Economics of Food Security Challenge

Colony Collapse Disorder: Current and Future Effects on U.S. Food Production.

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Contents:

Section 1: Describe

A. A Snapshot of Honey Bee Industries and History
   a. Beekeeping History
   b. Commercial Development

Section 2: Analyze

A. Cross Referencing the Problem of CCD
   a. Pesticides and Genetically Modified Crops

A. Costs and Profit
   a. Seed Sellers and Pesticide Companies
   b. The American Farmer and Beekeeper

Section 3: Follow

A. Media and Culture Response

B. Government and Business Responses

Section 4: Works Cited
Can you imagine a world with no almonds? What about strawberries or blueberries? Can you imagine your garden missing half of its flowers and one ones it does have growing smaller and less vibrant every summer? The recent pandemic of Colony Collapse Disorder is a direct causation of a “perfect storm” of pesticides, environmental changes, and modified crops that is responsible for the loss of over 50% of North America’s honey bee population since the 1990s (Ballenger). Unfortunately, experts agree that the trend has only accelerated since the last in-depth studies, and virtually the entire bee population of North America will be gone within the next five years. Such an effect will astronomically raise prices on produce; put thousands of beekeepers out of business, and cost the consumer thousands more per year putting food on the table.

The honey bee, of the sub genus *Apis*, is one of over 20,000 species of bees in the world, and 44 subspecies in the genus. (Engel) The most common “domesticated” bee known for
producing honey, however, is the European Honey bee. Contrary to common belief, the European Honey Bee is not native to North America, and was first brought over in the mid-1600s by early Puritans. The greatest advantages to the two species were each other. The bees provided wax, honey, and pollination for many English plants including clover, which allowed for an easier growing of beef production. The bees in return were given shelter, as well as travel over mountains and difficult obstacles, allowing numbers to swarm and form new hives. As such, while there are many native pollinators in North America, the immigrated North American Honey Bee has become far and away the most numerous one.

Here, two beekeepers inspect honey production, with one holding a “smoker” likely filled with pine needles. Upon being hit with the smoke, the bees are instantly calmed, and attempt to clump up and clean the particulate off of them.

As the colonies were settled, beekeeping eventually became a commercial production in the Americas, using techniques that had been developed through hundreds of years. Bees spread quickly in the 1700s, with only two principal shipments of honey bees constituting the original bee populations (History of Agriculture). This rapid growth allowed many homegrown and commercial honey producers to simply walk out of their houses, grab a hive’s queen, and start their own hives en mass
Today, the same processes used back in the colonial days are still used. However, due to limited numbers of bees in crop growing areas, many companies have sprung up to transport dozens of hives containing thousands of worker bees from cash crop to cash crop, staying just long enough for the insects to do the job of pollinating the harvest (Commercial Bees). Indeed, until last year the largest beekeeping organization was in Arizona, until CCP hit their populations, leaving hundreds of hives completely barren but a few queens and brood inside them (American Beekeeping Association). The devastation meaning there is a massive strain on beekeepers to keep up with the third of all American produce that bees need to pollinate every year. This year, according to bee owners there were barely enough bees to successfully pollinate the California almond crop, and with hundreds of acres more being planted for next year, many beekeepers doubt they will have enough bees to successfully pollinate the cash crop (The Almond and the Bee).

Section 2: Analyze

With a $15 billion dollar agricultural industry on their shoulders, it appears that bee populations are floundering under pressure. Recent studies have shown that the current conundrum of CCD is traceable to a “perfect storm” of neonicotinoid pesticides, Varroa mites, Nosema apis parasites, and Israeli acute paralysis virus (vanEngelsdorp). According to the head beekeeper of the state of Pennsylvania, there were only 2.44 million honey bees in North America back in 2008, down from 4.5 million in 1980 and 5.9 million in 1947. Unfortunately, following this trend it appears that the populations are decreasing exponentially and not at a fixed rate, meaning that the a solution must be found soon or according to experts like
vanEngelsdorp, there may be no bees on the continent within a decade, and there will be no appreciable amount of bees to pollinate foodstuffs and fodder for cattle long before that. As of the mid 2000s, many scientists and company researchers were still battling back and forth over what could be causing such a rapid decline in bee population. Up until a few years ago many assumed that a fungus, *Nosema ceranae*, was behind flagging bee populations. However, a recent study by Harvard’s School of Public Health that suggests the main culprit is in fact the most common pesticide in the world: imidacloprid. The main author of the report, Alex Lu, recreated the believed environment in which CCP occurs in experimental testing. Over twenty three weeks, they tested four bee yards with different levels of imidacloprid exposure. In the first twelve weeks all of the hives appeared healthy, but at the end of the study 15 of the 16 imidacloprid treated hives were gone, with only the queen, a few young bees, and some dead

**Colony Collapse Disorder, Affected States**
workers clustered around each hive. The most striking finding in the experiment according to Lu was not the massive death toll of 94%, but that it only required trace amount of the chemical to cause CCD, less than what would be normally used in treating a corn crop or bee foraging areas.

While pesticides certainly a major factor in Colony Collapse Disorder, another highly likely suspect is genetically modified crops, such a corn manipulated to produce the *Bacillus thuringiensis* toxin. While there have been cases of colonies pollinating and foraging near Bacillus thuringiensis (Bx), producing crops with no cases of CCD observed, many beekeepers are drawing conclusions that while the toxin does not kill bees outright, it does weaken them to parasites, temperature changes, and other toxins and environmental factors (Genetically Modified Crops Implicated). In the most striking argument, it appears that the crops do not kill the bees at all, merely confusing them enough that they are unable to find their way back to the hive for the night and simply freeze to death (RFID Tracking).

Here is an example of CCD affected hives. Owners came to check on pollination rates one morning and found every hive to be completely empty aside from the queen and a few brood surrounding them.
However, while there are many compelling arguments over the main cause of CCD, the fact remains that there is very little consensus on the main factor causing the declining populations. Scientists have done their best to narrow the scope of the causes down to comparatively few, including: malnutrition, pesticides, aforementioned genetically modified crops, migratory beekeeping, lack of genetic biodiversity, beekeeping practices, parasites and pathogens, toxins in the environment, and electromagnetic radiation (Bee Deviled). Though a growing consensus is forming with beekeepers themselves that it is indeed pesticides that are harming populations the most.

Obviously, with bees such an integral part of America's agricultural security, something must be done to stabilize populations and quickly. But what how would such a collapse actually

**Figure 4:** US honey-producing colonies

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of honey producing bee colonies (x 1 000 000)</th>
</tr>
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<tr>
<td>1945</td>
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<td>1946</td>
<td>5</td>
</tr>
<tr>
<td>1947</td>
<td>4</td>
</tr>
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<td>1948</td>
<td>3</td>
</tr>
<tr>
<td>1949</td>
<td>2</td>
</tr>
<tr>
<td>1950</td>
<td>1</td>
</tr>
</tbody>
</table>

Data source: U.S. Department of Agriculture's (USDA) National Agricultural Statistics Service (NASS) NB. Data collected for producers with 5 or more colonies. Honey producing colonies are the maximum number of colonies from which honey was taken during the year. It is possible to take honey from colonies which did not survive the entire year.
affect agriculture? Additionally, how would a ban on these accused pesticides and modified
crops affect their producers, and indeed, the entire economy? Quite a lot it seems. According to
Monsanto’s own 2012 yearly earnings report, they had revenue in excess of $13 billion in 2012
alone, with a 14% growth from last year. (Monsanto Yearly Report) Additionally, they are now a
major beneficiary of the current presidential administration, having just signed a bill into law
preventing the EPA from taking any legal action against modified crop growers (Going To Seed).
As a whole, according to the EPA pesticide business was worth $39.4 billion in 2007, and one
can only assume that since food needs to be grown no matter what the industry was relatively
unaffected by the 2009-10 recession and slow economic growth, and can only be increasing
profits yearly. Indeed, one can only take a second look at Monsanto’s own data to see the
startling yearly growth rate. One must assume then that the outlawing of the world’s most used
pesticide would be a huge hit to profits, and dealing in genetically modified crops engineered to

Monsanto’s Yearly Sales and Operating Profits, as well as prospective performance into the
next decade show massive opportunities for growth.
produce pesticides, Monsanto would likely suffer huge losses unless able to develop new seeds to comply with a hypothetical ban on said crops and pesticides.

Upon further inspection, one must look at the effect of declining bee populations on the entirety of the US agricultural system. According to the Department of Agriculture, as of 2012 the combined net worth of the entire industry is $135.77 Billion dollars in exports, and $103 billion in imports for a total of $239 billion in net worth (USDA Economic Research Service). Considering that a full third of all plants eaten by civilized man are pollinated by bees, and that a plant pollinated by an insect is always more likely to produce greater quantity of fruit or root, and will always be tougher than non-pollinated plants, the bee industry must also be considered part of this wealth (Insect Pollination). On its own, the beekeeping industry is worth just over $14.6 billion, but following the logic of a third of our agriculture involving pollination, bees contribute up to $90 billion dollars of the United States’ agriculture, and far from just harming exports, a loss of bees would drive the costs of everything from tomatoes, to oranges, to apples, to cranberries through the roof. Indeed, it seems that in failing to address this issue quickly, we would lose far more in capital, at least on paper, than we would by continuing to use current methods and allowing the bee industry to die out, assuming that pesticides and genetically altered crops are the main causes of Colony Collapse Disorder.

Section 3: Follow

For many years, CCP was ignored by many news and media outlets. Indeed, aside from a few articles here and there in “Scientific American” or random blogs the discussion was usually only carried out in local beekeeping clubs. Now though, the media has readily hopped on the
bandwagon in bringing this issue to light. First, in February 2011, PBS aired an episode of *Nature* titled “Silence of the Bees.” Which focused on the mystery of why CCP is happening, the aspect of trucking bees across the country to pollinate certain crops and how agriculture depends on the aspect, and on the honey bee itself and what the world would be losing if it went extinct.

Following this, on April 2, 2013, *Dan Rather Reports*, devoted 35 minutes of an episode to reporting on the pollination efforts of bees on the almond crops in California, and interviewing beekeepers who insist that it is over-spraying of pesticides that are killing or crippling their hives (Buzzkill). In light of this, a movement is growing within the bee moving business, and many companies will no longer send hives to places that use pesticides or grow modified crops suspected of causing CCP in hives, costing companies thousands in contracts and fuel costs. In popular culture, there have been cases of protesters in France burning empty hives in the streets, arguing for the ban of modified crops EU wide. Such movements are also gaining ground in the US. Many beekeepers are beginning to question why their hive queens are only living one to two years instead of the usual four. Smaller beekeeping clubs that get their hives from commercial companies have to order more and more hives because they are not wintering as well in colder climates. (Interview) Gradually, though seen more as a fringe movement by most, the pro-bee groups are moving from “Greenpeace” to mainstream, with more and more reports coming out in papers such as the New York Times and Huffington post, focusing on the issues (Bee-Deviled).

Governments around the world have also responded to these claims, though they vary from country to country. The Northern Ireland Assembly released in their Minutes that they showed concern for the drastic decrease in bee populations, going so far as to call it a crisis
(Minutes From the Northern Ireland Assembly). They also stated interest in a full report by their Department for the Environment. Other countries like France, Belgium, Italy, and Spain have also reported drastic bee losses, and are all in different stages of research into pesticides and modified crops that could be to blame for their losses (Les abeilles.) The country that has taken the largest steps in an effort to preserve their bee populations, however, is actually Poland.

In the first research done in 2007, Poland quickly drew a link between their disappearing hives and corn modified to produce pesticides. On January 13, 2012 they banned both GM crops that the EU allows into Europe; both corn and potatoes sold by Monsanto. Since that time Poland has seen its bee populations suddenly spike back up. The trend continues as well. France has banned all GM crops since 2011. Currently, France is also the only totally agriculturally independent country in Europe, and by giving up these crops they have sacrificed much in economic returns, but have saved their important beekeeping industry and are able to maintain their returns based on natural pesticides and pollination alone.

Currently, the United States government has not done much in the way of serious action against pesticides or GM crops. However, the US Army Corps of Engineers has begun several studies in Montana on the effects of different pollutants on bees and pollination rates, working together with private scientists. Unfortunately, despite growing evidence proving pesticides and GM crops to be the main culprits in bee deaths, the Obama Administration recently signed into law the Agricultural Appropriations Bill, which features a “Farmer Assurance Provision” essentially ending the ability of the Environmental Protection Agency to conduct legal action against any seller of GM crops if found guilty of causing damage to an environment. So while
most agree on the cause of CCP troubles, legally nothing could be done about the situation. Moreover, the USDA currently has no plans to reimburse beekeepers that lose hives due to exposure to pesticide-treated crops. This leaves many beekeepers with absolutely nothing but hives to use are firewood.

China meanwhile, sat by and did nothing as their bee populations dwindled. Responsible for a large percentage of the world’s peaches, there are no natural pollinators in that part of the country to treat the whole harvest, and now companies are actually hiring human pollinators with feather dusters to treat individual peach buds on every tree. Sadly, the workers are paid in pennies, and it takes over 200 workers to pollinate roughly 50 to 60 trees a day, while a handful of hives could complete hundreds of trees. India has also had issues with disappearing hives. Bees from that part of the world are much more docile than the Western variety. Thus, in ever-growing villages, many simply go out during the day while workers are harvesting pollen and take the whole hive, honey and all. The end result is currently India only has 20% of its natural pollinators remaining, with many also dying to overwhelming pollution and human congestion.

Colony Collapse Disorder is a major issue in this country that must be solved quickly and decisively. Frankly, I personally believe that most numbers we have are severely understated, and if not handled quickly I believe, and the evidence supports, that there will be no serious amount of honey bees left in North America within the next five years. The results will be catastrophic with huge amounts of imports needed to meet demands for things like citrus and vegetables. Meanwhile, things we produce much of like almonds and berries, will become either non-existent or skyrocket in price. I believe this eventuality will cause the government
and industry to react and develop better pesticides that leave the bees alone, it may even end the process of genetically altering crops. However, I believe that by then it may be too late for the Western Honey Bee to come back due to low biodiversity. Now, all the average person can do is give the bees a voice, get out there and tell these companies that this is a major issue and sweeping it under the rug will not solve the problem. With a $200 billion dollar industry on the line, as well as all of our foods and vegetables, it is certainly the most important issue in agricultural security we face as a nation.

I feel that the only solution that could have a real and immediate effect on bee populations is a temporary ban on all neonicotinoid pesticides, and growth of GM crops. This ban should continue until well-planned and long-term studies can be carried out on the effect of such chemicals on bee behavior, not just bee fatalities. In addition, a wider campaign of information must be activated so that the American people will know that their agriculture is at risk. If the general public knew that 50% of the bees pollinating all their food were dead there will be much more pressure on the EPA to look into pesticide related bee deaths, and on Congress to draw a bill prohibiting or regulating their sale more readily. An overhauling of the “Monsanto Protection Act” would also free up the EPA in the future to ensure that pollinators are protected from farming chemicals and are able to successfully pollinate essential crops.

Also, commercial beekeepers should look into transporting bees more safely, and less distance to ensure that such travel times are not harming the hives, and try giving them real honey to eat while traveling instead of the corn syrup they are getting now. The snowball effect this would cause would hopefully allow the western honey bee to make a dramatic comeback on the continent. Frankly, while the pesticide business is a huge chunk of the US GDP, our agriculture as
a whole is much more important, and the honey bee is the hidden center of all of it. Bee-pollinated crops always produce more, always grow better, and always hold up to the elements and pests better than non-pollinated ones, and it would be a shame to lose so much value and food because we sat back and did nothing.
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24 Apr. 2013


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