage to coffee cherry.

Additionally, our previous research shows that to optimize net benefit (revenue minus costs) the most important management strategy, although other strategies need to also be followed, is to use appropriate sanitation practices to ensure a low initial infestation level at the start of the season (Woodill et al. 2017). Our paper compares a farm with an initial CBB infestation of 1% versus a farm at 6% to show there is a difference of $6,761 net benefit for the low-infestation farm. The primary reason for this difference is because CBB within the coffee beans are actively reproducing, so once a new crop starts to mature, it is extremely difficult and costly to reduce the numbers of infested beans. With a high initial infestation level, the growth rate of CBB can readily get out of control on the farm. Therefore, while following IPM strategies throughout the year is important, controlling the initial infestation level is the most important component in determining whether a season can be profitable.

While CBB has been the primary concern for coffee in recent years, the conversation may overshadow another threat especially in Kona and the rest of Hawai‘i Island. This study notes the long-term trends in declining production and yield that started before 1992, which may also be due to the effects of the coffee root-knot nematode (CRKN), *Meloidogyne konaensis*. Eisenback et al. (1994) describe CRKN as extremely pathogenic to coffee trees, causing a disease known as coffee decline (Serracin et al. 1999). Symptoms include substantial losses in yield and often result in the death of the tree. From the early 1900s, Kona coffee yields have exhibited a long-term decline, stemming first from a change in pruning styles and then likely from the spread of CRKN and its cumulative ef-

[2] *Beauveria bassiana* is an entomopathogenic fungus; that is, a fungus that is a parasite of insects, including CBB. Although it is naturally found in Hawai‘i, selected strains have been formulated into commercial bio-pesticides that are recommended as part of the IPM practices.

fects. The most recent statewide yield for the 2017–2018 season is 3,530 pounds of cherry per acre (USDA 2018), for which over half the acreage is not known to be affected by CRKN; the implication is that the infected areas have even lower yields. The only effective management strategy for CRKN is planting with trees grafted onto CRKN-resistant or -tolerant rootstocks. Although the problem had been recognized and a suitable rootstock identified (Bittenbender et al. 2001), a recent survey of farmers in 2017 showed 85% did not know if their farm was infested with CRKN, and only 19% had had their farm tested (Kawabata, pers. comm).

To ensure continuing research on the economic impacts of CBB (and other threats), complete and accurate data are essential. One of the limiting factors in understanding the economic impact of CBB in Hawai‘i is the inability to separate data from CBB-infested versus non-infested regions. Only statewide data are available, so the analysis in this paper includes islands and regions that did not have CBB. We cannot, therefore, discern the economic impacts of CBB using census data from 2007–2012 nor other historical data series, and are only able to generalize for the entire state.

Conclusions

The discovery of CBB in Kona, Hawai‘i, led to widespread concerns about how devastating this pest was going to be for farmers as well as what the industry-wide economic impact would be. In this paper, we use census results from 2007 and 2012, annual variables for the past 25 years, and recent information since the 2014–2015 coffee season in our attempt to estimate the impact of CBB infestation. We suspect the statewide data is masking and/or diluting effects in production regions where CBB is a problem.

With the use of census data from before CBB to shortly after the first discovery of CBB in Hawai‘i, an interesting result from this study is that by most aggregate measures, the economic impact of CBB appears to have been limited. The findings do not indicate that CBB significantly impacted Hawai‘i coffee production. The only changes can be attributable to an increase in coffee prices, which in turn may be partly related to CBB. In particular, CBB's impact on prices is uncertain because much of the state's coffee-growing regions do not have CBB, and the growth of mail-order and internet-driven sales undoubtedly is a major contributing factor to price increases.

The USDA census of agriculture analysis shows noncommercial farms experienced an increase in sales and a decrease in average acres from 2007 to 2012. Labor is the highest proportion of the farm-level cost of production with proportionately more operator labor than hired and contract labor for noncommercial farms, and the reverse for small farms. Otherwise, there are no statistically significant differences between 2007 and 2012; the data show no other changes associated with CBB.

The data for the 25 years from 1992 to 2017 exhibit trends, but we cannot ascertain an impact of CBB. After CBB's arrival, acreage first increased and then declined. Production and yield peaked in the late 1990s and since have declined for various reasons, but the value of production has been increasing because of rising prices.

More recently, since 2014, cherry that is harvested but not sold is likely not sold due to CBB but is not traceable to CBB-infested areas. The price of cherry has remained stable, while utilized production has been in decline. Reasons for the production decline include weather, volcanic activity, and CRKN. The labor shortage is also a concern due to the high demand for pickers during harvest season. The high demand for labor drives up labor prices, and with a shortage of laborers, ripe cherry goes unpicked. The recent trends favor farmers who are vertically integrated and can take advantage of rising prices beyond the farmgate even as production declines. In contrast, cherry farmers who see stable cherry prices but decreases in production are losing revenue and will be more likely to exit the market.

Continued research on CBB, coffee root-knot nematode, and new threats such as coffee leaf rust will help the industry deal with the pests when they appear. However, limited data availability at anything less than the statewide level is a severe constraint for estimating the economic impact of these pests and the efforts to manage them.

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Appendix Table 1: Summary of Cost of Production (2007–2012)

	Farms	2012 Mean (s.d.)	2007 Mean (s.d.)	Mean Difference (t-stat)	Farms	2012 Mean (s.d.)	2007 Mean (s.d.)	Mean Difference (t-stat)
	Noncommercial				Small			
Machinery and Land Rent	21/41	1,986 (1,903)	1,468 (1,455)	5 (1.09)	73/77	2,862 (2,870)	3,194 (5,925)	-332 (-0.44)
Utility and Fuel	208/228	910 (1,564)	855 (2,093)	56 (0.32)	222/203	2,876 (5,932)	2,865 (5,694)	11 (0.02)
Labor	73/89	4,067 (11,619)	--	--	168/137	18,148 (32,147)	22,720 (75,817)	-4,572 (-0.66)
Operator Labor	40/56	3,319 (9,165)	1,721 (3,235)	1,597 (1.06)	103/87	7,776 (16,325)	5,934 (11,412)	2,683 (1.33)
Fertilizer and Chemicals	199/233	1,123 (3,651)	853 (1,660)	270 (0.96)	211/201	3,411 (4,711)	4,451 (10,798)	-1,040 (-1.26)
Maintenance and Custom Work	158/212	929 (1,381)	1,097 (2,577)	-169 (-0.81)	201/199	3,334 (9,456)	3,151 (4,932)	183 (0.24)
Interest	26/37	--	10,688 (16,847)	--	48/50	7,944 (14,359)	9,439 (16,129)	-1,495 (-0.49)
Taxes	205/203	987 (1,577)	1,147 (1,925)	-169 (-0.97)	201/169	1,556 (2,190)	1,313 (2,028)	244 (1.11)
Depreciation	41/55	3,964 (7,157)	2,679 (5,669)	1,284 (0.95)	86/80	8,411 (14,373)	8,155 (10,889)	256 (0.13)
Other	51/68	1,394 (2,340)	--	--	73/90	4,480 (13,142)	5,866 (34,766)	-1,386 (-0.35)

Source: USDA Census of Agriculture (2007 and 2012)