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Fruit and Tree Nuts Outlook: Economic Insight

U.S. Pollination-Services Market

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Pollination Market Overview

Insect pollinators transfer pollen to flowers and assist with the fertilization of a diverse array of flora from alfalfa to zucchini (Crane and Walker, 1984; Morse and Calderone, 2000). For some flowering plants, such as almonds and apples, abiotic processes, like wind, are largely ineffective for transferring pollen for reproductive purposes, rendering these plants dependent on insects for pollination (National Research Council, 2007). Such pollinator-dependent crops often require the services of commercial bee hives, which growers rent from beekeepers who then place the hives in cultivated fields and orchards at prescribed rates (Klein et al., 2007). In North America, *Apis mellifera*, otherwise known as the European honey bee, is largely preferred over other pollinators (e.g., bats, wasps, and butterflies) due to the relative ease of transporting population-dense colonies of active honey bees throughout the growing season (National Research Council, 2007).

Pollination Industry at a Glance

According to the U.S. Department of Labor, Bureau of Labor Statistics (BLS) *Quarterly Census of Employment and Wages* report, the equivalent of 2,552 individuals were employed full time in the U.S. apiculture or beekeeping sector in 2012. A total of 387 establishments were counted among those engaged in private commercial apiculture activities in the same year (DOL/BLS, 2014). Among all States, California claims the largest number of registered beekeeping operations (110) that use honey bees for pollination services. Registrations in Texas, Florida, North Dakota, South Dakota, and Montana combine to account for an additional 133 beekeeping operations. Collectively, 63 percent of all private beekeeping entities in the United States are registered in these 6 States, an indication of the importance of pollination services to crop cultivation in these areas. In addition, the Upper Midwest States provide floral resources to foraging honey bees in the summer. Based on service fee data gathered from crop- and location-specific enterprise budgets, USDA/National Agricultural Statistics Service (NASS) production estimates, consultation with extension agents, members of the beekeeping industry, and university researchers, gross revenue from pollination services in 2012 is estimated at $655.6 million.

Almonds Account for Nearly Half of Collected Pollination Fees

The aggregated 2012 national-level pollination fee data reflect the findings of Caron (2011) and Caron and Sagili (2011) in terms of the relative importance of almond pollination to the commercial honey bee industry. Total almond pollination fees accounted for 45 percent of total fees collected in the same year (table 1).

Sunflowers are the second largest source of pollination fees, yet claim a comparably small 17 percent of total fees. The importance of almonds to the pollination services sector is clear; however, it is also apparent that a relatively small number of crops, compared to the total number that benefit from honey bee pollination, are responsible for generating the majority of pollination service revenues. Pollination of almonds, sunflowers, canola, grapes, and apples collectively acount for an estimated 88 percent of all pollination fees collected in the United States. Producers of the top 10 crops paid nearly 96 percent of all fees charged in 2012 (table 1).

The Provision of Pollination Services

The services of commercial honey bee pollinators are commonly arranged through a broker, and most beekeepers work on a contractual basis (Caron and Sagili, 2011). Brett Adee, one of the largest commercial beekeepers in the United States with more than 60,000 hives, notes that contract terms typically cover frame strength (measured in numbers of frames containing adult bees per hive, ranging from 6 to 12), pollination fee(s), date(s) of service, and various contingencies (Champetier, 2011). Contracted bees are transported to pollination sites by truck and can be shipped across the country on tractor trailers which typically carry between 400 and 500 hives each (Delaplane et al., 2013; Adee, 2014). Individual hives contain a single queen and commonly include between 10,000 and 30,000 worker bees, depending on the number of frames and hive health; by midsummer, a colony can include as many as 50,000-60,000 worker bees (Pettis, 2013; Sagili and Burgett, 2012).

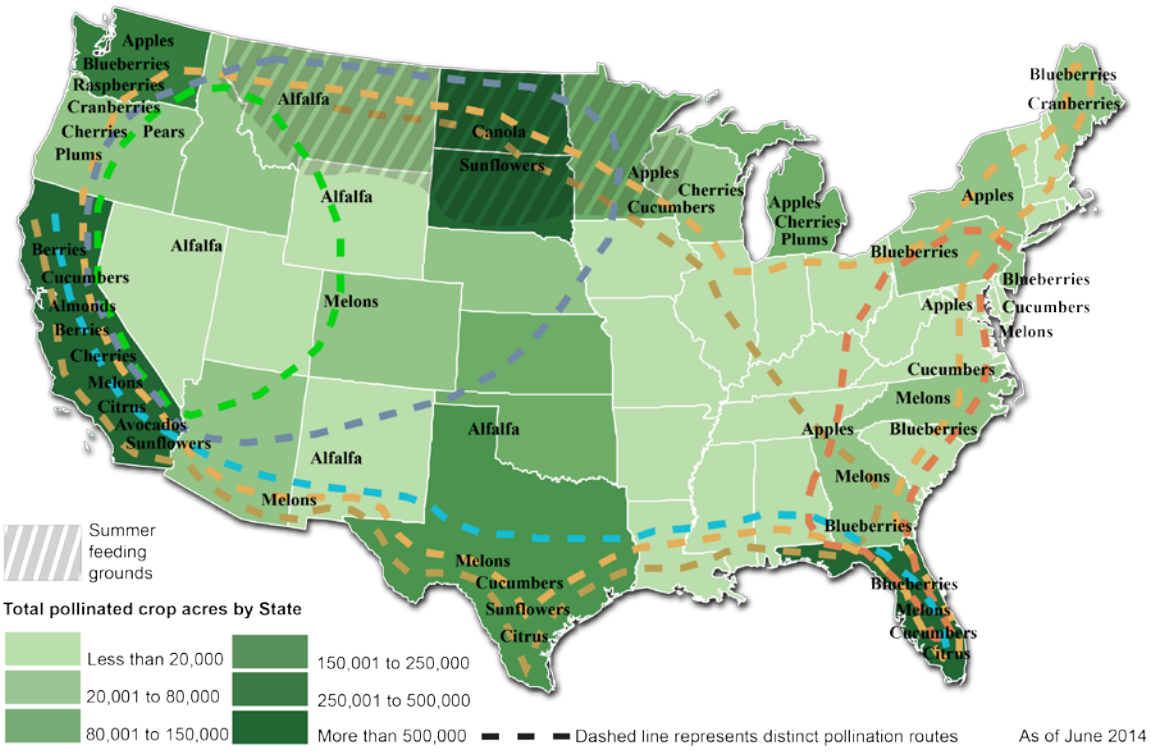
To minimize losses during transport, hives are covered with nets and loaded at night or before sunrise when bees are in their hives and relatively inactive (Drummond, 2002; Delaplane et al., 2013). Within particular fields, hives are placed in locations that maximize pollination potential while minimizing environmental stresses and pesticide exposure (Delaplane, 2010; Pettis, 2013; Adee, 2014). Numbers of hives placed per acre are typically prescribed according to crop type and in correlation to the number of flowers per acre that require pollination (Calderone, 2012). However, bees are known to fly 2 to 3 miles to forage, so neighboring producers with adjacent fields may also benefit from uncompensated pollination services (Delaplane et al., 2013; Pahl et al., 2011). The length of stay varies by crop and weather, though 3 to 5 weeks are typically required for bees to sufficiently pollinate a given crop (Adee, 2014).

Table 1: Top ten sources of pollination fees and shares in U.S., 2012

Crop	Pollination fees charged	Proportion of total collected fees
	---U.S. dollars---	*---Percent---*
Almonds	292,500,000	44.6
Sunflowers	110,460,000	16.8
Canola (seed)	108,927,000	16.6
Grapes	43,294,500	6.6
Apples	23,601,600	3.6
Sweet cherries	13,452,450	2.1
Watermelons	10,462,500	1.6
Dried prunes	8,525,000	1.3
Cultivated blueberries	8,215,200	1.3
Avocados	7,446,000	1.1
Total Top 10	***626,884,250***	**95.6**
Other Crops	*29,195,133*	4.4

Source: USDA, Economic Research Service calculations using data from USDA, Natural Resources Conservation Service and USDA, QuickStats data portal.

Figure 1: Pollinator movements and crops in the United States



Source: Adapted by USDA, Economic Research Service from Kautzmann (2011), with input from commercial beekeepers and apiculture experts, including Dr. Jeff Pettis and Dr. David Epstein, an entomologist and authority on pollinators with the USDA's Office of Pest Management Policy. Crop production acres are from USDA, NASS, 2012 Agricultural Census, 2014.

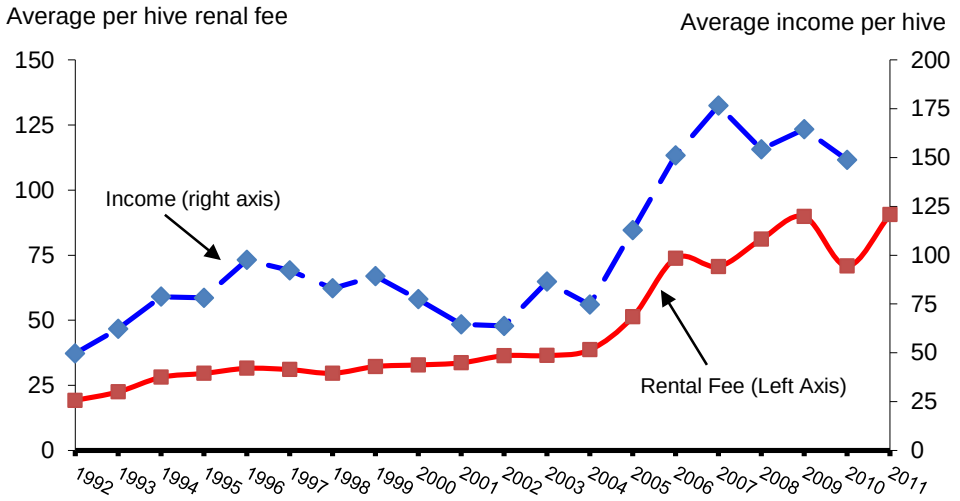
Commercial beekeepers tend to be semi-nomadic, often driving long distances to service clients' crops during peak bloom periods (Adee, 2014). Several common migration routes includes a stop in California to pollinate the almonds in early spring, between February and March (fig. 1). An estimated 60 to 75 percent of all U.S. commercial hives are employed for the State's almond bloom, and apiarists bring hives from as far away as Florida and Texas (Horn, 2006; Souza, 2011). Migratory paths diverge after the almond bloom; some beekeepers move their colonies north to service specialty crops, while others depart for Southern and Eastern U.S. locations or remain in California for their bees to forage in citrus groves and other nectar-rich locales. An estimated 65-80 percent of the Nation's commercial hives spend part of the summer in North and South Dakota, Montana, and Minnesota (Adee, 2014; USDA/NRCSa, 2014). At the end of the pollination season, hives are typically returned to overwintering sites in Southern States.

Average Pollination Fees on the Rise

Pollination fees for select crops have risen significantly in recent years (Carman, 2011). The average rental rate for a single honey-bee colony for almond pollination increased from $76 in 2005, just prior to a surge in honey-bee overwinter loss rates, to an average of $157 per hive in 2009, when a then all-time high was observed. The cost of honey-bee almond pollination services is believed to have risen in connection with increased costs of maintaining hives in the midst of an industrywide overwintering loss epidemic which is attributable to, but not limited to, colony collapse disorder (CCD) and in response to inelastic demand for pollination services, particularly for almonds (Carman, 2011; Rucker et al., 2012).

Spanning 26 years, an annual survey of commercial and semi-commercial beekeepers registered in Oregon, Washington, and Idaho provides further evidence of increases in pollination fees over time. Until 2004, rental rates appear relatively stable; between 2004 and 2005, per hive rental fees increased by 33 percent (Caron and Sagili, 2011). For the next several years, pollination fees increased at an average annual rate of 13 percent and contributed to an increase of 176 percent in the average per-hive pollination fee between 2000 and 2011 (from $32.85 to $90.62)

Figure 2: Average Pacific Northwest hive rental fee and income: 1992-2011



Sources: M. Burgett, 2011; D.M. Caron, R. Sagili, and M. Cooper, 2012.

(fig. 2). Much of the increase in pollination fees is attributable to expanded pollination of almond crops, which command a premium relative to fees charged for the pollination of other tree and row crops (Caron and Sagili, 2011; Caron et al. , 2012).[1] This premium is a function of the limited commercial value of honey produced from almond pollination and the higher management costs associated with preparing hives to pollinate an early-season bloom. Pollination fees can be reduced when valuable honey production results from forage activities (Browning, 2013; Cheung, 1973; and Rucker et al., 2012).

In 2010, hive rentals for the pollination of the California almond crop accounted for 27 percent of all rentals made by Pacific Northwest (PNW) beekeepers included in the Caron and Sagili (2011) sample and 52 percent of all rental income in the same region. The California almond bloom occurs before the bloom for a number of other fruit, nut, and row crops in the region (typically February thru March), and PNW hives have a shorter distance to travel to blooming orchards in Washington and Oregon than Southern and Eastern U.S. hives that also provide services for the almond bloom. Following the almond bloom, a relatively large number of commercial pollinators are in the PNW, resulting in lower pollination fees for regional row and orchard crops than in other parts of the United States, where pollinator supplies are relatively less abundant at that time (Browning, 2014).

Summary

Through the provision of pollination services, honey bees support the cultivation of an estimated 90-130 crops, the harvest of which, directly and indirectly, accounts for up to a third of the U.S. diet (Berenbaum, 2007; Crane and Walker, 1984; McGregor, 1976). Gross revenue generated from employing managed bees for pollination services in 2012 totaled $655.6 million. Fees collected from almond pollination are the largest source of service revenue followed by sunflowers. In recent years, average pollination fees have generally increased with much of the rise being attributed to increases in almond fees. Fluctuations in pollination fees over time have been linked to recent honey bee health challenges including CCD and a variety of diseases which have served to increase beekeeper management costs. Fee variations across crops are a function of bloom time, pollinator supply, and the quality and volume of honey that can be produced from related honey bee foraging activities.

[1] Honey bees make honey by first visiting flowers and gathering nectar that is then stored in a special “honey” stomach. In the honey stomach, enzymes convert (via inversion) sucrose in the nectar to glucose and fructose. Once the bee returns to the hive, the stomach mixture is then regurgitated into a cell of a honeycomb, after which, worker bees repeat the consumption and regurgitation process. Later, worker bees fan the inverted nectar with their wings to speed evaporation within the cell of the honeycomb. When the honey has evaporated to contain between 14-18 percent water, the cell is capped with wax and sealed. (Adapted from National Honey Board, 2014)

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