Think Globally, Eat Locally

An Analysis of Williams College's Food Consumption

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Introduction

Food is such an essential part of everyday life that it sometimes becomes invisible, especially in an institutional setting such as Williams College. Students go to the dining hall, swipe their ID cards, serve themselves from prepared trays of food, eat with the provided utensils, and return their dirty dishes to be washed. It is all too easy to become blind to the larger context of food production when one sees neither the raw ingredients nor the preparation; we don't even directly pay for our food, let alone touch or interact with it in its raw state. Even students who cook for themselves usually buy their ingredients in a supermarket, where casual shoppers can trace the origins of their purchases only as far as the crates in the walk-in cooler or the trucks at the loading dock. The grocery store is only slightly more informative than the dining hall. Where does food really come from? How is it produced? And what are the impacts of its production? Not only do people not know the answers to these questions, but many people have forgotten even to think about asking them. This thesis strives to address some of these issues in the context of Williams College's food consumption.

Due to limitations on time and availability of data, this thesis addresses only the meat and dairy products consumed at Williams. These sectors are of interest for several reasons. First, together they make up approximately half of the total food expenditures of the College. This means that these sectors have a considerable economic impact. Second, livestock production can have very significant environmental impacts. Third, meat and dairy products can be produced locally, which means that there is good potential for positive change in these sectors. And fourth, although an effort to trace the production of these commodities faces many significant challenges and obstacles, these items are somewhat more traceable than other products that undergo further processing before arriving at Williams.

The impacts of on-site food preparation, while certainly important, are not examined in this thesis. They are already being addressed to some extent by Bob Volpi, Director of Dining Services at Williams, who is very interested in improving the efficiency of the various processes involved in preparing and cleaning up from meals in the dining halls. Furthermore, most of the components of food preparation that have environmental impacts also have direct costs to the institution. Water, electricity, and waste disposal, for example, all must be paid for directly. Therefore, wastefulness is negative not only from an environmental standpoint but also from an economic perspective. This direct monetary feedback means that efficiency of resource use in on-site food preparation processes is already on the radar screen.

The impacts of agricultural production, on the other hand, are often much more difficult to track through existing and obvious channels. While of course agricultural producers do pay for many of their inputs (water, electricity, fuel for machinery, fertilizers and pesticides, etc.), the effects of these inputs are much less internalized in the system's economic structure. For example, chemical inputs such as fertilizers and pesticides have impacts such as environmental contamination and human health effects that are not factored into the monetary costs of the products. Because these externalities do not have direct costs to the farmers and consumers, they often receive much less attention than those impacts that have both environmental and economic dimensions.

What's more, alternatives exist by which the impacts of agriculture can be greatly reduced. Organic production is a technique that is gaining popularity and prominence, but it remains a niche market whose products are significantly more expensive. While purchasing organic products would certainly reduce the environmental impacts of Williams' food consumption, it may not be the most cost-effective way to spend the limited funds available for alternative food products. Purchasing locally-produced products is another option; this strategy reduces the impacts caused by the transportation of the food. In addition, the agricultural operations present in the Berkshire Region are quite different from the large-scale industrial agriculture of the midwestern and western United States, and many of them maintain a degree of environmental consciousness. Both of these alternative options (organic and local) are explored here.

Institutions the size of Williams College are large enough to have significant impacts through their patterns of consumption. It takes a lot of food to feed close to 2000 people; the process of production of this food certainly affects its surroundings. Furthermore, Williams' size means that it can have some influence on the market through its purchasing. Increasing demand for alternative products will ultimately encourage increased production, which will translate into lower prices as the startup and capital costs are distributed over a greater number of production units.

In addition, Williams could provide a large and steady demand for the region's production. This would be very beneficial to small producers, who need guaranteed sales to ensure their profitability. The constant demand created by Williams (and perhaps other local institutions that follow our example) may contribute to the maintenance of agriculture as a viable component of the region's economy. Because agriculture, which has been an important part of the region's culture and economy for centuries, is experiencing a severe decline, purchasing food from local producers will not only decrease the environmental impacts of the College's food consumption but also help maintain this region's cultural identity.

But all this begins with a look behind the steam table or the supermarket packing crate. In order to make sound, informed decisions about food consumption, it is necessary to understand the context in which the decisions are being made, the constraints within which the institution operates, and the implications and consequences of the various options. This thesis begins with a discussion of the historical, economic, social, and environmental context and consequences of food production in the United States and in Berkshire County. It provides a snapshot of the present state of agriculture on the national and local scales as well. It then presents information on the quantity of food consumed at Williams and the geographic origins of these products; these sections are followed by a set of quantitative estimates of various environmental impacts of the production of the food consumed at Williams. Lastly, this information is used to inform an action plan that would help improve and mitigate the environmental impacts of Williams' food consumption.

Chapter One
National Context

In order to fully understand the complexities of the current food supply situation, it is important to place the present in context. Therefore, this chapter presents an overview of the development of agriculture in the United States followed by a description of its current status. The environmental impacts of agriculture are another important component of the context in which this study is operating; the next section of this chapter discusses these impacts. The last section of this chapter describes some of the alternative food supply movements that have taken root during the past years and decades as a response to the current trends in agriculture.

Historical Background: Agriculture in the United States

Agriculture has been a key part of life in the United States since long before this land area had that name. The Native Americans cultivated flat, fertile lands along river valleys and coasts, developing sophisticated polycultural cropping systems and managing the productivity of the land through fertilization and rotational planting. Because the land in more hilly or mountainous regions was more difficult to till and cultivate, Native American agriculture remained confined for the most part to bottomlands. The uplands were reserved for hunting game and gathering forest products

The so-called "three sisters," corn, beans, and squash, were the mainstay of Native American agricultural production. Corn was planted first, in hills often fertilized with fish. Beans came next and used the corn stalks for support; being legumes, they helped enrich the soil with nitrogen. Squash was then planted between the hills of corn and beans, acting as a groundcover and weed suppressor. Together, these three crops provided very good nutrition for their cultivators.

Despite the successes of the Native Americans' agricultural practices, the early English settlers had some trouble establishing agricultural productivity in their new homes. The earliest permanent settlers of the South, who established themselves at Jamestown, VA, came unprepared for the hard work that would be required of them in order to achieve self-sufficiency. They spent several years dependent on imports from Europe and the mercy of the local Powhatan Native American population. When Sir Thomas Dale arrived in 1611, he brought men and cattle and began the first real efforts at colonial agriculture. Dale brought 100 head of cattle and 200 pigs; his agricultural efforts focused on livestock husbandry and the raising of corn.[1] Tobacco, which became one of the South's most important cash crops, was first cultivated by the colonists when John Rolfe planted it in 1612.[2]

The subsequent decades were characterized by liberal land policies designed to encourage the establishment of more agricultural operations. By 1629, Virginia had 5000 people, 2000 head of cattle, 3000 head of other livestock, and plenty of corn, as well as fish, deer, and other natural resources that were plentiful in the area.[3] Efforts were made to grow silk, flax, and hemp, but these met with little success, especially compared to corn, tobacco, and livestock raising.

Maryland followed Virginia's model beginning in 1634; its settlers also grew corn and tobacco and raised hogs, poultry, and cattle. Agriculture in the Carolinas and

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[1] Carrier 121 (Footnotes in this paper give the author's name, the date if necessary to distinguish between multiple works by the same author, and the page number; full citations for the works can be found in the References section, which begins on p.108.)
[2] *Ibid.* 124
[3] *Ibid.* 127

Georgia developed along a somewhat different track. These regions were settled several decades later, and their most important products were rice, indigo, cotton, and some silk. During this early period, all the settlers also produced staple foods (corn, wheat, beans, and peas) for their own communities, as inter-colony trade was extremely limited.

In the North, the Pilgrims arrived at Plymouth during the winter of 1620 and began farming in the spring of 1621, when they planted 20 acres of corn and five acres of grain and peas.[4] They brought little with them in the way of agricultural supplies; the first livestock to arrive were three heifers and a bull, which were brought over from England by Edward Winslow in 1624. No horses or sheep were present at this settlement until after 1627, although the nearby Massachusetts Bay Colony had more livestock during this time. The Pilgrims began with a system of common land ownership, but they abandoned this system and moved to a private property system within a few years. Other settlements were begun in the region during these years, and their residents pursued similar agricultural efforts. They grew corn, beans, wheat, rye, oats, barley, and vegetables.

The Northern settlers' efforts to raise livestock were hampered for a while by the difficulty of importing animals from Europe. In 1630, for example, 200 cattle were shipped from England, and 70 of these died during their voyages.[5] But enough animals were successfully imported during the 1630s to establish self-sustaining herds; these were fed on straw, corn stalks, and marsh hay. The native forage was generally found to be inadequate, so pasture plants were imported from Europe, but they took some time to become widespread. By 1650, the Northern colonies were producing surplus goods, especially meat products, for export.

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[4] *Ibid.* 140
[5] *Ibid.* 144

The Middle Atlantic colonies, especially Pennsylvania, were settled in the mid-1600s and benefited from the advances that had been made by their neighbors. They were able to obtain livestock and assistance with cultivation from the Northern colonists. Pennsylvania quickly became the leading colonial producer of wheat, which was raised as a cash crop and exported to the Southern colonies and to the West Indies. The colonists in Pennsylvania also grew corn for their own consumption, along with barley, oats, rye, peas, beans, squash, and other such crops.

Trade quickly became an important component of the colonial economic system. The Southern colonies exported tobacco, rice, and indigo to Europe; because these were goods that could not be produced in England, the demand was quite high. The Northern and Middle colonies, on the other hand, produced essentially the same agricultural goods as were produced in Northern Europe, so their exports were directed to the West Indies and to the Southern colonies, which were so focused on their own export crops that they produced insufficient staple goods for the survival of their residents. The chief exports from the North and Middle colonies during the 1600s were wheat, beef, pork, peas, and corn, along with some live animals.

Colonial agriculture continued in approximately the same vein until the Treaty of Paris was signed in 1763, ending the French and Indian War. The relative peace that followed this treaty opened new lands for English settlement. To this point, the colonists had settled a strip of coastal plan approximately 100 miles wide; after 1763, they pushed further inland and up river valleys to find new resources and new land to cultivate. Northern New England, upstate New York, and western Pennsylvania were the next areas to be settled. The colonists who pushed north remained somewhat connected to the coastal settlements, while those who moved across the Alleghenies into the Ohio River valley were somewhat more removed, for there were no good ways to transport goods back east.

These pioneering colonists followed essentially the same pattern that had been established in the coastal settlements, growing crops (mainly corn, rye, wheat, and potatoes) for their own subsistence and raising livestock for the same purpose. They cleared land either by girdling trees and waiting for them to fall or by felling the trees by hand and burning the slash as it lay on the ground. The former method was better for the soil in the long run, but it required several years before it really paid off; the latter, on the other hand, produced a cash crop of potash in the first year. Colonists who wished to settle on the land generally chose to girdle their trees and wait for the benefits, while those who were more interested in moving further and further west were more likely to clear the land by burning.

Colonial agricultural methods advanced very little from the early part of the seventeenth century to the end of the eighteenth. Farmers in the Eastern colonies practiced little crop rotation and failed to take advantage of the natural fertilizer that their livestock's manure provided.[6] (In their defense, though, many of the animals ran more or less wild, so the collection of their manure would have required an extraordinary effort.) Some colonists followed the example of the Native Americans and used fish to fertilize their corn crops; others used seaweeds that washed up on the shoreline. These practices were not widespread, however, and many of the eastern soils became exhausted after many decades of continuous cultivation.[7]

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[6] Bidwell and Falconer 86-7

[7] Trautmann, Porter, and Wagenet 1998a

Like the cultivation practices, colonial methods of livestock husbandry remained essentially unimproved during this period. The Northern colonists had not yet devised a good program of winter rations for their animals, most of which also were without adequate shelter during the winter months. There was little specialization in cattle raising – dairy and beef cattle were undifferentiated. Most of the cattle that were butchered were either old cows or worn-out oxen; the dressed carcasses averaged around 400-500 pounds.[8] The dairy industry was developing, but the cheese and butter produced during this time were generally considered to be of poor quality and were consumed almost exclusively in the homes of those who made them.

During the later part of the 1700s, regional specialization began in the Northern and Mid-Atlantic regions. Wheat began to fail in New England due to soil exhaustion and to the persistent plague of the "blast," or black stem rust. Wheat also became cheaper to import than to produce at home due to the success of Pennsylvania's wheat production. As a result, New England's farmers focused their attention more on corn production and on livestock husbandry. Rhode Island's farmers, who generally held farms many times larger than their counterparts in the rest of the region, specialized in livestock production. The Mid-Atlantic region's wheat production met with continued success; these states exported wheat to New England in ever-increasing quantities.

Improvements in agricultural equipment during the early 1800s benefited all farmers, allowing them to plow and harvest more efficiently. Farming practices improved during this period as well. Farmers began to employ techniques of crop rotation, including clover and other leguminous plants to help replenish the soil's nitrogen stores. They also began to make better use of their on-farm manure as a fertilizer for their

[8] Bidwell and Falconer 108

cultivated fields. Other soil amendments came into use as well, including gypsum and lime.

The first half of the nineteenth century also saw the development of a thriving industrial sector in the Eastern United States. These manufacturing operations attracted a large labor force; the growing urban populations meant an increase in demand for agricultural products coupled with a decrease in the labor force available to produce them nearby. These developments spurred the agricultural producers on the western frontier (the Ohio and Mississippi River valleys) to transport more of their crops back east to feed the hungry factory workers. This established a relationship of interdependence between East and West: the Western farms provided agricultural goods to feed the factory workers, while the Eastern factories provided manufactured goods for the Western farmers.

The construction of a system of railroads and canals during this period spurred the development of commercial agriculture in what is now the Midwest. The opening of these new modes of transportation drastically reduced the cost and hardship of transporting frontier goods to the Eastern markets. The frontier region also developed some of its own commercial centers; Cincinnati and Chicago became centers of the meat-packing industry in the mid-1800s. Meat and wheat were the chief export crops of the Western states, but corn production was also extremely important. Corn could be grown in vast quantities on the fertile soils of Kentucky, Ohio, Indiana, Illinois, Iowa, and Missouri; it was produced as feed for fattening cattle.[9] This fattening industry was a critical component of the Western meat industry; this is still true today.

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[9] *Ibid.* 264

These developments meant that agriculture on the East Coast had to undergo some reorganization. New England was particularly hard-hit, as nearly every agricultural product the region's farmers could grow was produced in greater quantities and at a lower price elsewhere. In a speech at a Concord, MA, cattle show in 1838, William Buckminster described the situation along with his idea of a solution as follows:

> The times are changed and we must change with them. … The virgin soils of the west and the increasing facilities of intercourse with that region render it probable that much of our grain will be imported thence; and when no obstacles are thrown in the way of progress, this is no evil. We purchase, not because we cannot produce the same commodity, but because we can produce others to more profit. Let them supply our cities with grain. We will manufacture their cloth and their shoes. Our artists may eat bread from the west – we will supply them with what cannot be brought from a distance.[10]

Buckminster's prognostications were quite accurate, as this is exactly the course that New England's farmers pursued. Wheat, corn, hogs, beef, and sheep had all been rendered unprofitable by environmental and economic conditions, so they focused their efforts on dairy products and other fresh goods that could not withstand the voyage from the West. The growing manufacturing sector provided other employment to some displaced farmers and continued to provide a demand for milk, butter, cheese, and other fresh farm products that had to be produced nearby. In addition, further improvements in agricultural technology also aided the New England farmers and helped them stay in business despite the competition from the Western region.

The mid-1800s also saw the development of agriculture and the growth of settlements on the West Coast. Alfalfa became an important crop in California and the Pacific Northwest. Meanwhile, the Corn Belt was relatively stable in a location very

[10] Quoted in Bidwell and Falconer 256

similar to its present one (Iowa, Missouri, Illinois, Indiana, and Ohio), while the Cotton Belt pushed westward toward Oklahoma and Texas as southeastern soils became exhausted.[11] The upper Midwest also produced large quantities of wheat; Wisconsin and Illinois were the nation's leaders in this crop.

The expansion and improvement of the railroads during the latter part of the nineteenth century allowed the pioneers to continue pushing the frontier, transporting people and their equipment and supplies one way and the produce of their agricultural operations the other. The advent of barbed wire allowed large-scale fencing on the Plains and throughout the West; this allowed pioneer homesteaders and semi-nomadic stockmen to define the boundaries of their properties more clearly. The frontier mentality remained predominant through the end of the century as farmers continued to practice intensive agriculture on a given parcel of land until the soil was exhausted and then moved on.

The late 1800s were the beginning of the end of the pioneer era. Homesteads continued to spread across the Midwest and West until the majority of the nation's agricultural land was privately owned. The number of farms and the number of acres in farmland in the United States increased by close to 300% during the last 40 years of the nineteenth century.[12] As their mobility and their number increased, farmers began to be more conscious of the need for improved agricultural practices that would help them deal with soil erosion, livestock diseases, pests, and climatic variation.

Irrigation systems began to develop at the very end of the nineteenth century. The Reclamation Act of 1902 aided the spread of these new technologies; 25 irrigation projects had been initiated under this act by 1915.[13] The development of new strategies to

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[11] Rupnow and Knox 30
[12] *Ibid.* 62
[13] *Ibid.* 56

increase productivity allowed the western United States to become the nation's breadbasket, the source of approximately one quarter of the nation's hog production, one third of the country's cereals, and one half of the wheat, cattle, and sheep produced during this period.[14] At this time, cattle were predominant in the Southwestern and Mountain regions; Idaho, the Dakotas, and Oklahoma also produced grains, vegetables, fibers, and other cash crops.

The first twenty years of the twentieth century brought ever-increasing mobility, technological advancement, and political organization to the farmers of the United States. Agricultural production was dedicated more and more to cash crops and marketable commodities instead of to the products necessary for self-sufficiency. Urbanites and rural dwellers alike came to depend on the country's growing transportation infrastructure to satisfy their daily needs. Many farmers organized themselves into cooperatives that shared machinery, processing equipment, and marketing efforts.

During this period, various regions of the country became more specialized than ever. New York and the Great Lakes states developed a strong dairy industry; the states of the northern plains specialized in wheat; the Mountain states fenced more land for the raising of cattle; California began exporting produce to the rest of the country. Between 1910 and 1920, tractors and other farm machinery were improved and mass-production began. This made this equipment more affordable and more available to the average farmer, sparking a period of rapid and widespread mechanization. The end of that decade and the beginning of the 1920s also saw increased development and use of agrochemicals, and researchers also improved the understanding of crop genetics and hybridization.

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[14] *Ibid.* 62

In the 1920s, the number of farms in the U.S. began to decline and the average farm size began to increase. The increased use of machinery drove productivity per hour of labor up and decreased the cost of production for many commodities. In addition, the end of World War I left many Europeans in need of food; the United States' farmers stepped in to meet this need. However, when this post-war boom came to an end, the U.S. farmers found themselves producing so much surplus that they caused prices to drop and could not sell all the crops they produced.

Adding to these economic woes was a series of climatic challenges; a long dry period coupled with soils depleted and destabilized by ten to fifteen years of monoculture led to the Dust Bowl. Farming in the United States did not recover fully until the country entered World War II, when another wartime boom began. Fertilizer use increased from 8.3 million tons in 1939-40 to 12.5 million tons in 1944 as farmers strove to improve their productivity.[15] The circumstances of this period made farmers even more dependent on their machinery, as much of the work force was absent due to the draft and to the war industries. The 1940s saw another tractor boom; by 1950 there were more tractors than horses present on farms in the U.S.

Between 1950 and 1975, total farm output in the United States increased by more than half on slightly fewer acres and with 60% fewer hours of labor required to produce any given commodity.[16] During this same period, yields per acre of corn, cotton, wheat, and soybeans nearly doubled.[17] Despite (or perhaps because of) this vast increase in

[15] *Ibid.* 100
[16] *Ibid.* 109
[17] *Ibid.* 113-116

productivity, the number of farms in the U.S. in 1975 was 2.8 million, about half of the figure from 1950.[18]

In 1975, the agricultural specialties of the country's regions remained essentially unchanged from the beginning of the century. Farmers in the Northeast accounted for about six percent of the United States' total agricultural productivity, focusing their operations on dairy products, some broiler chickens, and some vegetables and fruits. The Mid-Atlantic region produced eight percent of the U.S. total; this region specialized primarily in tobacco and secondarily in peanuts, cattle, and dairy products. The Southeastern U.S., whose farmers accounted for seven percent of the nation-wide total agricultural production, produced mostly peanuts, cotton, broilers, cattle, and produce. The Mississippi Delta region produced six percent of the country's total, most of it through cotton, rice, soybeans, and livestock.

The Midwestern states, as mentioned above, retained their Corn Belt status and produced 25% of the U.S. total agricultural output, including some soybeans, wheat, beef, and hogs, in addition to corn. The Plains states, which produced over 60 percent of the nation's wheat, made up almost another 25% of the country's total agricultural product. Texas was the nation's leader in cotton and beef production. The Great Lakes states maintained their focus on dairy products, which were supplemented with hay, forage, and pasture. The Mountain states held onto many of their large farms and continued to produce livestock and irrigated crops, contributing seven percent of the U.S. total output. The West Coast, which made up eleven percent of the country's total, produced mainly wheat, fruit, and vegetables.[19]

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[18] *Ibid.* 130

[19] *Ibid.* 131-137

These regional product specializations have remained similar over the past few decades, but there have been some changes in the process of production. The overall amount of farmland under cultivation has decreased, as has the number of farms in operation; average farm size has increased significantly. Mechanized equipment has become even more prevalent, as have chemical inputs such as fertilizers and pesticides. Genetically modified crops have also come into use. From 1996 to 2004, a total of about 670 million acres of GMO crops were planted.[20] Corn, soy, and upland cotton are the three main genetically engineered crops currently in production; as of 2004, 45% of the corn, 85% of the soybeans, and 76% of the upland cotton grown in this country were genetically engineered varieties.[21] The impacts of genetically modified organisms on the environment and on people have not been very well characterized as yet; it remains to be seen what this trend will mean for the future of agriculture.

Thus, the past 400-plus years of agriculture in the United States have been characterized by a dynamic, ever-evolving process of cultivation. Agriculture has moved from subsistence production at a local level to complete integration with the global economic system. It is now nearly impossible to tell where a particular crop will end up or where a particular food product originated. This progression from small to large, from local to global, has been a mixed experience, full of both beneficial and detrimental effects. It is a process that will continue to evolve into the future; its current status is described in the next section.

[20] Benbrook 2004, 5
[21] *Ibid.* 44-46

Present Status of U.S. Agriculture

Today, the food consumed by people in the United States comes from many disparate and non-local sources – this is easy to see simply by walking through any supermarket. Agriculture in the United States has total annual sales of over 200 billion dollars and production expenses of approximately 173 billion dollars.[22] Nearly one billion acres are currently in production, divided into several uses as shown in Figure 1. The number of farms[23] operating in the country is approximately 2.1 million; the average farm size is 441 acres. This figure is somewhat misleading, though, because of the distribution of the total farmland and income across the farms. As shown in Figure 2, about two-thirds of farms in the country fall into the two smallest size classes (less than 180 acres). Figure 3 illustrates the inverse trend between the percentage of the total farms that fall into a given size class and the percentage of total farm income that falls into that class. In fact, the number of farms reporting a net gain (993,861) is lower than the number of farms reporting a net loss (1,134,879) from their agricultural operations.

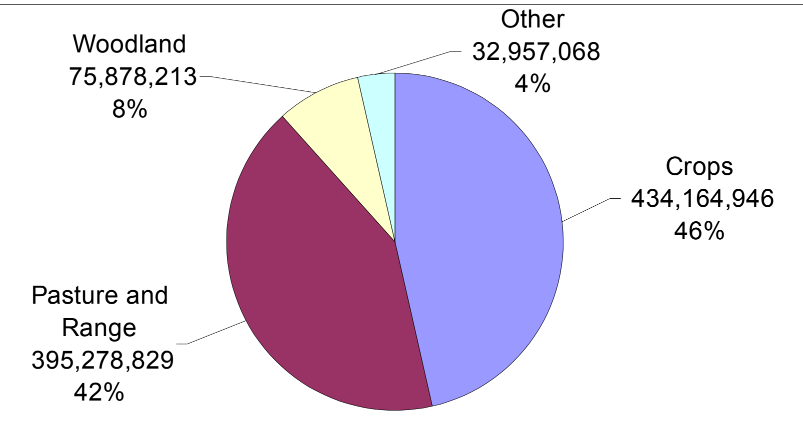

Figure 1. Agricultural land use distribution, United States, 2002.

[22] This and other statistics in this section are derived from USDA/NASS 2004a unless otherwise cited.
[23] For the purposes of the U.S. Agricultural Census, a "farm" is defined as "any place from which $1,000 or more of agricultural products were produced and sold, or normally would have been sold, during the census year."

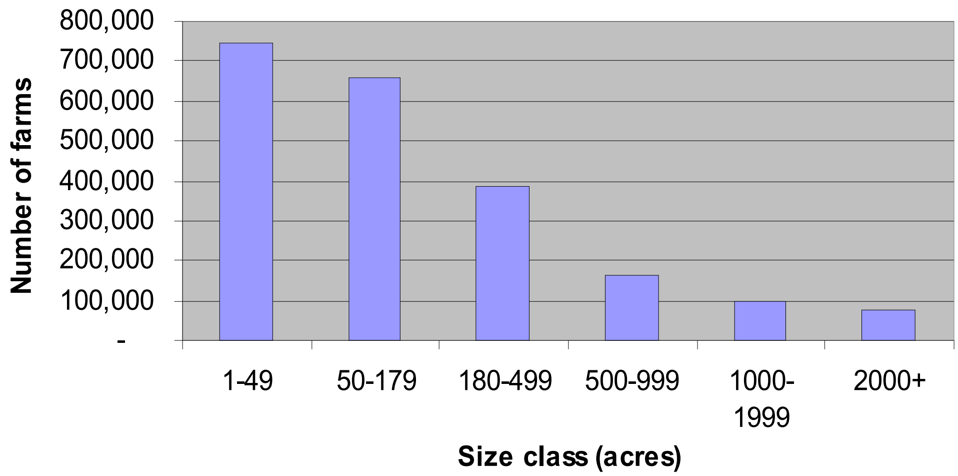

Figure 2. Size Distribution of U.S. Farms, 2002

The total value of livestock, poultry, and their products sold annually in the United States is currently about 105 billion dollars, distributed as shown in Figure 4. Millions upon millions of animals are raised in this country; Table 1 presents a summary of the numbers of various types of animals that were present in the U.S. in 2002.[24] These animals are raised on nearly 400 million acres of land.

The total value of crops sold annually is approximately 95 billion dollars; these products are distributed as shown in Figure 5. The acreage dedicated to various crops is presented in Table 2.

Agricultural practices are becoming more and more consolidated. In livestock operations, herd sizes are increasing and speed of growth is prioritized. Beef production is a good example of this phenomenon (see Figure 6, which shows the number of cattle in feedlot operations of varying sizes).[25] As described by Michael Pollan in his essay entitled "Power Steer," the life of a typical beef cow goes something like this. For the

[24] Figures in this table are from USDA/NASS 2004c.

[25] Similar figures can be seen in USDA/NASS 2004a for hogs (Table 23) and poultry (Table 27).

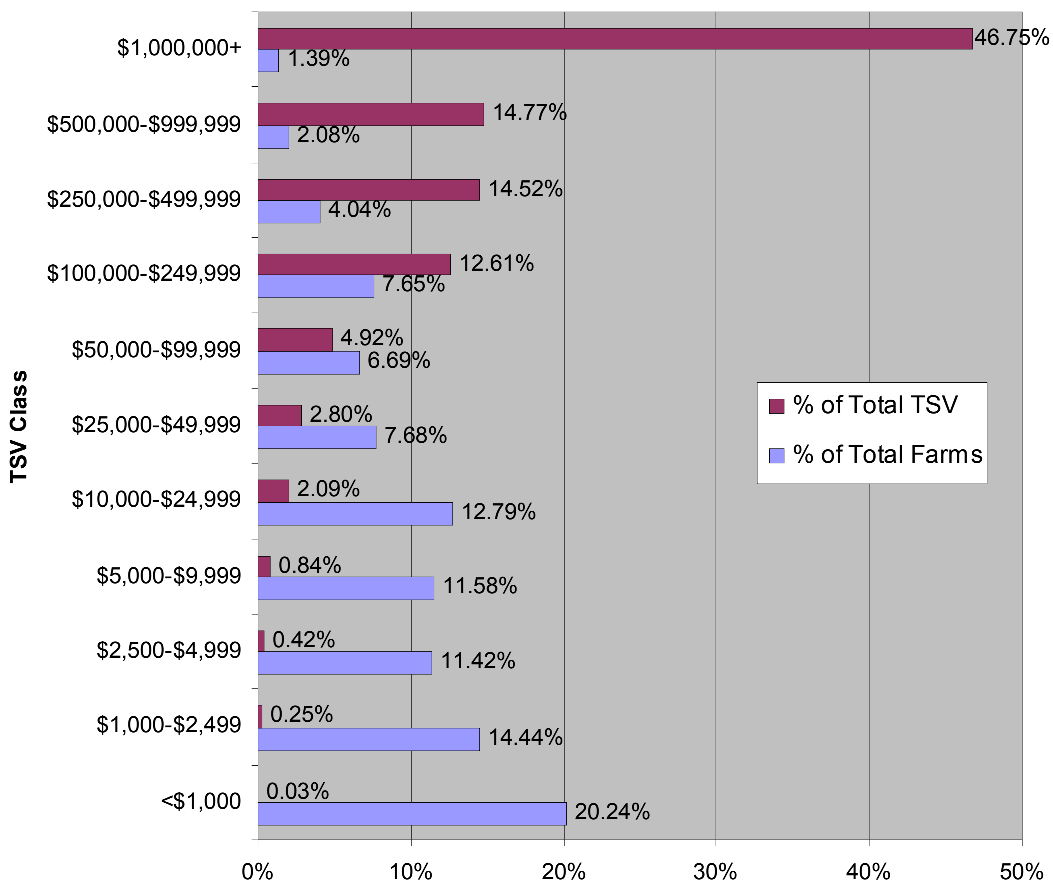

Figure 3. Total Sales Value Distribution in U.S. Agriculture, 2002.

first six months of their lives, calves destined for slaughter live on ranches scattered throughout the Midwest and West, grazing on a variety of grasses. They are then weaned from their mothers, and the industrial beef production process begins. The calves are sent to feedlots, where tens of thousands of cattle are packed into pens and fed from concrete troughs. Their rations are made up of about 25 pounds of corn per day plus another 7 pounds made up of hay and silage, fat and protein supplements, vitamins, antibiotics, and hormones. The fat and protein supplements contain ingredients such as beef tallow, feather meal, fish, remnants from pig slaughterhouses, and chicken manure. “Protein is protein” and “fat is fat” are the mottos of these operations, although the animal rendering

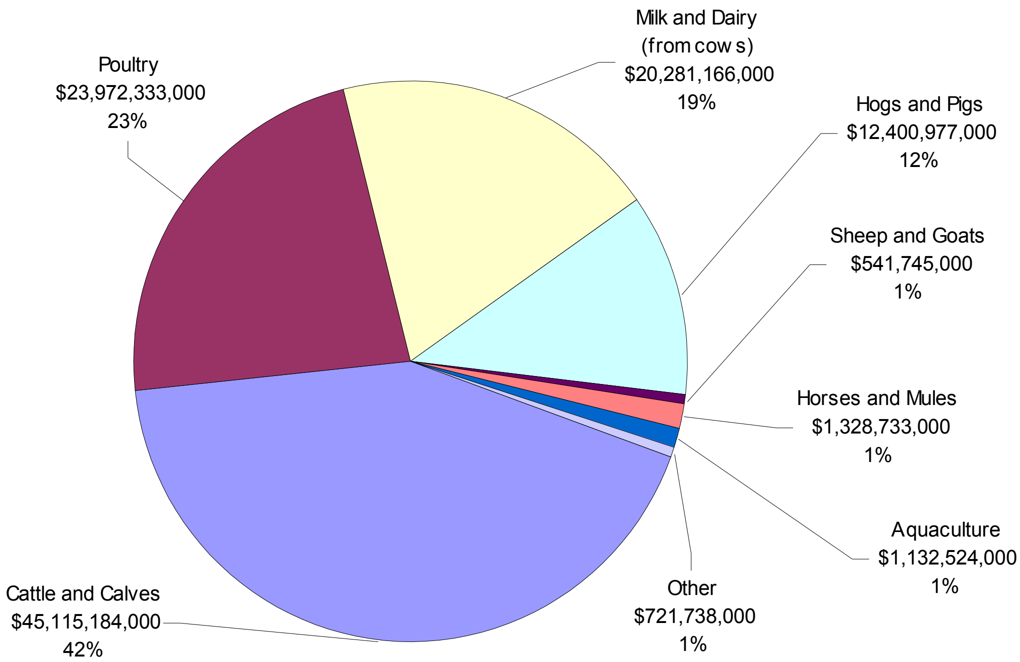

Figure 4. Total Sales Value of U.S. Livestock and Their Products, 2002.

components that can be included in feed have been limited somewhat since the Mad Cow scare.

The antibiotics that are included in the feed mixture, which are necessary to prevent disease due to the crowded and unsanitary feedlot living conditions, are some of the same ones that are used in human medicine; this can lead to problems of resistant strains. In fact, some of the deadly strains of bacteria (*E. coli* 0157, for example) that have caused severe illnesses and deaths in recent years are found in the guts of more than half of feedlot cattle, where the acid environment created by corn consumption coupled with high ambient levels of antibiotics drive a process of natural selection for bacteria that can

Table 1. U.S. livestock production, 2002.

Livestock Category	Number (1000s)
Cows (Meat and Dairy)	96,704
Hogs and Pigs	59,554
Sheep and Lambs	6,685
Chickens	9,034,061
Turkeys	272,429

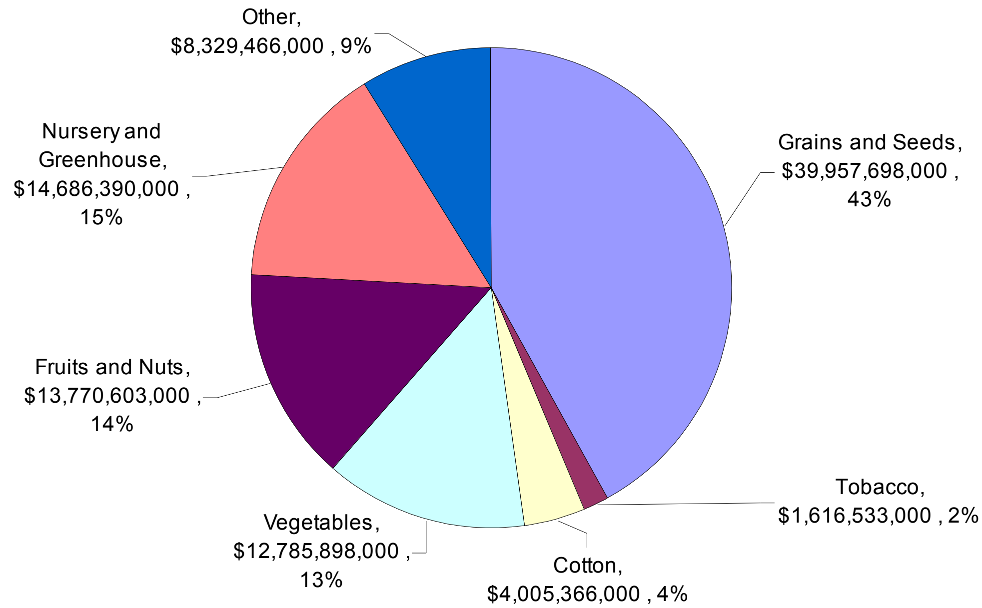

Figure 5. Total Sales Value of U.S. Crops, 2002.

survive in human digestive tracts and resist antibiotic treatments. The hormones, generally a form of synthetic estrogen, have not been shown to cause human health effects, but neither have they been proven safe. Observable levels of hormones do show up in meat, and fish living downstream from feedlot wastewater discharges have been observed to show abnormal sex characteristics.

On these rations, the calves grow into steers at a rate of approximately 3.5 pounds per day. However, this extremely rapid rate of growth has its drawbacks – many of the animals suffer from inflammation and diseases of the rumen and liver. These problems would claim many cows' lives if it were not for the high doses of antibiotics that they are fed; as it is, they cause illness and discomfort. The cause of these problems is the corn rations that the animals are consuming – cows are

Table 2. U.S. crop acreages, 2002.

Crop	Total Acreage
Corn	74,914,518
Soybeans	72,399,844
Wheat	45,519,976
Cotton	12,456,162
Rice	3,197,641
Vegetables	3,698,744
Orchards	5,330,439
Tobacco	428,631

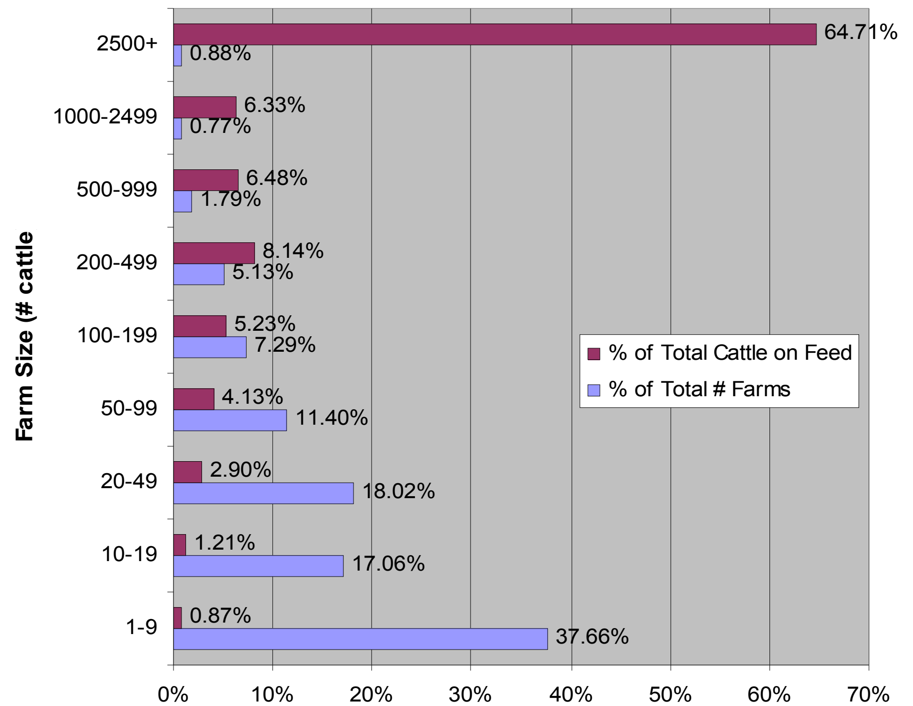

Figure 6. Herd Size Distribution of U.S. Cattle on Feed, 2002.

well-adapted to consuming grass and forage, but their digestive tracts cannot handle a grain-based diet. At the time of slaughter, which occurs after six to eight months in the feedlots, more than 13% of steers have severely abscessed livers. The whole feedlot system is dependent on cheap corn. This is produced by systems of cropping that are consolidated and mechanized to maximize efficiency. Corn is grown on approximately 75 million acres, of which about 44% are in farms of at least 500 acres (Figure 7). Modern agriculture in this country functions through specialization; this means that the vast majority of this corn is produced in large monoculture fields, where it is planted, tended, and harvested by large machinery. Its growth is abetted by the application of large quantities of fertilizers and pesticides, most of which are energy-intensive to

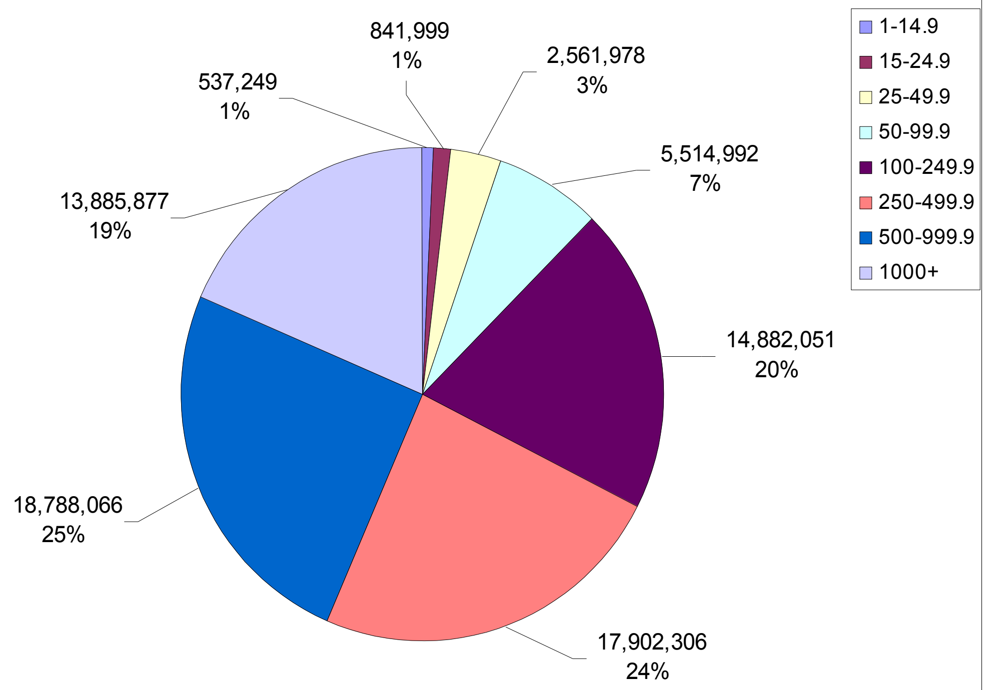

Figure 7. Total U.S. Corn Acreage by Farm Size Class (acres).

produce, and many of which are derived from petroleum products. The quantities of inputs used annually in corn production are shown in Table 3.[26]

Several alternative agricultural methodologies have become increasingly popular in recent years and decades; these production strategies include organic, grass fed, free range, and integrated pest management. Organic production excludes the use of synthetic chemical inputs and genetically modified organisms, and it must be certified by the USDA. Grass fed animal production, as the name suggests, means that the livestock are fed on grass and other forages rather than on corn and other grain products. Free range production means

Table 3. Agrochemical use in the United States, 2002.

Input	Quantity (1000 lbs.)	% of Acres Treated
Fertilizers (Nitrogen)	9,949,300	98%
Fertilizers (Phosphate)	3,526,200	82%
Fertilizers (Potash)	4,068,500	67%
Herbicides	95,777	89%
Insecticides	3,931	24%

[26] Table 3 is based on data from USDA/NASS N.D. and from USDA/NASS 2004c.

that the animals are not kept in cages but instead are allowed to move about freely in outdoor areas. Integrated pest management (IPM) looks at an agricultural system on a macro scale and attempts to deal with pests by encouraging their natural predators rather than by applying chemicals to kill them; IPM generally relies on chemical inputs as a last resort control method to be used only in emergency situations or when all else has failed.

Although these alternatives are growing in popularity, their viability as major contributors to the national food supply is still questionable. The fact remains that their productivity is often lower than that of intensive conventional agricultural systems while their cost of production is often higher. A large-scale switch seems unlikely to happen at this point; furthermore, it is still somewhat unclear whether that would be feasible in terms of the food supply. However, as the cumulative environmental impacts of agriculture and other human activities continue to mount, these alternative agricultural forms may become more appealing.

Social and Cultural Impacts of Current Trends

The increased consolidation of agriculture in this country has had a number of social impacts. Most notably, current agricultural trends affect the people who work in this sector. Because farms are becoming larger and more corporate, they require more hired employees. Many of these employees are migrant workers, who experience significant marginalization in a variety of arenas. Job security, family stability, and availability of health care are only three of the issues facing migrant farm workers. Many migrant workers are also immigrants who may or may not have legal status in the country; this adds an additional level of complexity to the situation. In addition, all agricultural workers can be exposed to harmful chemicals when treating or harvesting crops. As of 1990, there were over 21,000 accidental poisonings caused by pesticides each year in the U.S., and an estimated 6000 people per year developed pesticide-induced cancers.[27]

The consolidation of agriculture affects non-farm sectors of the economy as well. As small-scale farmers are squeezed out of operation and sell their land to developers, the firms with which the farmers did business lose their customer base. Local farm equipment and supply stores, for example, depend on farmers to keep them in business; when farms close, these businesses can be forced to close as well. Even if small farmers sell their land to larger-scale operations that keep the land in agricultural production, long-standing local businesses may lose revenue, as these corporate farms often have their own mechanics and suppliers and are therefore less likely to do business with local firms. This trend can lead to increased unemployment and economic depression in rural areas.[28] Rural economies are additionally hard-hit by corporate agriculture because the profits of these operations often do not stay in the area to the same extent that they do when operations are more locally-owned.

Another social issue that has been exacerbated by agriculture is conflict over water rights.[29] Farmers are currently struggling with government officials and biologists over potable water resources, especially in the western and southwestern states. Farmers need water to sustain their livestock and to irrigate their crops; government officials need water to sustain the human populations of the area, and biologists need water to maintain appropriate water levels in rivers and other water bodies in order to sustain many aquatic species, including some that are endangered. These are difficult issues to resolve, and

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[27] Pimentel 1990, 11
[28] *Ibid.* 7
[29] For examples, see Cody and Sheikh; Jehl; McClurg and Totten.

they are inextricably tied in with the environmental and economic issues facing this country's farmers.

Not all the impacts of current trends in agriculture have been uniformly negative. In fact, the increased mechanization, consolidation, and energy input into agricultural production have caused the prices of many commodities to decrease, turning what were once luxury goods into everyday products. Beef, for example, has gone from a rarity to a staple over the course of the last few decades. Whether or not this is beneficial to the health of the general populace or to the health of the environment is debatable, but the fact remains that people's diets are much more varied now than they were before the advent of modern agricultural strategies.

Environmental Impacts of Agriculture

As mentioned above, agricultural production has significant environmental impacts. It is important to identify and discuss these in order to better understand the current food supply situation and the reasons why changes to this system may be in order.

Effects on Soil Resources

In 1776, the estimated average soil depth in the United States was approximately 23 centimeters. In 1995, the average soil depth had decreased to about two-thirds of that figure.[30] Erosion, which occurs on exposed soils through the action of water and wind, is a serious problem in American agriculture (and in the rest of the world, as well). In the United States, cropland erosion currently averages 17 t/ha/yr (tons per hectare per year);

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[30] Pimentel *et al.* 1995, 1119

pastureland erosion is somewhat slower but still significant, averaging 6 t/ha/yr.[31] The average rate of soil formation in these regions is approximately 1 t/ha/yr; any rate of loss above this is unsustainable.

Soil loss seriously affects the productivity of the land. Erosion reduces rates of infiltration of precipitation and water-holding capacity; it also reduces available nutrients and organic matter. In addition, erosion has negative effects on the physical and chemical structure of the soil and on the soil biota, both of which are important for crop productivity. Eroded soils are therefore less fertile, less absorbent, and less able to retain nutrients, fertilizers, and pesticides.[32] Corn productivity, for example, has been observed to decrease by as much as 65% on eroded soils in the United States.[33]

Effective soil conservation techniques have been developed and are used in some areas. These include contour planting, crop rotation, manure application, minimum tillage, and the use of cover crops.[34] Most of these techniques, however, are incompatible with the modern system of huge monocultural fields and mechanized management. As the small polycultural farm has been squeezed out by the large corporate operations, hedgerows and fallow strips that break the wind and slow erosion have been removed, and large machinery that compacts the soil and damages the soil ecosystem has been employed to plant and harvest the crops. In order to remain competitive, near-term efficiency is of the utmost importance. Thus, the short-term costs of soil conservation techniques often exceed the short-term benefits to the farmer, so they are frequently passed over in favor of the more immediate benefits of conventional cropping systems.

[31] *Ibid.* 1117. This figure is for current soil loss, while the previous one is a cumulative figure; together, these numbers suggest that the vast majority of erosion has occurred in recent decades rather than centuries ago. Considering the advances in technology that have been made over time, this seems logical.

[32] Trautmann, Porter, and Wagenet 1998a

[33] Pimentel *et al.* 1995, 1118

[34] Pimentel *et al.* 1976, 151

The long-term effects of this neglect are likely to be quite severe; they have been put off by increased use of chemical inputs, but they will be felt eventually.

Effects on Water Resources

Agriculture affects water resources in several ways, including depletion, siltation, and contamination. The sheer quantity of water consumed in agricultural operations has a significant impact. In fact, irrigated agriculture accounts for over 80% of the total consumptive water use in the United States.[35] Producing one pound of corn in an irrigated system requires approximately 170 gallons of water; one pound of rice requires 560 gallons. One pound of grain-fed meat requires 300-500 gallons of water when the water required to produce livestock feed is taken into consideration.[36] Many aquifers, including the Ogallala aquifer that lies beneath much of the United States' most productive agricultural land, are being severely overdrawn. As of 1990, the rate of withdrawals from groundwater in the lower 48 states exceeded the rate of recharge by about 25 percent.[37] Water rights have become a significant issue in recent years as people begin to realize the extent to which the availability of fresh water is limited, especially in the western United States. Agriculture's contribution to this situation cannot be understated, and conflicts between water uses such as agriculture, drinking water, and wildlife habitat are likely to become even more pronounced in the near future.

The erosion problems described above can have serious impacts on water quality. One to three billion tons of sediment enter waterways in the lower 48 states each year,

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[35] Sweeten and Humenik 4

[36] Pimentel 1990, 9. Though this figure at first seems incongruous with the previous number for water consumption in irrigated corn production, it can be reconciled by noting that not all corn production is irrigated. Three to five hundred gallons of water per pound of beef does, however, seem to be a conservative estimate.

[37] *Ibid.* 10

and approximately 60 percent of that comes from agricultural land.[38] This sedimentation degrades wildlife habitat and also causes deterioration of anthropogenic structures such as reservoirs and dams; it can also lead to flooding by making riverbeds shallower. The increased need for dredging and for constructing new infrastructure is extremely costly, as are the losses in recreational value and habitat quality.

Contamination by chemical-laden runoff is the third major category of water resource impacts. These contaminants include both synthetic and natural chemical byproducts of agricultural operations. Runoff containing high levels of animal wastes, for example, can contaminate water bodies with high levels of nitrates and with fecal coliform bacteria, both of which can be hazardous to health. Chemical fertilizers can also cause nitrate and phosphate contamination, which can bring about algal blooms and eutrophication. Pesticides are another threat to water quality. At least 46 pesticides have been found in groundwater in at least 26 states, and testing is not as widespread as it should be.[39] In addition, at least eighteen states have reported groundwater contamination by as many as eight herbicides.[40] Groundwater contamination is extremely expensive to deal with and is nearly impossible to clean up, and it is quite widespread in the United States.[41] Unfortunately, groundwater contamination is not well monitored, so no precise estimates of its full extent are available.

Surface waters are also threatened by pesticide contamination; various agrochemicals have been found in watersheds all across the country.[42] The levels and

[38] *Ibid.* 9
[39] Trautmann, Porter, and Wagenet 1998b
[40] Trautmann, Porter, and Wagenet 1998a
[41] For examples, see Anderson, Opaluch, and Sullivan; Fenelon and Moore; Ferrer, Thurman, and Barcelo; Wade, York, and Morey.
[42] For examples, see Clark; Domagalski, Dubrovsky, and Kratzer; Fenelon and Moore; Gilliom, Barbash, and Kolpin; Hapeman *et al.*; Harman-Fetcho, McConnell, and Baker; Marvin *et al.*; Qian and Anderson; Rebich, Coupe, and Thurman.

toxic effects of this pollution vary depending on the characteristics of the site and the contamination, but pesticides have a uniformly negative impact on aquatic ecosystem health. In addition its negative effects on aquatic biota, pesticide contamination can lead to lost recreational values and to serious human health effects. The EPA estimates that agriculture contributes to the impairment of more than 170,750 miles of rivers, more than 2.4 million acres of lakes, and more than 1827 square miles of estuaries.[43] Responsible management of wastewater helps to prevent some of these problems, but runoff is inevitable, and as long as toxic chemicals are applied to land, some are bound to end up in the nation's water bodies.

Effects on Air Resources

Agriculture's effects on air quality take several forms. The most noticeable is often odor, especially in the case of animal operations. Manure contains many odorous compounds, and even when properly managed, it does release these compounds into the air. These odors are generally not a health hazard except in enclosed areas with very poor ventilation, but they can be a nuisance to neighbors of agricultural facilities.[44]

Particulate matter is another agricultural air quality impact. Dust is released into the air during the plowing, planting, cultivating, and harvesting processes. In addition, particulate matter is released during agricultural processing (grinding grain, ginning cotton, etc.). Particulates can be quite harmful to health, especially when they are less than ten micrometers in size and can penetrate deep into the recesses of the lungs. The combustion of fossil fuels, particularly diesel fuel, is another major source of particulate

[43] USEPA 2004b
[44] Sweeten and Humenik 14

matter. Tractors and other such agricultural equipment generally have less clean-burning engines than cars and trucks because they and other non-road vehicles were not subject to emissions regulations until the mid-1990s. As of 2003, land-based non-road diesel engines (including construction, agriculture, and industrial equipment) were responsible for about 44% of diesel particulate matter emissions and about twelve percent of total NO_x emissions from mobile sources in the United States.[45] Particulate matter can cause such ailments as asthma, bronchitis, decreased lung function, and even premature death,[46] while NO_x contributes to acid rain, smog, and climate change, as well as to the eutrophication of water bodies.

The spraying of agricultural chemicals is another agricultural process that affects air quality. When agrochemicals are sprayed from planes, some of the chemical being applied invariably remains airborne. It can then spread to other areas where it was not intended to go (an estimated 25-50% of the total quantity sprayed does this[47]) or be inhaled by people or animals, causing health effects that range from mild to very severe. Careful selection of spraying days and times, taking into account the wind and climatic conditions, helps to mitigate this problem, but when agrochemicals are aerially sprayed, there is invariably some negative impact on air quality.

Effects on Energy Resources

The growth in use of chemical inputs and the increasing mechanization of agriculture dictate a corresponding increase in energy use. The manufacture of agrochemicals is an energy-intensive process: nitrogen fertilizers, for example, require

[45] USEPA/OTAQ
[46] USEPA/OAQPS
[47] Pimentel 1990, 11

between twelve and fifteen thousand kilocalories per kilogram,[48] while herbicides require about 57,000 kcal/kg and insecticides require about 44,000 kcal/kg.[49] The process of applying of these chemicals further increases the country's agricultural energy demand.

Mechanized planting, cultivating, and harvesting operations also require energy, mainly from fossil fuel sources. This energy source has essentially replaced much of the human and animal labor that once went into agricultural production. In absolute terms, this has allowed a drastic increase in productivity. However, when the energy output-input ratio is examined, mechanized production is shown to be much less efficient than by-hand production. In corn production, for example, mechanized techniques yield 2.47 kcal of corn output per one kcal of fossil fuel energy input, while by-hand methods yield 128.2 kcal of corn per one kcal of human energy.[50] That is not to say that going back to production by hand would be ideal – as mentioned above, increased agricultural productivity has given many people access to diverse and plentiful foods that were not previously available. But it is important to recognize that modern agricultural production does demand significant amounts of energy, the production of which has significant environmental impacts.

Reactions to the Trajectory of Growth and Present Status of U.S. Agriculture

The changing landscape of American agriculture has provoked much thought and discussion. Several movements have sprung up in recent years as reactions to the present state of agricultural affairs. While the motivations behind these movements are quite diverse (including concern about the health effects of pesticides, worry about dwindling

[48] Pimentel 1980, 24
[49] *Ibid.* 45
[50] *Ibid.* 67-68

oil supplies, desire to preserve farmland, identification of alternative products as status symbols, etc.), their unifying feature is that they all represent people who are willing to pay more for food products produced in manners different from the conventional systems described above.

Farm to School Movement

Colleges and universities around the country have recently become interested in adding more locally-produced products to their food supplies. Farm-to-college projects have begun at Bates College, Beloit College, Cornell University, Dartmouth College, Middlebury College, Northland College, the University of Montana, the University of Northern Iowa, Pennsylvania College of Technology, the University of Washington, the University of Wisconsin, Vassar College, and Yale University, among others. These schools have established contacts with local farmers and are purchasing food directly from these producers. In most cases, these programs have yielded positive results for all involved. Table 4 provides descriptions of several of these programs. Elementary and secondary school systems, too, have started farm-to-school projects. School systems in California, Florida, New York, Pennsylvania, and Wisconsin, among other places, have begun purchasing produce, dairy products, and other foods from local producers.[51]

Numerous non-profit organizations have arisen to support the growing farm-to-school movement. These include national groups such as the Community Alliance with Family Farmers, the Center for Ecoliteracy, the Center for Food and Justice, the FoodRoutes Network, the SARE (Sustainable Agriculture Resources and Education) Program, the Community Food Security Coalition, and others; regional groups such as

[51] See Community Food Security Coalition, Gottlieb and Joshi, USDA/NRCS, Wisconsin Homegrown Lunch.

Table 4. Farm-to-College programs.

Institution	Start Date	Impetus	Scope	Status	Challenges	Successes
Northland College Ashland, WI	1994	CIAS Research; student and administration commitment; student research and pressure.	Small campus (~800 students); now serving ~20% of produce from local/organic sources (apples carrots, potatoes, onions, other vegetables and grains).	Contracted food service (Chartwells); contract stipulates that local/organic products will be provided whenever possible; has been well-received by students; dining service staff is committed.	Very short local growing season; working with profit-oriented food service contractor can be difficult.	Partnerships established between Northland and local farmers; increased cost mitigated by economizing on other food products; educational efforts tie in with curriculum.
University of Montana Missoula, MT	2003	Interest and commitment of dining service director; student research.	~6% of budget spent on local products ($366,000) in 2003-04 (beef, pork, eggs, dairy products, various vegetables); local products in campus store, dining halls, and special events.	In-house food service; efforts to institutionalize the program; good reception and results to this point.	Budgetary constraints; scale of production; processing of local products.	41 local producers involved during the program's first year; partnership established with Mission Mountain Market (a local producer-aid organization); educational programs for staff.
University of Northern Iowa Cedar Falls, IA	1997	Research by U.N.I.; outside grant to set up Local Food Project.	$8900 spent on local food products in 2002 (supply includes meat and produce items).	In-house food service; good reception to this point; program is small but expanding.	Rigid food service contracts; insurance requirements; lack of supply; lack of processing infrastructure and labor.	Partnerships established between UNI Local Food Project and local restaurants and businesses; educational efforts for students.
University of Wisconsin Madison, Platteville, LaCrosse, and Superior campuses	1994; expanded ~2000	Research by U.WI.-Madison's Center for Integrated Agricultural Systems (CIAS); student and faculty/staff demand.	4 campuses; usually in one dining hall at a time; many local/organic products for special meals; some everyday products (local apples, corn, salad greens, tomatoes, potatoes; other organic products).	In-house food service; program has been quite successful and well-received so far, and is still growing; students are enthusiastic; administration is committed to making this work.	Bidding process and vendor requirements are difficult for small farms; finding large enough suppliers can be difficult; seasonality puts constraints on availability; labor required to process local products is expensive.	20 special local/organic meals 1996-2001; educational efforts at special meals; press coverage; a la carte setup allows price differentials for everyday products to be passed on to consumers.
Vassar College Poughkeepsie, NY	2002	Cornell University's farm to college research program.	First year of program focused on special events; second year worked to incorporate more local items into everyday food service operations (apples and other fruits, cider, various vegetables, dairy products).	Contracted food service (ARAMARK); Farm to College committee manages the initiatives; program has been well received by students and local growers.	Working with profit-oriented food service contractor can be difficult; local items are sometimes more expensive.	Farm to College committee includes faculty, dining service managers, ARAMARK representatives, cooperative extension educators, and campus sustainability committee members; special events and educational programs such as Hudson Valley Farm to School Summit.
Yale University New Haven, CT	2001	Student interest and pressure; administration interest; outside interest and sponsorship.	One of ten colleges' dining facility dedicated to local/organic foods; first year was brainstorming, second year was planning, third year was imlementation; all items served in Berkeley College dining hall are local, seasonal, and as much organic as possible.	Contracted food service (ARAMARK); program has been very well received by students and food service staff; Berkeley College program is seen as a pilot that will guide future efforts.	Identifying reliable local suppliers with enough capacity can be difficult.	Sustainable Food Project includes curricular integration and guest speakers; student-run garden project is very popular.

the New Jersey Urban Ecology Program and the Iowa Food Policy Council; and local groups such as CISA (Community Involved in Sustaining Agriculture) in central Massachusetts and Berkshire Grown in western Massachusetts.

Local Food Movement

Educational and non-profit institutions are not alone in the trend toward locally-produced food. Individuals and businesses nationwide have joined the local food movement. Farmer's markets have been organized in many communities that previously lacked a source of fresh, locally-grown produce. From 1994-2004, the number of farmer's markets in the United States more than doubled, growing from 1755 to 3706 in that ten-year period (see Figure 8).[52] In Berkshire County, farmer's markets now exist in seven towns,[53] providing the county's residents with opportunities to purchase fresh, high-quality food and providing the county's producers with opportunities to sell their produce for reasonable prices to people who appreciate it.

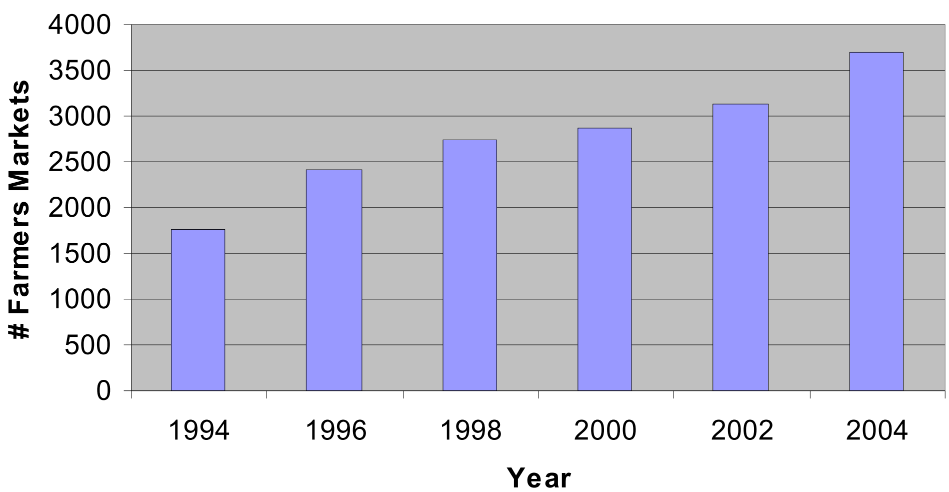

Figure 8. Growth in Number of U.S. Farmers Markets, 1994-2004.

[52] USDA/AMS

[53] Berkshire Grown 2004

Health-food stores and food co-ops have also seen a surge of growth in recent years. Wild Oats, Inc., a chain of natural food markets, has seen its sales grow by about 8% per year, reaching $1.05 billion for fiscal year 2004.[54] Whole Foods, another natural food retailer, has experienced sales growth of eight to fourteen percent per year for the past five years; Whole Foods' sales reached $3.86 billion for fiscal year 2004.[55] These businesses generally purchase locally-produced items when possible, providing a more institutionalized and larger-scale outlet for regional producers. They also make it easier for consumers to obtain locally-produced products by making them more accessible – these stores are open for more hours than a weekly farmer's market and sell more than just locally-produced fresh items, reducing the need to make a special trip to obtain these products.

Restaurants, too, have begun to show interest in local foods. Chez Panisse, in Berkeley, California, is one such restaurant; its proprietor, Alice Waters, is a leading advocate of sustainable food production. Chez Panisse has made a public commitment to purchase their food products only from "known and trusted purveyors, known to be committed themselves to sound and sustainable practices, and trusted to remain informed and responsive to these values in a rapidly changing society."[56] Although Chez Panisse does not make an absolute guarantee that every product in the kitchen is organic or local, most of the products on the restaurant's menu are identified by the farm where the main ingredient originated. The restaurant also lives up to its commitment through its Chez Panisse Foundation, a non-profit organization that works to incorporate sustainable food

[54] Yahoo! Finance
[55] Whole Foods web site
[56] Chez Panisse web site

production and consumption into the meals and curricula of the Berkeley public school system.

The Farmers Diner, in Barre, Vermont, is another restaurant committed to serving local food products. Tod Murphy, its founder and CEO, has background in both business and farming; he has made a commitment to purchase locally while also taking advantage of the savings that can be achieved through economies of scale and vertical integration. Currently, the Farmers Diner spends more than 65 cents of every food dollar on products produced within 70 miles of the restaurant.[57] The single most important factor in the success of this venture is the Farmers Diner commissary, where fresh products are taken for processing so that the restaurant's cooks can work with the more standardized ingredients to which they are accustomed. The commissary is inspected and approved by the USDA and processes meat products as well as vegetables. By founding the commissary and training its staff to deal with the challenges posed by nonstandard products (heirloom varieties that need special treatment, for example, or vegetables that are not quite the standardized shape found in supermarkets), Murphy surmounted two of the biggest obstacles that face institutions hoping to use local foods. The commissary provides a supply that is consistent in quantity and quality; it also allows the restaurant's employees to save time by ordering products from one supplier rather than from many smaller ones.

Community Supported Agriculture

Community Supported Agriculture projects, or CSAs, are another method of reconnecting producers with consumers that has grown rapidly in recent years. In these

[57] Farmers Diner web site

programs, people buy shares of the harvest of a farm in advance of the growing season and then receive fresh produce on a regular basis (usually weekly or semiweekly) as it is ready for harvest. This arrangement is profitable to both the producer and the consumer. Consumers enjoy the availability of fresh, high quality food, while producers have a guaranteed income even if the weather does not cooperate and the harvest is suboptimal in a particular year. In addition, many CSA operations allow or require members to participate in some of the labor of the farm; this helps the producers accomplish the many tasks required for a successful harvest and brings the consumers into direct contact with the production of their food. The CSA movement began in Germany, Switzerland, and Japan during the 1960s, and gradually spread elsewhere in the world. The first CSA in the United States was founded in 1986; by 2003, there were over 3000 such organizations in the country.[58] There are currently 5 CSAs in Berkshire County.[59]

Organic Movement

In addition to the burgeoning interest in locally-produced food, there has been a surge of interest in organic products worldwide. This interest is generally spurred by concerns about the health effects and environmental impacts of the chemical inputs used in conventional agriculture. Research has shown that agrochemical residues are indeed present in many produce items at the time of their sale to consumers, but information about their health effects is less readily available. The environmental effects of agrochemical use, on the other hand, are well-documented.

[58] Mander 9
[59] Berkshire Grown web site

At this point in time, organic products remain a luxury item for the most part, consumed by people with significant disposable income for whom the higher price is not an obstacle. This phenomenon has been observed worldwide.[60] But despite higher prices and a limited consumer base, sales of organic products have dramatically increased in recent years. The worldwide organic market has been growing at a rate of fifteen to twenty percent per year since the mid-1990s;[61] in the United States, this growth has occurred at a similar rate.[62] While organic products now make up a noticeable portion of the market share, it is unlikely that they will become really prevalent until their prices drop, and this is also unlikely to occur in the near future. However, the growth in consumption of organic products seems likely to continue as people become more and more interested in knowing where their food comes from and how it was produced.

[60] For examples, see Aguirre; Alberta Department of Agriculture, Food and Rural Development; Borges da Fonseca; Collins *et al.*; Hammerland; Hill and Lynchehaun; and Ritchie *et al.*

[61] Miller

[62] Dimitri and Greene

Chapter Two
Regional Context

In addition to the national-scale context discussed in the previous chapter, an understanding of the region's characteristics is important to a sound analysis of Williams College's food consumption. The College was founded in an area that was used only lightly for cultivation by the Native Americans, who certainly had the technology to practice more intensive agriculture should they have chosen to. This legacy suggests that this region is only marginally suited to farming, a fact which has been borne out by centuries of up-and-down cycling of various commodities. The first section of this chapter discusses these historical cycles; the second section describes the current state of agriculture in the region.

Historical Background: Agriculture in New England and Berkshire County

For the most part, Berkshire County was not considered prime agricultural land by the Mahicans who lived here before the European colonists arrived. This region was used as a hunting ground where temporary encampments were set up from time to time; permanent settlements and agricultural installations were not pursued.[63] Much of the land was forested, and the uplands provided habitat for many types of game animals.

Agriculture became a necessary way of life when the earliest European settlements in western Massachusetts were established in 1722 in the area around Stockbridge and Great Barrington.[64] These settlers had a difficult task ahead of them as they began to prepare the land for planting. The European settlers relied on primitive

[63] Smith 35
[64] *Ibid.* 50

agricultural hand tools such as hoes and mattocks; plows were very scarce for several decades. Sometimes neighbors would share a plow and the cost of its maintenance; this helped the situation, but many farmers were left to till their land by hand. This shortage of labor-saving tools and the difficulties of preparing the soil meant that early farms were quite small by today's standards, usually in the range of ten to forty acres.[65]

These early settlers' staple crop was maize, or Indian corn, which they grew in a style modeled after that employed by the Native Americans in nearby areas.[66] As described in the previous chapter, the trio of corn, squash, and beans was the most prevalent early form of agricultural production. Corn was a particularly good crop because its yield was higher than other crops and it was less sensitive to harsh weather conditions.[67] In addition, it required little labor once it was planted, freeing the farmers to tend to other duties. The early settlers also grew other crops, including wheat, barley, peas, oats, rye, flax, and buckwheat, but none of these was as prevalent or as successful as corn. Livestock husbandry was practiced as well, but the settlers struggled to establish a nourishing program of winter rations for the animals. Those farmers who managed to keep livestock established a commons system to govern the raising of crops and the grazing of livestock on communal property.

During the eighteenth century, farmers experienced advances in the tools at their disposal. The new labor-saving implements allowed farmers to till more land; the average farm size in New England during this period increased to 100-200 acres.[68] At the end of this period, land use in Massachusetts was divided as shown in Table 5.[69]

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[65] Bidwell and Falconer 37
[66] *Ibid.* 11
[67] *Ibid.* 10
[68] *Ibid.* 115
[69] *Ibid.* 119

Table 5. Massachusetts and Berkshire County land use, 1801.

Land Use Category	Berkshire County		Massachusetts	
	Acres	% of Total	Acres	% of Total
Total Taxable Land	475,147	100	3,099,615	100
Tillage	28,320	6.0	170,727	5.5
Upland Mowing	28,558	6.0	198,798	6.4
Fresh Meadow, Salt Marsh	10,717	2.2	188,109	6.1
Pasture	86,827	18.3	707,356	22.8
Woodland, Waste	320,725	67.5	1,834,625	59.2

The major cities in the northern states generally served as central hubs of commerce, including trade in agricultural commodities. Boston, New York, and Philadelphia were the biggest markets in the northern states; the former two, especially New York, were the most important for Berkshire County's agricultural producers. Wool and dairy products were Berkshire County's most important agricultural products during this period. Dairy farmers in Berkshire County tended to produce value-added products such as butter and cheese that were shipped south to New York City, Pennsylvania, and the southern states, as well as west to the Mississippi and Ohio River valleys. Advances in livestock husbandry in the early 1800s included improved food and shelter for the animals as well as improved strategies of breeding and caring for calves. These developments resulted in an increase in milk production of approximately 20% between 1800 and 1840.[70]

This period also saw the peak of agricultural societies in the region. These organizations were essential to the development and improvement of Berkshire County and New England agriculture from the early 1800s on; the Berkshire Agricultural Society for the Promotion of Agriculture and Manufactures was founded in 1811 and served as a model for many other such societies nation-wide.[71] The Berkshire Society was founded

[70] *Ibid.* 229
[71] Smith 405

by a group of men led by Elkanah Watson, a businessman turned gentleman farmer who lived in Pittsfield. Watson and his colleagues organized a livestock exhibition on the Pittsfield town square in 1810 that was met with widespread approval; in order that such events should continue, Watson and the others obtained a charter from the Massachusetts Legislature during its next session.[72]

Agricultural exhibitions and fairs were the backbone of the Berkshire Agricultural Society for many years. They provided the local farmers, whose daily lives were often quite isolated, with an opportunity to congregate, share stories and ideas, show off their prize produce and animals, and discuss new developments in the field. The wealthier members of the group, who had more resources to invest in improvements (breeding programs, etc.), took advantage of the events to educate those who were less well-off. In time, the fairs and exhibitions were expanded to include handicrafts such as knitting and weaving, food products, and crop production in addition to livestock.

The Berkshire Agricultural Society and others like it enjoyed several decades of interest and importance, but during the mid-1800s their influence began to decline. This was sparked by the confluence of many factors. The expectations of farmers were one important cause of this decline. Many farmers joined the societies enthusiastically and expected great results; when they found that the organizations were often only marginally helpful, they became frustrated and began to lose interest. This loss of popular support combined with the loss of state financial support to spell the end for most county agricultural societies by the 1850s. Berkshire County, however, seems to have been an exception – the Housatonic Agricultural Society was founded in southern Berkshire

[72] *Ibid.* 407

County in 1841 and received its charter in 1848, and the Hoosac Valley Agricultural Society formed in 1850 in northern Berkshire County.[73]

By the middle of the nineteenth century, hay was New England's most important crop, but it was certainly not the only agricultural commodity being produced. A typical crop rotation on a farm in this region began with corn, which was followed by potatoes and then oats; the parcel was then seeded with grass (usually clover or timothy) and spent three to six years as a hayfield.[74] These years served dual functions: they provided fodder for livestock and they helped to replenish the soil's fertility. Soil improvement also grew in popularity during this time. Farmers generally used compost, manure, and gypsum as soil additives, and much of their production depended on this improved soil stewardship.

Competition from the ever-expanding western frontier region, with its cheap land and railroad transportation, was the cause of many up-and-down agricultural cycles over the course of the nineteenth century in New England. Wool production, for example, became very popular in this region during the 1830s due to high prices and the spread of Merino sheep, whose fleeces were generally considered the finest available. However, western herds increased as well, and prices suffered a sharp drop in 1837. From 1837 through the early 1840s, wool prices dropped significantly; many farmers who had invested all their resources in wool went through some difficult times during the transition. According to an 1838 report published by the Massachusetts Board of Agriculture, hired hands on Berkshire County's sheep farms "asked for money for their labor; but money was not to be had because the clipping of wool, owing to the derangements of business, had not been sold. They asked to receive their pay in grain;

[73] *Ibid.* 410-413

[74] Bidwell and Falconer 369

but the wool farmer had abandoned all cultivation for the sheep husbandry. They asked for their pay in pork, but the farmers who raised no grain could raise no pork."[75] Some families went without bread for a time while wool could not be sold and the wheat crop was being reestablished.

Wheat and corn followed wool as the boom-and-bust cycles continued. As commodity after commodity became economically unfeasible for New England farmers, some moved toward industry as an alternative source of income. During the 1840s and 1850s, agricultural industry grew in the Eastern region. Plow manufactories, for example, became quite profitable. The eastern states made manufactured goods that were helpful or necessary for farm life and shipped them to the western states via the ever-expanding network of canals and railroads. The western states, in return, sent their agricultural products eastward.

But New England's farmers did not all leave the agricultural business. Many moved into dairying, and this became the chief focus of the region's producers during the second half of the nineteenth century. The dairy industry's growth was aided by the increasing ease of transportation, which meant that Berkshire County's dairies were able to ship their products to the New York and Boston markets. Butter and cheese became particularly profitable for the region's farmers. The 1850s saw the development of improved dairy breeds such as the Holstein, the Jersey, and the Ayrshire; during this decade, the number of dairy cattle in Massachusetts increased from 130,000 to 144,000.[76]

By 1860, dairying and hay production were the main focuses of New England's agricultural production. Wheat, corn, swine, beef, and sheep had all become unprofitable

[75] *Ibid.* 407
[76] *Ibid.* 434

due to competition from western producers, although these industries (particularly sheep) were still present on some farms. Much of the hay that was produced was fed to the dairy cattle in addition to their pasturage. Milk, butter, and cheese were important cash crops for the region's farmers, whose dairy products reached markets as far away as the southern states and were known for their quality.

The late 1800s were a period characterized by increased growth of the manufacturing and industrial sectors, and with it, increased urban population. Agriculture remained an important component of the regional economy, but this was the beginning of its long decline. Dairy cows and swine were the most prevalent livestock in Berkshire County during this period, but they, too, began to decrease in number through the late 1800s and early 1900s. The development of new labor-saving technologies during this period contributed to the decline in livestock numbers as farmers could accomplish tasks with less and less animal labor. The 1920s saw a precipitous drop in livestock numbers as the region felt the shocks of the nation-wide post-war farm crisis.

The middle of the twentieth century brought another drastic drop in livestock numbers in New England. The pattern of competition from other regions held true during this period; as dairy farming became more and more widespread in the Great Lakes region,[77] the price of milk dropped below the cost of production for many New England farmers. This economic pressure has continued to make farming difficult in Berkshire County and has resulted in the decision by many farmers to sell their land. Over the past decade, for example, Berkshire County has seen over ten thousand acres of farmland sold for development.[78]

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[77] Wisconsin Historical Society
[78] Berkshire Grown web site

The local dairy industry went through more hard times during the 1980s. Nationally, supply was exceeding demand by a significant amount; in many cases, farmers could not even make enough money to cover their production costs. In 1987 the federal government instituted a dairy buyout program with the goal of reducing the supply and bringing prices back to levels that would allow dairy farmers to make a living. Farmers who were accepted were required to sell off their entire herds and to stay out of the dairy business for at least five years; not even their land or facilities could be used in milk production. Farmers who stayed in business had to pay a tax on all milk sales. The revenue generated by that tax went to help pay the farmers who sold their herds. The program cost $1.82 billion nationwide and reduced the milk supply by 12.2 billion pounds. Eleven Berkshire County dairies participated in the program, selling off 1431 cows and receiving payments totaling $1.83 million.

Despite the efforts being made by many organizations on both national and local scales, the decline of farming in Berkshire County has caused significant shifts in the sociocultural character of the region. Families whose primary occupation had been agriculture for many generations are being forced off their land. Land that had been open space for decades or centuries is being developed for residential or commercial use. These changes in land use and economic base have affected a broad group of people, including those who are not directly involved with agriculture as well as those whose livelihoods depend on the land.

As Berkshire County's dairy farmers have closed their barn doors and auctioned off their herds, many have lamented the change. Barbara Cook of Hancock, who, along with her husband Craig, sold off a herd of 114 cows and young stock in 1985, said, "We enjoy it. I know we're going to miss it. But you have to think of your family."[79] When he entered the 1987 dairy buyout, Warren Wilcox of Sheffield remarked, "Sure, I shed a tear. I was dreaming the other night and I think I saw every cow I ever owned."[80] Donald Hale, a fifth-generation Tyringham dairy farmer, said, "We're going to survive but that's not the point. The land is the point. This is not a case of our wanting to get out of farming. This is a case of us being forced out of it."[81] When he closed his dairy processing business in 1995, leaving High Lawn Farm as the only remaining dairy processor in Berkshire County, David Chenail (who recently returned to the dairy business) of Williamstown remarked, "I'm going to miss it. It's all I've ever done. Every day you do it."[82] "I've lived on this farm my whole life and worked it year in and year out. Retirement don't interest me. What would I do? Sit in the house? I don't know what I'm gonna do, but I know it's time," said Martin D. "Junior" Malnati of Richmond, who put his farm up for sale in 1998.[83]

At the same time, though, the farmers recognize the economic realities of the situation. Said Mary Hale of Tyringham, "The only way anyone in their right mind would ever dairy farm is if they're born into it and they love it. You've got to really love it and you've got to have deep pockets."[84] After selling off 120 of their 130 cows, Hale's husband Donald commented, "It was a losing battle. It was costing us more than $13 to

[79] O'Connor, Gerald B. "Fletchers' Herd Auctioned, Marking End of a Dairy Era." *The Berkshire Eagle*, July 27, 1985. pp. 9, 18.
[80] O'Connor, Gerald B. "Selling the Herds: Regret and Relief." *The Berkshire Eagle*, April 4, 1986. pp. 1, 11.
[81] Author unknown. "A Harbinger of Tougher Times Ahead for Other Farms?" *The Advocate*, September 18, 1991. p. 3.
[82] Burchard, Linda. "Another Dairy Takes Co-op Route." *The Berkshire Eagle*, January 6, 1995. pp. B1, B4.
[83] Bergman, Peter J. "Losing Agricultural Land in Berkshire County." *The Advocate*, September 30, 1998. pp. 1, 9.
[84] Author unknown. "A Harbinger of Tougher Times Ahead for Other Farms?" *The Advocate*, September 18, 1991. p. 3.

make 100 pounds of milk, and all we could get was $10.50 for it."[85] The 69-year-old Malnati of Richmond said, "The price of butter is about $4 a pound, and milk is nothing and nobody wants to buy it. I've had no choice left except to sell this place. I got no kids and there's no one to leave this to. What do I need this for, at my age?"[86] An anonymous Williamstown farmer who had just entered the dairy buyout program summed up the dilemma by saying, "You could milk for 10 lifetimes and still not see the kind of money you can make from selling your land."[87]

Dairy farmers are not the only people feeling the effects of the region's agricultural decline. As more open space is developed, Berkshire County's bucolic, pastoral character has begun to change. Farmland is being converted into residential and commercial uses at an ever-increasing rate; sprawl is becoming a significant concern. This transition affects not only those whose occupation and lifestyle are shifting, but also those involved in tourism and real estate. The area's rural character is an important part of what makes it attractive to tourists and homeowners, and it also is an important part of residents' quality of life.

Present Status of Regional Agriculture

Agriculture in present-day Berkshire County is but a faded relic of its past. The 2002 United States Census of Agriculture showed a total of 401 farms[88] in the county,

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[85] Daley, Lynne A. "Cheese Keeps Hale Farm Going." *The Berkshire Eagle*, September 27, 1992. pp. A1, A5.
[86] Bergman, Peter J. "Losing Agricultural Land in Berkshire County." *The Advocate*, September 30, 1998. pp. 1, 9.
[87] Gendar, Alison. "Williamstown Farmers Face Agonizing Dilemma." *The Berkshire Eagle*, November 14, 1986. pp. A1, A12.
[88] For the purposes of the U.S. Agricultural Census, a "farm" is defined as "any place from which $1,000 or more of agricultural products were produced and sold, or normally would have been sold, during the census year."

occupying a total of 68,630 acres.[89] This makes up approximately 11.5% of the county's land area. The majority of these farms are less than 180 acres in size (Figure 9). The average farm size is 171 acres, while the median size is 75 acres. The total value of the produce of Berkshire County's farms is close to 22 million dollars annually; this income is divided as shown in Figure 10.

The total value of livestock, poultry, and their products sold annually in Berkshire County is just over twelve million dollars, distributed as shown in Figure 11. The numbers of various animals raised in the county are presented in Table 6. The total value of crops sold annually is just under ten million dollars; the majority of this income comes from greenhouse and nursery products.[90]

Figure 9. Berkshire County Farm Size Distribution, 2002.

Farming in Berkshire County is becoming more of a supplementary activity than a primary occupation. Of the 401 farms, 168 are operated by people whose primary occupation is something other than farming; this is more than 40 percent. In addition, more than half the farmers (210 of 401) spend some time working at off-farm jobs. The

[89] This and other statistics in this section are derived from USDA/NASS 2004b unless otherwise cited.

[90] Precise figures for the distribution of income and acreage across crops in Berkshire County are not given in USDA/NASS 2004b due to concerns about respondent confidentiality.

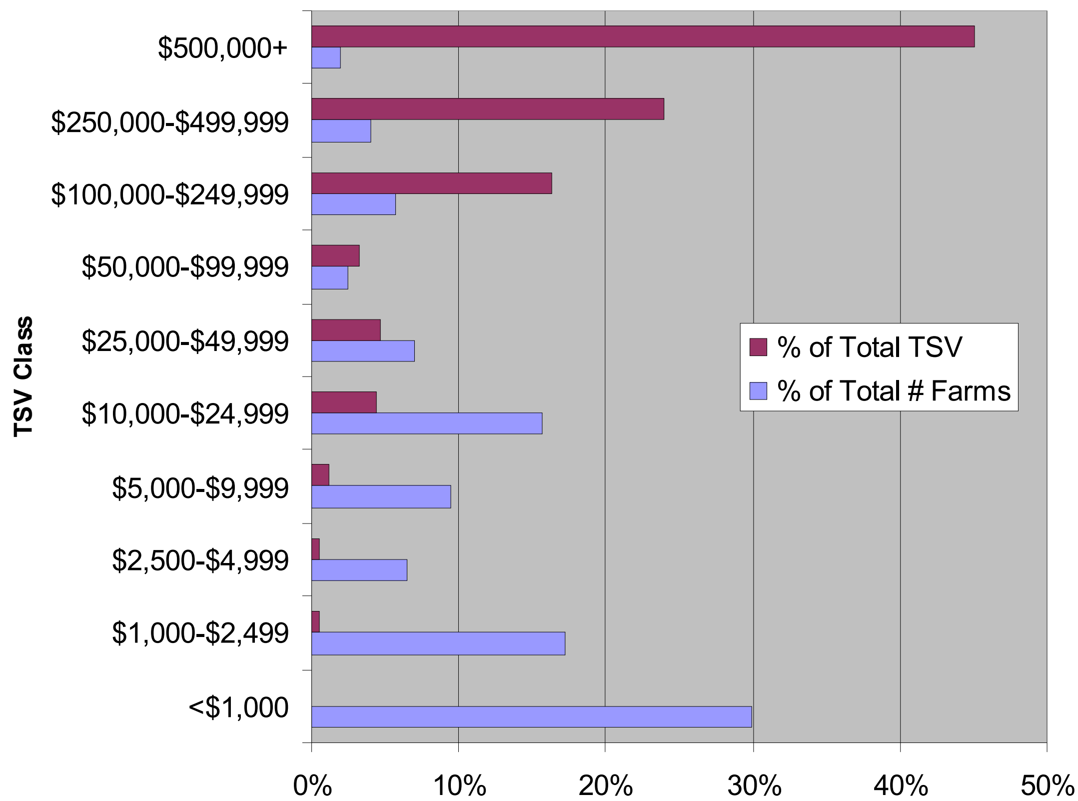

Figure 10. Total Sales Value Distribution among Berkshire County Farms, 2002.

economics of farming in the county provide some insight into the need for off-farm income: of the 401 farms in the county, 255 (almost two-thirds) report annual net losses averaging $17,670 from their agricultural operations.

To supplement these quantitative data, the following sections provide more qualitative descriptions of various agricultural sectors in Berkshire County. For specific listings of producers, see Appendices B and C.

Dairy Farming

The local commercial dairy industry has all but disappeared, with one notable exception. High Lawn Farm, located in Lee, MA, has been in continuous operation as a

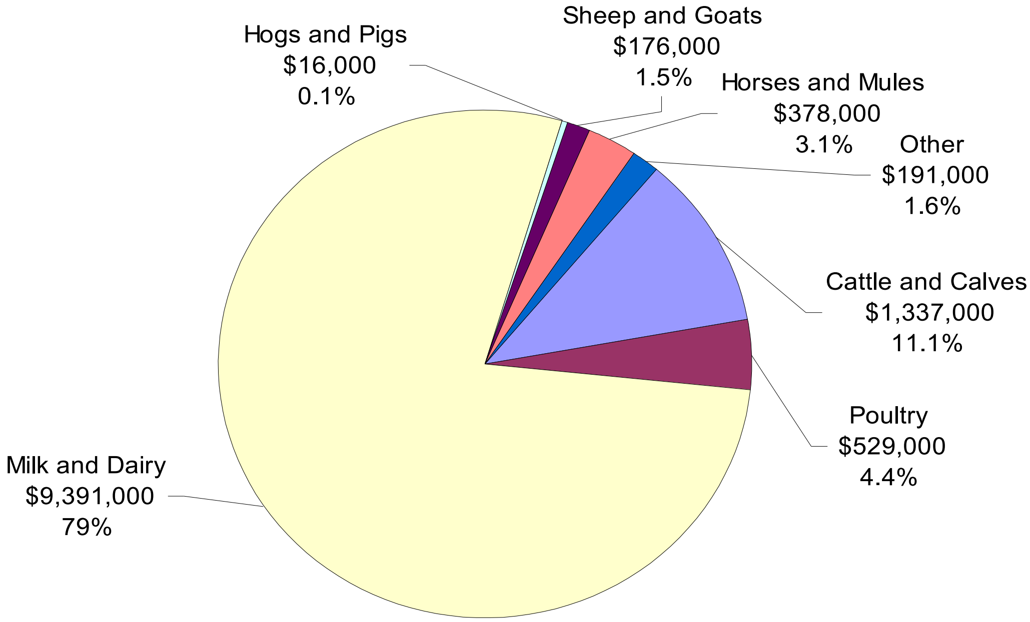

Figure 11. Total Sales Value of Berkshire County Livestock and their Products, 2002

dairy farm and milk bottler for over 100 years. It was taken over in 1935 by Colonel H.G. Wilde and Mrs. Marjorie Field Wilde, having been run previously by Mrs. Wilde's family. It remains in the Wilde family to this day. The High Lawn Farm herd is composed exclusively of Jersey cattle; production records for the herd have been kept continuously since 1923. Some of the members of the current herd have lineages that trace back to the original herd of Jerseys, which was started in 1918.

Table 6. Berkshire County livestock, 2002.

Livestock Category	Total # Present
Cattle and Calves	8,629
Beef Cows	770
Dairy Cows	3,963
Hogs and Pigs	224
Sheep and Lambs	1,016
Chickens	25,690

High Lawn Farm is currently run by General Manager Roberto Laurens and Assistant Manager Brad Torrey, along with several other staff members who assist with the day-to-day farm operations. The herd currently includes 375-400 head of cattle, of which 200 are young stock and 175-200 are milkers.[91] Much of the feed is produced on the farm's 1300 acres. The soil in each field is tested each year and fertilized as needed; most fertilization is accomplished with manure, but some fields require specific chemical fertilizers. No pesticides are used, but the fields are treated with herbicides before the corn comes up. In addition to home-grown silage, alfalfa, and hay, the cattle are fed grain pellets that are purchased from Cargill at the rate of approximately 50 tons per month. The pellets contain corn, wheat, soy, and oats, in addition to vitamins and minerals, and are certified to be free of genetically modified ingredients. High Lawn Farm does not use antibiotics or growth hormones in raising its cattle.

High Lawn is the last remaining dairy in Berkshire County that processes and bottles its own milk. High Lawn's operation is sizable: each cow produces an average of 44 pounds (22 quarts) of milk per day, for a total of around 1000 gallons per day. High Lawn also has a six day per week home delivery business with about 1200 customers. Home delivery is a costly and challenging way to do business, but it currently makes up about 20% of High Lawn's sales. High Lawn also has institutional clients, including Williams College, Legal Seafoods, and many smaller restaurants. In addition, their milk is sold in retail stores such as Wild Oats and Stop & Shop in western and central Massachusetts.

While High Lawn Farm is the only self-sufficient dairy still in operation in Berkshire County, other farmers still maintain smaller dairy herds. They sell their milk through a cooperative called Agri-Mark, which has a processing plant in West Springfield, MA. Agri-Mark serves farmers in all six New England states and in upstate New York; it has a total of approximately 1300 members and processes over 300 million

[91] Information about High Lawn Farm operations comes from Torrey and Laurens, pers. comm.

gallons of fresh milk annually.[92] This member-owned cooperative was founded in 1916 as the New England Milk Producers Association, which became Agri-Mark in 1980. In the past 25 years, the company has merged with other cooperatives in the region; its members' milk now goes into making such products as the well-known Cabot brand butter and cheeses, for example. Agri-Mark sells many value-added products such as cheese, powdered milk, condensed milk, cottage cheese, yogurt, and butter, in addition to fluid milk. Agri-Mark's plants are essentially the sole processing option for dairy producers in Berkshire County who wish to sell their milk.

Crescent Creamery in Pittsfield is a local distributor of dairy products; some of the milk that Crescent Creamery distributes comes from Agri-Mark in Springfield, so some of it may actually be from Berkshire County's producers. Crescent Creamery also distributes Cabot cheeses and Stonyfield Farm yogurts, both of which are produced in New England. Several other small producers market dairy products locally; most of their products are specialty dairy items such as cheeses and ice cream.

Meat and Poultry Products

Berkshire County's current meat production is limited to relatively small-scale operations, but there is potential for further development in this area. The Berkshire Grown Business to Business directory[93] lists nine beef producers, four chicken producers, three lamb producers, two pork producers, two turkey producers, and several assorted specialty meat producers. In addition, six egg producers are listed in the directory.

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[92] Agri-Mark web site
[93] Berkshire Grown 2004

The county does have one larger-scale meat production organization. The New England Heritage Breeds Conservancy (NEHBC) and its New England Livestock Alliance (NELA) program market a variety of heritage breed meat and poultry products, all raised on grass in as natural a fashion as possible. NEHBC is a non-profit organization that "conserves historic and endangered breeds of livestock and poultry and encourages production of these breeds to advance farmland preservation, biodiversity and sustainable agriculture."[94] The Conservancy has a four-part mission, which includes developing breeding programs for heritage breeds, educating youth and adults about the importance of conserving genetic diversity in livestock, providing assistance to farmers who are interested in working with heritage breeds, and creating marketing alternatives that allow these farmers to find niche markets that keep the project economically viable. NELA is a program operated by NEHBC that focuses on beef; some of its products are purchased by Yale University as part of the Yale Sustainable Food Project.

Produce

There are numerous small-scale fruit and vegetable producers in Berkshire County (the Berkshire Grown Business to Business directory lists 41). Apples, pears, plums, peaches, berries, tomatoes, cucumbers, squash, pumpkins, potatoes, lettuce and other salad greens, sweet corn, mushrooms, and herbs are some of the products listed. These products, of course, are seasonal.

[94] NEHBC web site

Marketing Options

There are several farmer's markets at which Berkshire County producers can sell their wares. Markets currently exist in Great Barrington, Lee, Lenox, North Adams, Pittsfield, Sheffield, and Williamstown. In addition, neighboring towns in Vermont and New York provide an expanded market for farmers who are willing to travel the extra distance. These markets, combined with pick-your-own programs and farm stands, account for approximately $1.35 million in sales each year for Berkshire County's producers.[95]

Another marketing option for local growers is provided by an organization called Berkshire Grown. Berkshire Grown is a community-based group that works to support local agriculture in a variety of ways.[96] Berkshire Grown organizes community events to increase awareness of and appreciation for the county's farms and their produce and runs a marketing campaign to encourage the consumption of locally-produced products. In addition, Berkshire Grown organizes the Business to Business Program, which links local producers with local consumers. Restaurant owners and other food consumers submit requests for the items they wish to use, and farmers submit lists of the items they produce; Berkshire Grown matches people who are producing a particular product with people who want to purchase that product. This program has received rave reviews from all sides – restaurant owners, cooks, and customers appreciate the freshness and quality of the food, and producers appreciate having a steady demand for their produce. The Business to Business Program had almost 200 members in 2004; its membership continues to climb, having begun at just 26 when the program was founded in 1998.

[95] USDA/NASS 2004b
[96] Berkshire Grown web site

Berkshire Grown and other similar organizations play a critical role in helping farmers in this region continue to produce in an economically viable fashion. Without this assistance, local agriculture would most likely have declined much further than it already has. The struggles of local farmers are due in part to the economies of scale enjoyed by Western and Midwestern operations and in part to the inherent environmental conditions of the area. Despite these constant difficulties, however, agriculture has played an important role in the region's development and continues to be important, albeit less so than in previous centuries, in modern-day Berkshire County.

CHAPTER THREE
ANALYSIS OF WILLIAMS COLLEGE FOOD CONSUMPTION

In light of the historical, economic, sociocultural, and environmental implications of agriculture, it is important to examine our own food consumption here at Williams. This chapter describes the context in which this consumption takes place and attempts to estimate some of the environmental impacts of the production of the food we eat.

Institutional Context

From July 1, 2003, through June 30, 2004, Williams College Dining Services spent approximately $2.44 million on the ingredients used in the foods we eat, distributed as shown in Figure 12. A broad range of issues are considered when making purchasing decisions; these factors include budgetary constraints, consumer preferences, quality and consistency of supply, and institutional values, among others.

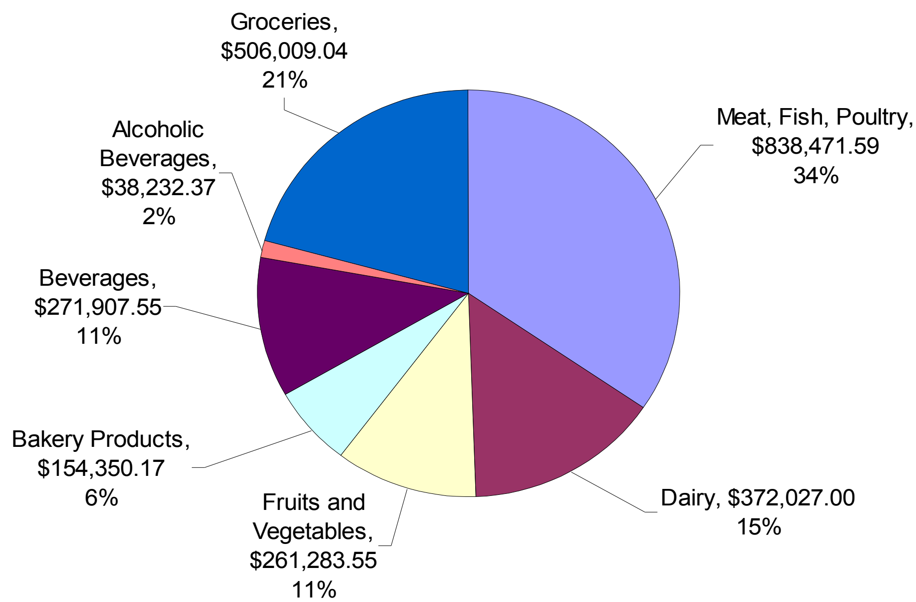

Figure 12. Williams College Food Expenditures by Product Group, 2003-2004.

Budgetary Constraints

The 2003-04 average plate cost (the cost of the food for each meal, not including labor) for Williams Dining Services was approximately $3.00.[97] Although the Williams administration is aware of and receptive to the idea of purchasing locally-produced and organic foods, the constraints of the budget leave little leeway for purchasing these products if they cause cost overruns. However, under the leadership of Director Bob Volpi, Dining Services has found ways to include these products in its operations while keeping its operating costs within budget.

Volpi, who grew up in Adams, MA, came to Williams in 2002. Before taking this job, he served as Director of Dining Services at Bates College in Lewiston, ME; prior to that, he worked in corporate food service for ARAMARK, a large facilities management firm. While he was at Bates, Volpi established several new initiatives to make Bates' food service more environmentally responsible. Volpi brought with him his commitment to local and organic foods when he came to Williams; being back in the region where he grew up makes these issues even more personal for him.

Volpi's experience working in both corporate and collegiate food service settings has left him with a proclivity for efficiency in all aspects of the operation. He relies on good communication and cooperation to identify waste and eliminate it. For example, attentive and precise management of inventory levels lets foods be ordered in appropriate quantities such that they are available when needed and are consumed before they spoil. In addition, training preparation attendants and cooks in the proper techniques for preparing various items helps avoid waste at that stage of the process. At the other end,

[97] Volpi, pers. comm.

dishroom employees often have a very good sense of which foods students like and which they don't based on what is left behind on the trays. If they communicate that knowledge to the managers, the menu planning can be altered to avoid the foods that end up being wasted. The compost and trash haulers have also been asked to monitor the quantities of waste being generated and to notify the managers if these amounts change significantly. Because Volpi is committed to providing high quality food, and because he values local and organic products, he has taken the savings generated by these improvements in efficiency and redirected some of those funds toward the purchasing of local and organic foods.

Volpi and Associate Director Mark Petrino have also reexamined Dining Services' purchasing contracts and have streamlined costs in this realm as well. In August of 2004, Williams began using SYSCO as its prime vendor. SYSCO is a huge corporate food service supplier; because of the company's size, it was able to offer the best prices on the products that Williams consumes. In addition, Williams negotiated the contract such that SYSCO will provide a broader array of organic products. By moving from several smaller contracts to one large one, Dining Services has saved money, and that money has been reinvested in the quality of the products purchased. However, it does seem somewhat ironic that the effort to purchase more local and/or organic products is being supported by more corporate contracts and a management style focused on efficiency. Given the budgetary constraints within which Williams Dining Services operates, though, it is difficult to envision other strategies that would allow the goal of purchasing more local/organic products to be achieved.

During the year under study, Williams Dining Services did not have a specific target for the percentage of food costs spent on locally-produced or organic products. The general strategy was to buy these products whenever feasible based on availability and budget, and to supplement them with conventional products. This means that the actual amount of these products purchased varies depending on the productivity and the finances of the season as well as on the person doing the purchasing.

Consumer Preferences

Menu decisions are made by attempting to balance a number of factors; these include student acceptance, nutrition, and resources available (labor, money, products, etc.).[98] Ginny Skorupski, the college nutritionist, and Mark Thompson, the head chef, collaborate at the early stages of this process. Williams Dining Services' philosophy of consumer satisfaction is a broad one – rather than offering specialty products for particular clienteles at particular dining halls, they provide a wide variety of offerings at every facility in an effort to please as many people as possible. Skorupski likened this to "trying to be everything to everyone all the time," and acknowledged that this may mean that students with a particular preference will be less satisfied than they would be with a specialized dining facility. However, Skorupski believes that this strategy leads to the highest level of overall satisfaction. A great advantage of this approach is that students can select dining halls based on the schedule and location of their classes and other commitments and be sure that there will be something palatable wherever they go.

In order to balance their broad strategy with instances of depth, Dining Services does offer some events with specialty foods at particular locations. The monthly vegetarian dinners, for example, cater to a particular clientele and provide some more unusual options that are not regularly available. Events such as these have a built-in

[98] Skorupski, pers. comm.

feedback mechanism: attendance is the best indicator of student opinion. If many students go out of their way to eat at a particular dining hall on vegetarian dinner nights, Dining Services knows that this is a good idea, and if attendance drops drastically on those nights, they may decide to try something else. Dining Services' computerized record-keeping system provides an easy way to track this information.

Supply Issues

An institution such as Williams Dining Services, which is responsible for feeding close to two thousand people each day, clearly needs its supplies to be consistent in availability and quality. This is one of the reasons that purchasing locally-produced and organic products can be challenging. New England's seasonality means that most produce items are only available locally in the summer and early fall. Root vegetables are available until mid to late fall and can be stored through the winter, but in the winter and spring there is little that can be grown without an extensive (and energy intensive) greenhouse system. Meat and dairy products, on the other hand, are available more or less year-round.

Quality is another area in which local/organic products are sometimes inconsistent. Because they are produced without chemical fertilizers or pesticides, organic produce items can be smaller, differently colored, or otherwise less desirable in appearance than their conventionally-produced counterparts. Superficial defects such as these can be an obstacle for some consumers. Similarly, grass-fed beef has a much more gamey flavor, has significantly less fat, and can be somewhat less tender than corn-fed feedlot beef. For consumers accustomed to the flavor, marbling, and texture of conventional beef, these characteristics can take some getting used to.

Dealing with fresh local and/or organic produce that is much less processed and less standardized than its conventional alternative also requires more labor on the part of Dining Services. Instead of simply opening a can or package, employees have to wash and prepare the items on their own, which translates into more employee time spent on preparation. This increased labor requirement is another potential obstacle associated with using local and organic products in the institutional context.

Institutional Values

Despite the challenges named above, Williams Dining Services remains committed to purchasing local and organic products. This is in large part due to institutional values – Volpi, Petrino, and other employees believe that this is an important issue, and they are willing to expend some extra effort on this front. This dedication by those in leadership positions has a twofold effect: the leaders' commitment is a model to be followed by others, and the policies created by the leaders shape the decisions that others can make. But this commitment is not confined to the leadership of Williams Dining Services. The cooks and other staff also make regular contributions by monitoring supply, quality, and reception of various products. Making local and organic products work in the institutional setting takes teamwork, and that is another strong value of the Williams Dining Services staff. As a group, they are committed to providing high quality food to Williams' students and to operating in a responsible manner.

The administration of Williams College is also relatively sympathetic to environmental issues in general. In the past four years, Williams has begun purchasing recycled paper, made an institutional commitment to composting of food waste, installed efficient technologies (compact fluorescent light bulbs, water-saving washing machines, and vending machine power management devices, for example), and committed itself through policy and practice to sustainable building design and construction. Although the budget and the college's operations are still tightly controlled, the administration is supportive of environmental causes and is willing to consider spending money to make changes in this arena.

Food Consumption at Williams

Before we can recommend changes that could be made to help mitigate the environmental impact of Williams' food consumption, it is important to understand what exactly we consume and what the environmental implications of our consumption are. This section describes Williams' consumption and presents some quantitative estimates of the energy, water, and transportation impacts of the production of that food.

Consumption Profile

Williams College Dining Services served about 775,000 meals over the course of the year under study (July 1, 2003 to June 30, 2004)[99]. As this study's focus is on Williams' dairy and meat consumption, it is necessary to examine these sectors in more detail. Cheese, eggs, and milk were the top three products in terms of expenditures in the dairy category, followed by ice cream, yogurt, and frozen yogurt (see Figure 13). In the meat category, beef and chicken were the top two products in terms of expenditures, while pork and turkey were third and fourth (see Figure 14). The total and per capita quantities of these products purchased can be found in Table 7.

[99] Volpi, pers. comm.

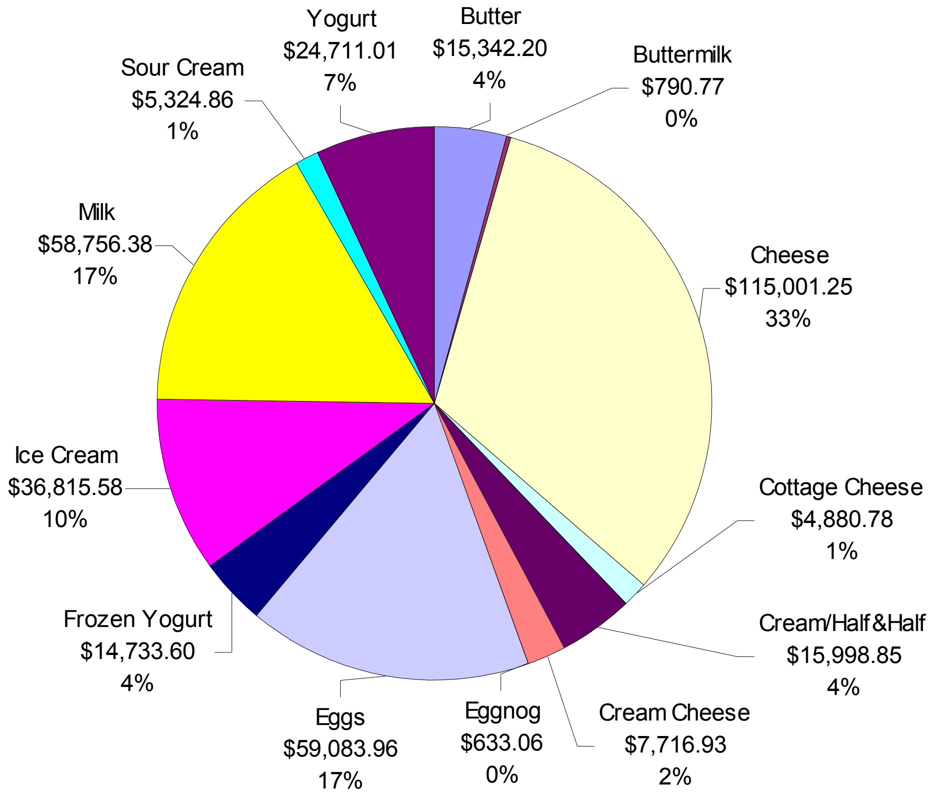

Figure 13. Dairy Expenditures by Product, Williams College, 2003-2004.

These are clearly large quantities of food, though they represent only a small fraction of the total annual production in the United States. Perhaps a useful way to get a sense of scale is to think of the barnyard population that would be necessary to provide these food products. Williams would need 86 beef cows (two or three per dormitory), 187 hogs (approximately five per dorm), and 48 dairy cows (twelve per class year). In addition, Williams would need a flock of 19,172 broiler chickens (nearly ten per student), 1745 laying chickens (close to one per student), and 1247 turkeys (about 35 per dorm). The amount of land area that would be required to support this menagerie is quite significant; so, too, is the amount of time that would go into the management of this farm. It is easy to imagine that students' academic and extracurricular pursuits could be seriously crimped if they were responsible for managing their own food production. In

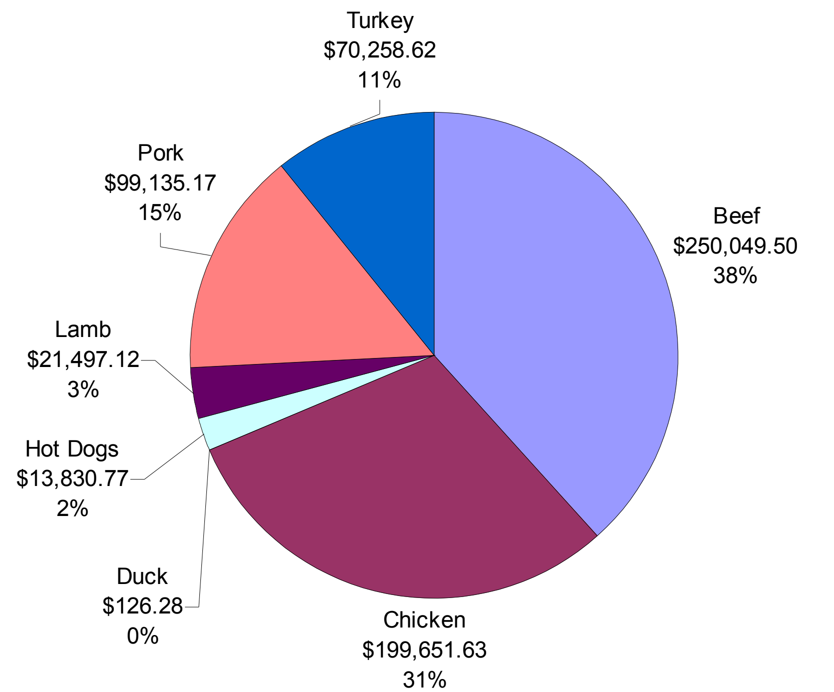

Figure 14. Meat Expenditures by Product, Williams College, 2003-2004.

other words, the delegation of these tasks to the vendors from which Dining Services purchases food products is necessary for Williams to function as it does.

Despite the fact that food and eating are critical parts of everyday life both biologically and socially, there is very little knowledge in the general population of what goes on behind the steam table or grocery store shelf. Even for those who want to know, information about food production is hard to come by. The following section explores the origins of the meat and dairy products consumed at Williams College.

Origins of Food

Two different stories emerge from a close look at the supply chain for the meat and dairy products consumed at Williams during the year under study. Many of the dairy products were relatively local, while the meats came from large-scale, corporate, industrialized agricultural operations. This difference manifested itself in the ease (or

Table 7. Annual consumption of meat and dairy products, Williams College, 2003-2004.

Product	**Total Consumption (lbs.)**	**Per Capita Consumption (lbs.)**
Beef	64,291	32.1
Pork	37,171	18.6
Lamb	3,407	1.7
Chicken	72,852	36.4
Turkey	26,184	13.1
Eggs	231,742	115.9
Milk	199,965	100.0
Cream	202	0.1
Butter	13,606	6.8
Cheese	46,293	23.1
Yogurt	18,389	9.2
Ice Cream	51,733	25.9
Frozen Yogurt	18,370	9.2

lack thereof) with which one could find out where exactly the products come from. The more local operations were significantly more transparent, while the national corporations were a maze of complex layers that were much more difficult to navigate.[100]

In the case of dairy, more than 75% of Williams' purchasing was done through Crescent Creamery of Pittsfield, MA. All fluid milk products and the majority of cheeses, yogurts, and other cultured dairy products came from Crescent Creamery. Slightly less than 20% of the dairy purchasing was done through Butler Wholesale of Adams, MA, with eggs and cheese being the main products purchased. About 4% of the dairy expenses went to Dole & Bailey of Woburn, MA; cheese contributed the vast majority of these expenditures. The remaining fraction of the purchasing was spread among several vendors who were used essentially as substitutes when the required item was not available from the usual source. Table 8 presents information on the origins of the major dairy products Williams purchased in the year under study.[101]

[100] Some of the corporate vendors were unwilling to provide specific information about their suppliers for business reasons; when that happened, I obtained as much general information as possible and substituted approximations based on censuses and other aggregate data when necessary for calculation purposes.
[101] Information about dairy product origins was provided by Bob Keegan of Crescent Creamery, George Atkins of Butler Wholesale, Chip Joyce of Dole & Bailey, and the corporate web sites of these vendors' suppliers.

Table 8. Suppliers of dairy products, Williams College, 2003-2004.

Product	Vendor	Location	Supplier	HQ Location	Notes
Butter	Crescent Creamery	Pittsfield, MA	Cabot	Cabot, VT	Cooperative of ~1350 farms in New England and upstate New York
	Butler Wholesale	Adams, MA	Summer Maid	Pennsylvania	
Cheese	Crescent Creamery	Pittsfield, MA	AMPI	New Ulm, MN	Cooperative of ~4600 farms in IA, MN, MO, NE, ND, SD, and Wi
	Butler Wholesale	Adams, MA	Kraft	Northfield, IL	
	Dole & Bailey	Woburn, MA	unidentified importer		Cheese comes from a variety of European and domestic producers
Cream/Half & Half	Crescent Creamery	Pittsfield, MA	Hood	Portland, ME, and Vernon, NY	Processing plants for a network of farms in northern New England and upstate New York
	Butler Wholesale	Adams, MA	Crowley (Hood)	Binghamton, NY	
Eggs	Crescent Creamery	Pittsfield, MA	Rock Ridge Farm	Richmond, MA	
			unidentified wholesaler	Springfield, MA	Eggs come from large national producers
	Butler Wholesale	Adams, MA	Papetti Hygrade Eggs (Michael Foods)	Minnetonka, MN	Eggs come from large national producers
Ice Cream/Frozen Yogurt	Crescent Creamery	Pittsfield, MA	Hood	Suffield, MA	Processing plant for a network of farms in northern New England and upstate New York
	Butler Wholesale	Adams, MA	Colombo (General Mills)	Golden Valley, MN	
Milk	Crescent Creamery	Pittsfield, MA	Hood	Barre, VT	Processing plant for a network of farms in northern New England and upstate New York; guaranteed rBST-free
			Agri-Mark	West Springfield, MA	Processing plant for a cooperative of ~1300 farms in New England and New York; guaranteed rBST-free
Yogurt	Crescent Creamery	Pittsfield, MA	Stonyfield Farm	Londonderry, NH	Certified rBGH-free
			Colombo (General Mills)	Golden Valley, MN	

In the case of meats, Dole & Bailey was the main vendor, accounting for 60% of the expenditures. Butler Wholesale contributed 25%, including more than half of the turkey and about 35% of the chicken, while Wohrle's Foods of Pittsfield, MA, made up 14% of the expenditures. As is the case in the dairy sector, the remaining fraction of the purchasing was divided among several supplementary vendors. Table 9 presents the origins of the major meat products that Williams purchased during the year under study.[102]

Environmental Impacts of Food Production

If information about the processes by which food is produced and the areas from which it comes is hard to find, information about the environmental and social impacts of these production processes is even more elusive. But in order to make wise decisions in one's consumption, it is important to recognize that, as Michael Brower and Warren Leon write in *The Consumer's Guide to Effective Environmental Choices*, "not all consumption has an equal impact on the environment. For that reason, a 10 percent across-the-board reduction in Americans' consumption would not be the most effective way to reduce environmental damage."[103] This section explores the environmental impacts of the production of the meat and dairy products consumed at Williams College.

Continuing the trend set by earlier sections of this research, precise data with which to attempt quantitative estimates of the environmental impacts of food production proved paltry at best. The following calculations, therefore, are not meant as exact numerical measures of the environmental impacts of agricultural production; rather, they

[102] Information about meat product origins was provided by Paul Maxwell of Dole & Bailey, George Atkins of Butler Wholesale, John Pickwell of Wohrle's Foods, and the corporate web sites of these vendors' suppliers.
[103] Brower and Leon 10-11

Table 9. Suppliers of meat products, Williams College, 2003-2004.

Product	Vendor	Location	Supplier	HQ Location	Notes
Beef	Dole & Bailey	Woburn, MA	Excel (Cargill)	Wichita, KS	
			Greater Omaha Packing	Omaha, NE	
			Catelli	Collingswood, NJ	Supplies veal
	Butler Wholesale	Adams, MA	IBP (Tyson)	Springdale, AR	Largest beef producer in the world
	Wohrle's Foods	Pittsfield, MA	IBP (Tyson)	Springdale, AR	Largest beef producer in the world
			Excel (Cargill)	Wichita, KS	
			National Beef Packing	Kansas City, MO	
Chicken	Dole & Bailey	Woburn, MA	Townsend Chicken	Wilmington, DE	Vertically integrated operation
			Bell & Evans	Fredericksburg, PA	Vertically integrated operation
	Butler Wholesale	Adams, MA	Carl's Boned Chicken	New Haven, CT	Wholesaler - distributes chicken from major national producers
			Tyson	Springdale, AR	Vertically integrated operation
Lamb	Dole & Bailey	Woburn, MA	Catelli	Collingswood, NJ	
Pork	Dole & Bailey	Woburn, MA	Hatfield	Hatfield, PA	
	Butler Wholesale	Adams, MA	Hatfield	Hatfield, PA	
			Hormel	Hatfield, PA	Supplies bacon products
	Wohrle's Foods	Pittsfield, MA	Farmland Foods	Kansas City, MO	
Turkey	Dole & Bailey	Woburn, MA	Carolina Turkey	Mt. Olive, NC	Vertically integrated operation
	Butler Wholesal	Adams, MA	Carolina Turkey	Mt. Olive, NC	Vertically integrated operatior

are meant to provide a sense of the order of magnitude of these impacts and to illustrate the importance of initiatives that might help mitigate the environmental ramifications of food production.

Energy

The energy crisis of the late 1970s spurred a great deal of research into energy consumption in various industries, and agriculture was no exception. Because of this, there exists a strong body of work on this topic, but the vast majority was published during the 1980s. Updates seem not to have received high priority; this is an area where future research would be quite useful. Given the information available, the estimates presented here are somewhat outdated. The effect of this datedness on the calculations is somewhat unclear. However, the lack of more recent works leaves little choice but to recognize this uncertainty and proceed with the estimates.

The estimated energy use involved in the production of the major meat and dairy products consumed at Williams College is presented in Table 10. The process by which the beef calculations were accomplished is presented here in the text. The estimates for the other commodities were obtained in a similar fashion; their details can be found in Appendix A. The mammalian products are clearly much more energy intensive than the avian products. In general, the meat products require vastly more energy than the other animal products (dairy and eggs), with the exception of the "other dairy" category. This number is much higher than the number for fluid milk because it takes several pounds of milk to produce each pound of butter, cheese, yogurt, etc. Therefore, the energy required to produce that milk is concentrated into fewer pounds of the processed products.

Table 10. Estimated energy used in production of meat and dairy products, Williams College, 2003-2004.

Product	Total Energy Use (kcal)	Energy Per Pound (kcal)
Beef	260,000,000	4000
Pork	150,000,000	4000
Chicken	29,000,000	400
Turkey	16,000,000	600
Eggs	7,000,000	30
Milk	150,000,000	750
Other dairy products	520,000,000	3500
TOTAL	*1,132,000,000*	-

During the year under study, Williams College Dining Services purchased 64,291 pounds of beef. The average dressed weight of beef cattle slaughtered in the United States in 2004 was 746 pounds;[104] this makes Williams' beef consumption equivalent to approximately 86 steers. Two estimates of energy consumption are necessary to calculate the total in this case, as beef cattle spend part of their lives in pasture and part in feedlots. The estimated energy input per pound of output for cattle on pasture is 2525 kilocalories;[105] since the beef calves gain about 420 pounds before entering feedlots, this translates into energy expenditures of approximately one million kcal per head. Once at the feedlots, the energy input per head per day is estimated as 10,933 kcal.[106] Steers that spend six months (180 days) in the feedlots will thus require an energy expenditure of about two million kcal per head during that period. This means that two-thirds of the total energy required in beef production is expended during the second half of the steers' lives, during which period they gain more than half but less than two-thirds of their total weight.

104 USDA/NASS 2004c, VII-13

105 Pimentel 1980, 423

106 This figure is an average of three types of feedlots presented in Pimentel 1980, 418.

The sum of the pasture and feedlot energy requirements gives a total expenditure of about three million kcal per head; when multiplied by the 86 steer-equivalents calculated above, this yields an estimated total energy expenditure of over 260 million kcal to produce the beef consumed at Williams in one year.[107] This number and the others in Table 10 include only the energy required to produce the animals themselves. The estimated energy expenditure would increase vastly if slaughter and processing were included, but the data necessary to calculate these figures were not available.

When the numbers for each individual commodity in Table 10 are summed, the total energy used in the production of the major meat and dairy products consumed at Williams comes to over 1.1 billion kcal. This can be translated into quantities of various fuel sources that contain the equivalent amount of energy; Table 11 shows some of these equivalents.[108] Williams students might be surprised to know that the production of the meat and dairy products eaten in the dining halls by each one of them each year consumes a quantity of energy that is equivalent to the energy in about 175 pounds of coal. The total energy consumed in the production of Williams' meat and dairy products is also roughly equivalent to 1500 years' worth of calories for an average person on a 2000 kcal/day diet, or to the approximate annual food energy consumption of three-fourths of the Williams student body.

Table 11. Fuel equivalents of energy used in meat and dairy production, Williams College, 2003-004.

Fuel	**Quantity**
Coal	175 tons
Natural Gas	115,000 m^3
Diesel	32,000 gallons
Gasoline	37,000 gallons
Electricity	1,300,000 kWh

[107] The total presented does not appear to agree precisely with the other numbers in the text; this is due to rounding. In the calculations, rounding was performed only at the end of the process, but the intermediate figures have been rounded for the purposes of the text. The same is true of the other calculations in this section.
[108] Conversion factors used to calculate figures in Table 11 are from Pimentel 1980, 15

Water

For only one commodity (beef) was a relatively complete water use figure available. An effort to estimate subcomponents of water use in the production of other items succeeded only in finding enough data to estimate the drinking water consumed by the animals themselves. The information necessary to estimate the water consumption of other sectors of the industry, such as the cleaning of barns, the operations and sanitation practices of slaughterhouses and processing facilities, etc., was not available. Therefore, the estimates presented here (Table 12) should be interpreted as approximations that will provide a sense of the scope of agriculture's impacts on water resources.

The quantity of water required to produce one pound of grain-fed beef in the ways that are standard in today's conventional agriculture is conservatively estimated at 300-500 gallons.[109] For the purposes of this analysis, the middle of the range (400 gal/lb.) was used; based on the total consumption data described above, this yields a total water requirement of nearly 26 million gallons for the beef cattle raised to satisfy Williams' demand. This figure includes the water consumed directly by the steers as well as the water used in irrigation, sanitation, and other such inputs. In fact, the steers' drinking

Table 12. Estimated water used in production of meat and dairy products, Williams College, 2003-2004.

Product	**Total Water Use (gal.)**	**Water Per Pound (gal.)**
Beef	26,000,000	400
Pork	5,000,000	130
Chicken	3,000,000	40
Turkey	650,000	25
Eggs	2,000,000	9
Milk	3,500,000	18
Other dairy products	12,000,000	80
TOTAL	*52,150,000*	-

[109] Pimentel 1990, 9

water makes up only a small proportion of the total water consumed in beef production; this direct consumption was estimated as follows.

As described above, the beef consumed at Williams during the year under study is equivalent to approximately 86 steers. The estimated average drinking water consumption per steer per day is 15.6 gallons;[110] when multiplied through by the number of steers and their lifetimes (using twelve months as a conservative estimate), this gives a total direct water consumption of nearly 500,000 gallons for the beef cattle consumed at Williams in one year. This figure is significantly lower than the more inclusive estimate presented above due to its more limited scope.

Because more inclusive data were not available for the water requirements of other livestock, a different technique of estimation was employed. The ratio of drinking water consumption to total water consumption for beef can be calculated based on the above figures to be approximately 1:50. This ratio was applied to the quantities of drinking water calculated for each type of livestock (see Appendix A) in order to obtain rough, order-of-magnitude estimates of broader-scale water impacts.

The sum of the numbers in Table 12 gives a total water requirement of more than 52 million gallons to produce the major meat and dairy products consumed at Williams in the year under study. This quantity of water is approximately equivalent to the entire flow of the Hoosic River in Williamstown for almost seven hours or to the entire flow of the Green River in Williamstown for almost a full day.[111] This water is also equivalent to the volume of almost 53 Olympic size swimming pools (50m by 25m by 3m). In addition, this quantity of water would be enough drinking water (following the USDA

[110] Warrington

[111] The average flow of the Hoosic River in Williamstown over the past ten years is 2085 gal/sec; the average flow of the Green River in Williamstown over the past ten years is 665 gal/sec (USGS).

recommendation of eight 8-ounce glasses per day[112]) to sustain the entire human population of Massachusetts for more than sixteen days or the entire population of Berkshire County for more than two years.[113]

Surely there would be a public uproar if Williams College tried to claim a right to dam the Green River for a day and collect all the water. But because we are so removed from the production of our food and the environmental impacts of those processes, students do not think of damming a river when they serve themselves a hamburger or some chicken tenders. Conflicts over water use are played out far away, hidden among the invisible processes that take place behind the steam table or the supermarket shelves. The knowledge alone might not be enough to change behaviors on a large scale, but perhaps people would think twice if they realized that the meat in a hamburger patty requires about 100 gallons of water to produce, an eight-ounce glass of milk requires nearly ten gallons of water to produce, and a three-egg omelet requires about 3.5 gallons of water to produce.

Transportation

Fluid milk is the only product for which transportation impacts can be calculated with any degree of certainty because it is the most traceable. The other products that Williams purchases come from huge national producers whose production locations are scattered so widely that estimates of distance become futile. Because of the scarcity of detailed information available regarding the transportation of food products, this set of calculations is somewhat roundabout. Like those above, these numbers are intended as

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[112] Juan and Basiotis

[113] In 2003, the estimated population of Massachusetts was 6,433,422 people and the estimated population of Berkshire County was 133,310 people (U.S. Census Bureau).

conservative estimates to give a sense of the magnitude of these impacts rather than as exact quantifications.

Milk that comes from Crescent Creamery's Agri-Mark supplies must travel a minimum of 75 miles: 54 miles from the Agri-Mark plant in West Springfield to Crescent Creamery in Pittsfield, and 21 miles from Pittsfield to Williamstown.[114] The distance it travels from the farm to the processing plant cannot be calculated as precisely, but an estimate of 125 miles on average seems reasonable. A 125-mile radius from West Springfield reaches southern and south-central Vermont and New Hampshire, southern Maine, western Massachusetts, part of upstate New York, and Connecticut. Some farms are closer than 125 miles from the plant, while others are further away, but even those that are nearer to the plant may be on somewhat indirect collection routes. If this assumption holds, then Agri-Mark milk destined for Williams College must travel an average of 200 miles before reaching its destination.

Milk that comes from the Hood facility in Barre, VT must travel a base distance of approximately 155 miles: 134 from the plant to Crescent Creamery plus 21 from Pittsfield to Williamstown. A 50-mile estimated average farm-to-plant distance seems appropriate in the Hood plant's smaller catchment area – this radius reaches northern and central Vermont and New Hampshire and upstate New York. This gives a 205-mile travel distance for Hood milk destined for Williams. Information on the percentage of Crescent Creamery's milk supply that comes from each of the two plants was not available, so for the purposes of this analysis, a 50-50 split is assumed. This means that approximately 11,626 gallons (199,965 pounds divided by two and converted to gallons at a rate of 8.6 pounds per gallon) came from each source during the year under study.

[114] Distances were calculated using MapQuest.

The milk is most likely transported in large tanker trucks during the initial farm-to-processing-plant leg of the journey. These trucks come in various sizes, but 6200 gallons is standard for large tractor-trailer tankers; these trucks get approximately six miles to the gallon of diesel fuel.[115] If the milk that Williams ultimately consumes comes into each processing plant daily, it makes up approximately 0.5% of a truckload per day (11,626 gallons per year divided by 365 days and then divided by the 6200 gallon capacity of each truck). The fuel used to transport Williams' milk from the farms where it is produced to the Agri-Mark processing plant, therefore, can be calculated by multiplying 365 deliveries per year by 50 miles per delivery, dividing by six miles per gallon, and multiplying by the 0.5% of each delivery that is attributable to Williams' consumption. This calculation suggests that approximately 39 gallons of diesel fuel are used in this leg of the transportation process. Running the same calculation for the 50-mile delivery routes of the Hood plant yields a consumption of about 16 gallons of diesel annually.

The next leg of the journey – from the processing plants to Crescent Creamery – most likely takes place in large refrigerated trailers that hold the packaged milk. The large refrigerated truck units have a similar capacity to the large tanker trucks and get approximately equivalent gas mileage. If Crescent Creamery receives daily deliveries from each processing plant, the percentage of each delivery that is attributable to Williams is equal to the number used in the previous calculation (0.5%). Thus, calculations similar to those performed above (this time for 54-mile trips from Agri-Mark and 134-mile trips from Hood) yield approximately 17 gallons of diesel consumed in the trip from Hood and 42 gallons of fuel used in the trip from Agri-Mark.

[115] This figure is based on a survey of publications and web sites of the trucking industry.

To carry the milk from Crescent Creamery to Williams, smaller trucks are used; these are approximately one-third the size of the larger refrigerated units and can carry around 2000 gallons of milk. These medium-sized trucks generally obtain mileage rates of about ten miles per gallon. If we assume that Williams receives milk deliveries every three days (probably an underestimate of the frequency) and that there are several weeks each year when the dining halls are closed, we can estimate the number of deliveries from Crescent Creamery at about 100 per year. Approximately 12% of each delivery can be attributed to Williams' consumption (199,965 pounds converted to gallons at a rate of 8.6 pounds per gallon, divided by 100 deliveries per year, and then divided by 2000 total gallons per trip). Using these figures in the calculation process described above yields a total fuel consumption of about 24 gallons for the Crescent Creamery deliveries.

The sum of the above numbers gives a grand total of approximately 138 gallons of diesel fuel consumed in the transportation of the fluid milk consumed in a year at Williams. This figure is a conservative estimate due to the assumptions built into it. Its calculation was based on truck operation at full capacity and on estimated delivery frequencies that are probably lower than the actual numbers. In addition, this figure does not take into account the fuel consumed by trucks on their return trips. Thus, the actual fuel consumption is likely to be higher than this estimate.

The combustion of diesel fuel releases many pollutants into the atmosphere; the quantities released by the combustion of 138 gallons of diesel are shown in Table 13.[116] While these numbers are not huge, they are significant, especially when we consider that they represent the quantities emitted solely in the transportation of fluid milk to Williams; those 138 gallons of fuel translate into approximately one cup of diesel per student or

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[116] Table 13 is based on data from Pimentel 1980, 15 and USEPA 1997.

three-fourths of a fluid ounce of diesel of per gallon of milk to transport Williams' annual milk consumption.

Table 13. Estimated pollution generated by milk transportation, Williams College, 2003-2004.

Pollutant	Quantity (kg)
Carbon Monoxide	120
Hydrocarbons	9.8
Nitrogen Oxides	38
Particulate Matter	0.75

If we were to attempt to calculate the fuel consumed in the transportation of other products, these numbers would increase drastically, as most of the other products under study here come from much further away. While the milk consumed at Williams in the year under study traveled hundreds of miles on average, other meat and dairy products are likely to have traveled thousands of miles. This ratio can be used to obtain an order of magnitude estimate of the fuel consumed in transporting other products as follows.

Assuming that the other commodities under study here travel approximately an order of magnitude further than the fluid milk (thousands of miles instead of hundreds), we can multiply the per-pound diesel use of milk (0.00069 gal/lb.) by ten to obtain a figure of 0.0069 gallons per pound for the other products. Multiplying by the total poundage consumed gives the estimates shown in Table 14 for total fuel consumption and total emissions. While it is true that these numbers make up only a tiny fraction of the total annual emissions in this country, they are still important figures to present because they represent an implication of food consumption that never even crosses the minds of the vast majority of people.

A comparison between the energy required to produce these products and the energy required to transport them is informative as well (Table 15). The energy used in production is significantly greater than the energy used in transportation for all products listed with the exception of eggs, which we recall are the most energy-efficient in production (see Table 10, p.73). This information has important implications for

Table 14. Estimated total fuel consumed and pollution generated in meat and dairy product transportation, Williams College, 2003-2004.

Product	Diesel (gal.)	CO (kg.)	HC (kg.)	NOx (kg.)	PM (kg.)
Beef	440	370	31	120	2.4
Pork	260	220	18	71	1.4
Chicken	500	420	35	140	2.7
Turkey	180	150	13	49	0.98
Eggs	1600	1400	110	440	8.7
Milk	138	120	9.8	38	0.75
Other dairy products	1025	870	73	280	5.6
TOTAL	*4143*	*3550*	*290*	*1138*	*23*

purchasing decisions – it suggests that at least in the case of meat and dairy products, buying products that are produced in a less energy- and water-intensive fashion could make more of a difference than buying products that are produced in a conventional fashion but do not have to travel as far. However, as it works out in this particular region, many of the local producers also follow sustainable production practices, so purchasing local foods in Berkshire County is likely to be beneficial on both fronts.

New Developments at Williams College

In the months that have passed since the close of the year on whose consumption figures the calculations in this section are based, several initiatives have come to fruition and others have begun. Dining Services' dedication to tightening their budget and

Table 15. Energy used in production and transportation of meat and dairy products, Williams College, 2003-2004.

Product	Production Energy (kcal)	Transportation Energy (kcal)
Beef	260,000,000	15,000,000
Pork	150,000,000	9,000,000
Chicken	29,000,000	17,000,000
Turkey	16,000,000	6,000,000
Eggs	7,000,000	56,000,000
Milk	150,000,000	5,000,000
Other dairy products	520,000,000	36,000,000
TOTAL	*1,132,000,000*	*144,000,000*

reinvesting the money they save in the quality of the food they purchase has made possible several new efforts to buy local and organic products. Most notable is the transition to dairy products from High Lawn Farm in Lee, MA. All of the fluid milk served in the dining halls now comes from High Lawn's registered Jersey herds, providing more nutrition and lower environmental impacts than standard milk. High Lawn Farm's production process is very environmentally conscious; as described in the previous chapter, the farm produces all its own hay and silage and only has to transport the grain and vitamin pellets fed to the cows. The manure produced by the cows is used on the farm to fertilize the fields that produce the cows' feed. And the milk only has to travel from Lee to Williamstown, a distance of approximately 31 miles.

This is a significant improvement even over Williams' previous milk supplier, Crescent Creamery, which was a relatively local business already. While milk from Crescent Creamery traveled an average of 200 miles or so on its journey from the farm where it was produced to Williams, where it was consumed, milk from High Lawn Farm travels only fifteen percent of that distance. Assuming that the efficiencies and frequencies of the trips were approximately equivalent, this figure means that just 21 gallons of diesel fuel will be required to transport a year's worth of milk from High Lawn Farm to Williams.

In addition, there are content differences between High Lawn Farm's milk and conventionally produced milk. Because High Lawn Farm's herds are registered Jersey cattle instead of the standard Holsteins, their milk has 20% more calcium and 17% more protein. In addition, High Lawn Farm does not use hormones or antibiotics in the milk production process. While the milk from Crescent Creamery was also free of synthetic hormones, there was no guarantee about antibiotic use. Although the direct human health consequences of antibiotic use in dairy cattle are disputed, its contribution to the development of antibiotic resistance is certain; this makes High Lawn Farm's commitment to avoid antibiotics all the more valuable.

The High Lawn Farm contract worked out well for both the farm and the college because the farm's supply matched the college's demand. Many of High Lawn Farm's higher-end products, such as butter and cream, are sold at high prices to upscale restaurants and hotels in the Berkshires. But the farm doesn't have as large a market for its more mundane products, particularly skim milk. Williams Dining Services definitely could not afford to purchase butter and such products from High Lawn Farm, as they cost approximately four times the current price. However, as shown in Figure 15, skim milk constitutes the majority of Williams' milk consumption. Through the negotiation process, Williams and High Lawn Farm were able to work out a contract in which skim milk is actually cheaper than it was from Crescent Creamery while some other products are somewhat more expensive.

As of early August, 2004, the dairy contract in total was estimated to cost Williams approximately 5-8% more than it did before the changeover because of the volumes involved;[117] this is a price that Dining Services decided it was willing to pay for the benefits of this local product. However, in practice this contract has turned out to be an even better deal than was estimated. As of early December, 2004, the year-to-date dairy costs were 0.5% lower than they were the previous year due to a well-negotiated contract and to the good fit between High Lawn's supply profile and Williams' demand

[117] Petrino, pers. comm.

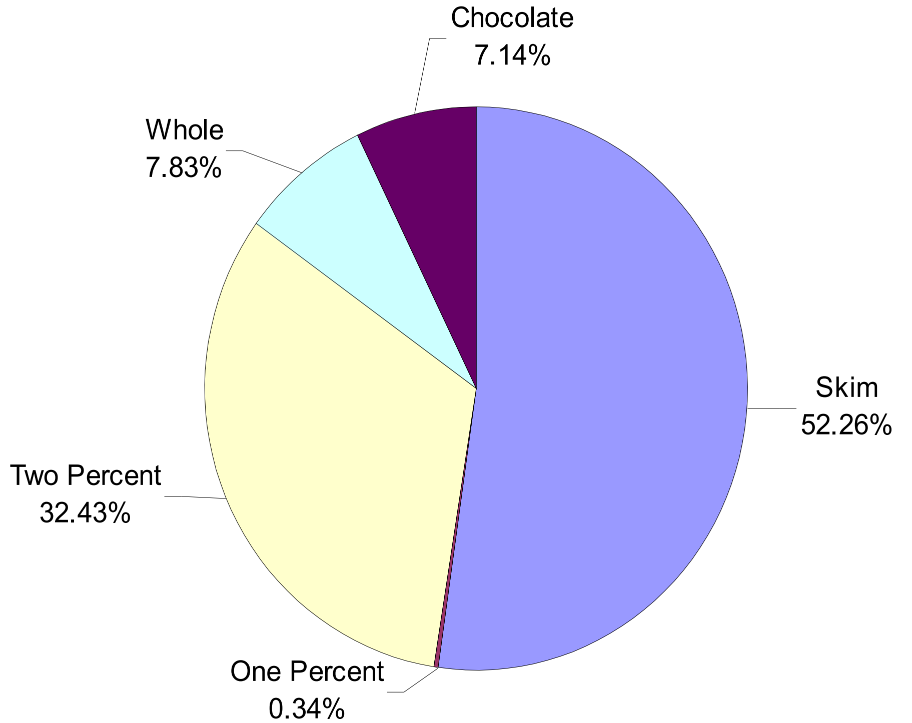

Figure 15. Williams College Milk Consumption, 2003-2004.

profile.[118] This is a concrete instance in which a local product makes economic sense in addition to providing environmental and quality benefits.

Another new local contract provides for the purchase of ground beef for Dodd House's nightly pub burgers from the New England Livestock Alliance (NELA), a program of the New England Heritage Breeds Conservancy. As described in the previous chapter, NELA helps local farms stay in the business of agriculture instead of being outcompeted by large-scale industrial operations; this contributes to the preservation of the rural character and agricultural history of the Berkshires as well as to the perpetuation of open spaces in the region. In addition, as is the case with the High Lawn Farm contract, it reduces the need for transportation and its negative environmental impacts.

[118] Volpi, pers. comm.

Instead of traveling from feedlots in Colorado or Kansas, the beef comes from farms in western Massachusetts, southern Vermont, or eastern New York.

Furthermore, the farms of NELA are generally small-scale and use sustainable agricultural methods. The beef is guaranteed to be free of hormones and antibiotics, and it is also grass-fed or free-range. These practices further reduce the environmental impact of the meat production. For example, grass-fed livestock production is estimated to consume 60% less energy than conventional corn-fed systems.[119] The beef from NELA, therefore, requires about 1600 kcal per pound instead of the 4000 kcal required by the conventional alternative. If Williams were to switch all of its beef consumption over to grass-fed alternatives, it would save nearly 160 million kcal per year, reducing the approximate per capita beef production energy expenditures from the equivalent of 40 pounds of coal to the equivalent of 16. In addition, the resulting beef is much lower in fat than its conventional alternative (untrimmed beef is usually less than five percent fat in grass-fed cattle versus about twenty percent in corn-fed cattle).

The negotiations of this contract have some similarities to the High Lawn Farm case. NELA has many upscale clients that purchase steaks, filet mignon, and other high-end meat products, leaving the Conservancy with a surplus of more everyday cuts such as ground beef. Williams has a high demand for these products, and their price differentials are less significant than those of the fancier meats. Therefore, once again there was a good match between supply and demand, and this led to the successful negotiation of a contract. The NELA ground beef is approximately 15% more expensive than the

[119] Pimentel 1990, 12

conventional alternative and made up about 10-12% of the total beef consumption as of August, 2004.[120]

Although the beef from NELA is more expensive than the conventional alternative, it has not caused Dodd's meat costs to balloon out of control. In fact, Dodd's per-plate meat costs from August to December, 2004, were the second lowest of the four dining halls.[121] This is in part due to the manner in which Dodd's pub burgers are offered – they are available in addition to regular entrees, so not all students who dine at Dodd will eat a burger. They have been serving approximately 80 burgers per night, and the reception has been positive from both the Dodd employees and the students who eat there.

The changes that have been made in the '04-'05 year have had very positive results. As a result of Volpi's focus on improved efficiency, the total year-to-date plate costs were down about 10% to approximately $2.70 as of December, 2004.[122] This has allowed Dining Services to introduce some new organic products into its food supply. In December, 2004, Volpi introduced a new organic initiative that adds twelve new organic products immediately and four more each month.[123] This "save first, then spend" mentality is looked upon favorably by the administration in its budget planning, and Volpi believes that this method is likely to be successful in continuing to shift the food supply toward more organic and local products.

In the spring of 2005 (as part of the 2005-2006 budgeting process), Williams Dining Services set a goal of making local and organic products comprise four percent of

[120] Petrino, pers. comm.
[121] Volpi, pers. comm.
[122] *Ibid.*
[123] Skorupski, pers. comm.

the total food supply. This is estimated to cost approximately ten cents per meal, for a total yearly cost of $77,500 (based on an annual average of 775,000 meals served).[124] This target figure may be increased in the future.

[124] Volpi, pers. comm.

Chapter Four
Action Plan

As described in the previous chapter, several recent developments have led Williams College Dining Services toward more environmental responsibility. The commitment to these initiatives demonstrated by the Dining Services staff is exemplary; these efforts could not have succeeded without hard work on all sides. Their work has paid off – the programs they have developed have made a significant impact. But there is still more that can be done. To that end, the following action plan outlines steps that should be taken to further the goal of environmental responsibility.

Part One: Keep Up the Good Work

Williams College Dining Services has done a lot of good work to increase the quantities of organic and locally-produced food items consumed here. The High Lawn Farm dairy contract, the NELA beef trial, and the expansion of the organic product line have been quite successful and should be continued. The four percent local/organic target is also an excellent effort; the results of this initiative will help inform the future steps that should be taken.

These programs have been generally well-received so far. Dining Services' educational efforts have not yet managed to overcome all of the apathy displayed by students, but many students do notice and appreciate the new efforts. The High Lawn Farm milk and the organic vegetables on the salad bar seem to receive the most comments; students seem to enjoy both the quality and the socially and environmentally responsible nature of these products

Part Two: Expand Existing Programs

In addition to sustaining the efforts that have been made so far, Williams Dining Services should expand these programs in the following ways.

A. More Local Meat

Meat is a product that can be produced in Berkshire County with relative success. There are a number of producers in the region (see Appendices B and C), but none that produce the quantity that Williams needs. It may be possible to purchase meat from a number of local producers, but this makes the logistics of ordering, payment, and delivery significantly more difficult and therefore may not be feasible. However, other options exist that might be more likely to succeed.

One possibility is to select one dining hall and purchase locally-produced meat products for that facility. This would make the required quantities smaller and would allow the demand to be met by a smaller number of suppliers. This strategy has worked well with the NELA beef trial in Dodd, and its potential for expansion is good.

Another option is to establish partnerships with local producers through which Williams Dining Services guarantees a certain amount of demand so that the producers can make up-front expenditures knowing that there will be a payback. This strategy could help local farmers who are feeling squeezed economically by helping to stabilize their financial situations. By helping to make agriculture a more economically viable option locally, this strategy could also help preserve the Berkshires' rural character and agricultural heritage by keeping farmland open and undeveloped.

If this second option is pursued, the partnership(s) should be established with associated criteria of environmental responsibility. Organic standards are one possible guideline; grass-fed husbandry is a somewhat less stringent option. Caution should be taken to avoid water pollution and erosion as well. This partnership could offer an educational opportunity as well: if the producers want assistance with the environmental aspects of raising livestock, Williams students could get involved, possibly through Environmental Studies or Biology courses or through summer internships.

Research would also be necessary into the availability of slaughterhouses and other meat processing facilities locally. Talking with NELA about their facilities is one possibility; consulting other schools that have set up local programs is another. Another resource who might be consulted is Tod Murphy, the founder and CEO of the Farmers Diner (see Ch. 1, p. 38). Murphy's restaurant has its own commissary, where it processes fresh meat and produce from local producers; he might be able to advise Williams and its partners about the intricacies of local food processing. This might also be an area in which Williams students could get involved in the research and planning.

B. Additional Organic Products

The current program to increase the number of organic products purchased is a good one, and it should be continued. The process by which these new products are selected should be improved. Clearly, this process must take into account the economics of the situation, but it would be good to also consider the environmental implications of the decision. Food products whose conventional production uses particularly chemical-heavy methods should be targeted, as far as economically possible, for the switch to organic. The Environmental Working Group identifies the following foods as the "Ten Most Important Foods to Buy Organic"[125]:

1. Baby Food – conventional products are often contaminated with pesticide residues.
2. Strawberries – these are the single most pesticide-contaminated fruit, produced by one of the most pesticide-heavy production processes.
3. Rice – there are significant concerns of groundwater contamination with herbicides and insecticides in many rice-growing areas.
4. Oats and other grains – these are often used in crop rotations between heavily-treated crops, so they, too, can be contaminated.
5. Milk – cows in conventional milk production are regularly treated with hormones and antibiotics, which have severe negative health impacts; there are concerns about the health effects on people who consume milk that contains residues of these chemicals.
6. Corn – this dietary staple is the recipient of about 50% by weight of agricultural pesticides used in the United States during its production.
7. Bananas – these are cultivated using heavy doses of pesticides, some of which are neurotoxins and have been linked to birth defects.
8. Green Beans – more than 60 pesticides are registered with the EPA for use in growing green beans, and this vegetable has been found to be contaminated with residues of chemicals including neurotoxins and endocrine disruptors.
9. Peaches – this fruit is above average in terms of frequency of pesticide residue contamination violations.
10. Apples – these are heavily treated with fungicides and insecticides during conventional production and have been found to be contaminated with residues of these chemicals.

Baby food is clearly not applicable to Williams, and milk is a product that has already been addressed here, but the remainder of the list is relatively pertinent. Rice, oats, and other grains are already targeted to some extent by organic purchasing efforts, but it would be good to make sure that these products are purchased organically as much as possible. Corn is slightly more challenging because it and its derivatives are so prevalent in many food products, but it would be possible to purchase at least some organic corn products (frozen corn kernels, for example). Strawberries, bananas, and other fruits would be a good set of foods to target for organic conversion in the near

[125] Stevens and Lydon

future. Of course, the feasibility of purchasing organic versions of these particular items will depend on the prices of the conventional and alternative products, but these commodities are certainly worth looking into.

C. Additional Local Products

As Appendices B and C suggest, many food products are available locally. Although of course not all of these producers could supply the quantity necessary to meet Williams' demand, some could, and others would be interested in selling what they can produce to the college. As mentioned above, perhaps one dining hall could serve a particular local product, or the product could be offered only in season or when available. This is not to suggest that Williams Dining Services should purchase products from every local producer; the logistical and economic issues must certainly be taken into consideration. However, increasing the consumption of local products will be good for the dining hall food supply, good for students (local products have received very positive feedback), and good for the local economy. In addition, Williams has relatively unusual demand characteristics; this can be an asset in negotiating mutually beneficial contracts as demonstrated by the skim milk from High Lawn Farm and the ground beef from NELA.

Because identifying potential local suppliers and negotiating contracts with them is a time-consuming process, the full burden of implementing these initiatives should not rest on already over-extended Dining Services employees. Students, perhaps, could help with the research through class projects or through summer internships such as the one completed by Allison Smith '07 during the summer of 2004. The contract negotiations should remain the domain of Dining Services employees, but other parts of the process could be delegated to students. Making an internship like Smith's into an annual or biennial position, funded either by Dining Services or through the CES summer internship program, would be one way to make sure there is a student available to carry out this research.

D. Increased Dedicated Percentage of Food Supply

The four percent target set by Dining Services during the spring of 2005 is an excellent beginning and will provide a concrete way of measuring Williams' expenditures on local and organic products. The data collected this year and in the near future will be extremely useful as a benchmark against which progress can be measured. As economic and logistical constraints permit, the four percent figure should be increased gradually to continue to raise the bar. Not only will this help Williams set and achieve concrete, measurable goals for local and organic expenditures, but it will also help to institutionalize the efforts that are being made now so that Williams' institutional commitment to these issues will be able to outlive any particular individual's tenure here.

Part Three: Add New Initiatives

The following new initiatives should be implemented to supplement the existing programs.

A. Environmentally Conscious Menu Planning

Based on the calculations presented in Chapter 3, it is clear that the production of poultry products is much less energy- and water-intensive than the production of beef and pork. A pound of chicken, for example, requires only ten percent of the water and an equivalent percentage of the energy used to produce a pound of beef. Therefore, it would make sense to plan more dishes that use poultry products and fewer that use beef and pork. This is certainly not meant to say that beef and pork should not be served at all, but simply that the environmental impacts of the ingredients should be taken into consideration when selecting recipes and menu items.

B. Dining Hall Specialization and Experimentation

It is most likely not currently feasible to make one of Williams' dining halls into an all organic/local option – neither the supply nor the funding to do this is currently available. However, the fact that Williams has several dining halls is an asset that should be utilized in the effort to increase sustainability. When a new product is being added, it can be tried at a single dining hall first to make sure it works out logistically and is well received by students. A local product with limited availability can be purchased for just one dining hall. Williams' multiple dining halls provide an ideal opportunity to experiment on a smaller scale instead of with the entire food supply.

In addition, the multiple dining hall setup allows for the collection of experimental data as these various programs are tried. If, for example, one dining hall purchases organic bananas for a month, that dining hall's produce expenditures can then be compared with its previous averages and with those of the other dining halls. This allows the administration to quantify the effects of a new program and estimate what that program's effects would be if it were implemented system-wide. This has already been done with the NELA beef at Dodd; it is an outstanding opportunity of which Williams should continue to take advantage.

C. Sustainable Food Committee

Because this action plan cannot possibly include all the current and future ways in which Williams College Dining Services can become more environmentally sustainable, and because this kind of research and its implementation take time that cannot simply be added into the already-full schedules of Dining Services' employees, a committee should be formed to continue studying these issues and to make future recommendations. By sharing the work in this way, no one person will be overloaded, although it will mean additional work for all involved. If Williams is committed to moving toward sustainability in its food supply, however, the work will have to be done.

Members of the committee should include Dining Services staff, particularly the Director (currently Bob Volpi), Associate Director (currently Mark Petrino), and Nutritionist (currently Ginny Skorupski). The Executive Chef (currently Mark Thompson) could also be included. In addition, there should be student and faculty representation on the committee. Students on the Dining Services Committee and on the Campus Environmental Advisory Committee (CEAC) could be tapped as potential members. Faculty who teach courses for the Center for Environmental Studies are an obvious group of potential members, but the committee should not exclude other perspectives if other non-ENVI-related faculty members are interested in participating.

One potential venue for this committee's formation is as a subgroup of CEAC, a student/faculty/staff collaborative committee that advises the Vice President of the College on matters of environmental sustainability. The Sustainable Food Committee could also be formed as a collaboration between CEAC and the existing Dining Services Committee.

D. Farm-to-College Consortium

Several other colleges and universities in the Northeast are working on issues of sustainable food consumption; it would make a lot of sense and be beneficial to all involved to set up more communication between them. This could take the form of a consortium, or it could be a more informal linkage, such as an email listserver through which members could share experiences and ideas. At the least, such a communication link should be established.

If there were interest at a number of schools, a consortium would provide other opportunities in addition to the sharing of ideas and experiences. For example, because many of these institutions are reasonably close to each other geographically, they could set up joint purchasing and/or processing ventures. A commissary, for example, could be set up to process locally-produced food items for several schools. Likewise, a larger agricultural operation could be established that would provide beef or other products to meet several schools' food service needs. A centralized processing facility would help schools avoid some of the obstacles that so often arise in attempts to link institutions and their food supplies to the farms and farmers who produce the products. Centralized processing would allow some standardization of the packaging, size, and level of preparation of the products when they arrive at individual schools, making these items much more manageable for the people who work in food preparation.

It will, of course, take time and effort to do the legwork required to set up such a consortium and the conferences that would bring its members together. This work could, perhaps, be accomplished by a student during a summer internship – perhaps it could be combined with the job mentioned above. Another strategy that would aid the establishment of such a consortium is to take advantage of existing organizations and their meetings. The Northeast Environmental Studies Group (NEES) is one such organization; the NEES conference in the fall of 2005 may include a panel discussion and planning session about farm-to-college efforts.[126] This is an opportunity to tap into an existing network of people who likely care about these issues and are in positions in which they can act on their convictions and priorities.

E. Funding

It would be quite beneficial to Williams' efforts toward food sustainability to find some external sources of funding to support these initiatives. Some other schools that are pursuing these issues have done so; Yale is perhaps the most notable example of this. Yale received a large donation from Alice Waters, the founder of Chez Panisse, whose daughter is a student at Yale. With these funds and with Waters' assistance, the Yale Sustainable Food Project was begun. It has met with much success, but it has been an expensive proposition.

Possible sources of funding that should be pursued at Williams include alumni, grants (from the non-profit sector, the business sector, and the government sector), and other donors. External sources of funding are another topic that could be further investigated by a student hired for a summer internship in food sustainability.[127]

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[126] Gardner pers. comm.; see also NEES web site

[127] Some places to start: Community Food Security Coalition, Leopold Center, National Farm to School Alliance, SARE.

Appendix A
Methods and Calculations

Energy

The method of calculation by which the energy expenditures on beef production were calculated is described in the text (p.73); other commodities' energy requirements were calculated in a similar fashion. After a review of the literature on energy and agriculture, the estimates of energy use per head or per pound given in David Pimentel's *CRC Handbook of Agriculture* were selected as the most complete. The details of the calculations by which the numbers in Table 10 (p.73) were obtained are presented here.

Pimentel's estimate of the energy requirements of pork production is 650,500 kcal per 100 kg (220 lbs.) live hog weight.[128] Williams consumed 37,171 pounds of pork in the year under study; the average dressed (carcass) weight of hogs slaughtered in the United States in 2003 was 199 pounds.[129] This number translates Williams' pork consumption into the equivalent of approximately 187 hogs. The average live weight of the hogs slaughtered in 2003 was 266 pounds, which means that Williams' consumption required the production of 49,700 pounds of live hogs. Multiplying by Pimentel's estimate gives a total energy expenditure of approximately 150,000,000 kcal to produce the pork consumed at Williams in one year.[130]

Williams College's chicken consumption in the year under study totaled 72,852 pounds. The average amount of meat per chicken slaughtered in the U.S. during 2003

[128] Pimentel 1980, 399

[129] USDA/NASS 2004c, VII-24

[130] The total presented does not appear to agree precisely with the other numbers in the text; this is due to rounding. In the calculations, rounding was performed only at the end of the process, but the intermediate figures have been rounded for the purposes of the text. The same is true of the other calculations in this section.

was 3.8 pounds;[131] this means that the equivalent of 19,172 average-sized chickens was consumed at Williams in that year. Pimentel estimates the average energy use per chicken to be about 1498 kcal,[132] which gives a total energy expenditure on chicken production of 29,000,000 kcal for the year under study.

The calculation of energy consumption in turkey production closely parallels the chicken calculation. Williams Dining Services consumed 26,184 pounds of turkey during the year under study. In 2003, the average amount of meat per turkey slaughtered was about 21 pounds,[133] which translates Williams' consumption into the equivalent of 1247 turkeys. Pimentel's estimate of energy required per turkey is approximately 12,613 kcal.[134] This means that a total of about 16,000,000 kcal were expended to produce the turkey consumed at Williams in one year.

Calculating the energy consumption in the production of the eggs consumed at Williams in the year under study is slightly more complex. The eggs take two forms: some (145,500 eggs) come as whole eggs, either raw or hard-boiled, while others (40,535 pounds) come pre-prepared as cartons of liquid egg. Using an average chicken egg weight of approximately 60 grams (0.13 lb.),[135] the 40,535 pounds of liquid eggs can be estimated to contain the equivalent of approximately 306,000 whole eggs, giving a total of about 452,000 eggs consumed. The average production per hen in 2003 was 259 eggs,[136] which means that 1745 laying hens were required to produce the number of eggs consumed at Williams in that year. Pimentel estimates the energy consumption per laying

[131] Calculated from USDA/NASS 2004c, VIII-37
[132] Calculated from Pimentel 1980, 383, using conversion factors from Pimentel 1980, 15
[133] Calculated from USDA/NASS 2004c, VIII-37
[134] Calculated from Pimentel 1980, 383, using conversion factors from Pimentel 1980, 15
[135] DiMasso *et al.*
[136] USDA/NASS 2004c, VIII-41

hen per year as about 4181 kcal;[137] when multiplied by the number of hens required, this gives a total energy expenditure of approximately 7,000,000 kcal to produce the eggs consumed at Williams in one year.

During the year under study, Williams consumed 199,965 pounds of milk. The estimated energy input for milk production is 166,000 kcal per 100 kg (220 lbs.),[138] which yields a total of about 150,000,000 kcal for the milk consumed at Williams in one year.

The energy required to produce the other dairy products consumed during the year can be estimated by converting them to milk equivalents. This method does not account for the energy costs of producing these various products from the raw milk, but the information required to calculate that component of the energy consumption was not available. To convert the major processed dairy products consumed at Williams (butter, cheese, ice cream/frozen yogurt, and yogurt) into milk equivalents, the ratio of pounds of milk equivalent per pound of product was calculated from nation-wide production and equivalency information.[139] The values of this ratio for butter (18), cheese (7.5), and ice cream/frozen yogurt (1.2) were calculated using actual data; the data necessary to calculate the value for yogurt were not available, so the ratio for ice cream/frozen yogurt was substituted due to the similarities in these products. By multiplying these ratios by Williams' consumption of these products and then summing the results, a total milk equivalency of about 700,000 pounds was obtained. This quantity was then treated as above in the fluid milk calculation, giving an energy expenditure of about 520,000,000 kcal for the milk equivalent of the processed dairy products consumed at Williams in the year under study.

[137] Calculated from Pimentel 1980, 383, using conversion factors from Pimentel 1980, 15
[138] Pimentel 1980, 365
[139] USDA/NASS 2004c, VIII-14 and VIII-19

Water

The method of calculation by which the water use in beef production was calculated is described in the text (p.75); other commodities' water requirements were calculated by estimating the drinking water consumed by the livestock in question and then dividing by the ratio of drinking water to total water use (about 1:50, or 0.02) obtained in the beef calculations. The body of published work on the topic of water use in agriculture is not as extensive as that of energy and agriculture, so the estimates presented here are based on data from a variety of sources. The details of the calculations by which the numbers in Table 12 (p.75) were obtained are described here.

The estimated direct water consumption by hogs at various stages of growth is presented in Table 16.[140] The breakdown by body size and age increases the accuracy of this estimate; unfortunately, this sort of detail was not available for all livestock types studied. When the water consumption rates per hog in each stage are summed and then multiplied by the number of animals produced to satisfy the demand for pork at Williams in the year under study (187 hogs, as calculated above), the total drinking water consumption for this sector comes to about 92,000 gallons. The application of the ratio of drinking water to total water gives a total requirement of approximately 5,000,000 gallons of water to produce enough hogs to meet Williams' pork demand.

Table 16. Estimated drinking water consumption of hogs at various stages of growth.

Stage	Weight (lbs.)	Days in Stage	H2O/Day (gal.)	Total H2O/Hog (gal.)
Nursery	<60	35	0.7	24.5
Growth	60-100	25	2.5	62.5
Finishing	100-250	101	4	404

[140] Based on data from Almond and from Tyson Foods, Inc.

The estimated drinking water consumption of broiler chickens is three gallons per chicken over a lifespan of approximately seven weeks.[141] Multiplying this number by the 19,172 chickens consumed by Williams yields a total direct water consumption of about 58,000 gallons. Dividing this number by the ratio of drinking water to total water gives an estimated total water requirement of 3,000,000 gallons to produce the chicken consumed at Williams over the course of the year under study.

The estimated direct water consumption of turkeys at two different life stages is shown in Table 17.[142] When these numbers are summed and multiplied by the 1247 turkeys consumed at Williams, a total drinking water consumption of about 12,000 gallons is obtained. The application of the ratio of drinking water to total water yields a total water requirement of approximately 650,000 gallons to produce the turkey consumed at Williams during one year.

As described above, the production of the eggs consumed at Williams requires a total of approximately 1745 laying hens. The average drinking water consumption per hen is estimated at 0.063 gallons per day,[143] giving a total direct consumption of about 40,000 gallons per year. When divided by the ratio of drinking water to total water, this gives an estimated total water requirement of 2,000,000 gallons to produce the eggs consumed at Williams during the year under study.

Table 17. Estimated drinking water consumption of turkeys at various stages of growth.

Stage	Days in Stage	H2O/Day (gal.)	Total H2O/Turkey (gal.)
0-4 weeks	28	0.02	0.55
4-18 weeks	98	0.09	9.19

[141] USEPA 2004a
[142] Based on information from Agri-Growth web site
[143] Agri-Growth web site

A conservative estimate of the drinking water consumption of dairy cattle is 65 liters (17.2 gallons) per head per day.[144] The average annual milk production per cow in the U.S. in 2002 was 18,571 pounds;[145] this figure translates Williams' annual milk consumption of 199,965 pounds into the product of approximately 11 cows. In addition, this figure translates the milk equivalent of Williams' annual consumption of other dairy products (695,221 lbs. milk equivalent, calculated above) into the product of approximately 37 cows. When these numbers are multiplied by the estimated drinking water consumption, totals of about 69,000 gallons of water for milk and about 230,000 gallons of water for other dairy products are obtained. Applying the ratio of drinking water to total water yields total water use figures of approximately 3,500,000 gallons (milk) and approximately 12,000,000 gallons (other products) for the production of the dairy products consumed at Williams in one year.

[144] Warrington

[145] USDA/NASS 2004c, VIII-6

Appendix B
Berkshire Grown Producers

The following food producers are listed in the Berkshire Grown 2004 Business to Business Directory.[146]

Fruit and Vegetables

Appletree Organic – Williamstown, MA
Bartlett's Orchard – Richmond, MA
The Berry Patch – Stephentown, NY
Blue Moon Shrooms at Indigo Farm – Housatonic, MA
Blueberry Hill Farm – Mount Washington, MA
Boardman Stand – Sheffield, MA
The Bradley Farm – Lanesboro, MA
Clover Hill Farm – Richmond, MA
Corn Crib – Sheffield, MA
David's Melons – Pittsfield, MA
Delftree Shiitake Mushroom Farm – North Adams, MA
Eastern Native Seed Conservancy – Great Barrington, MA
Eglantine's Garden – Hillsdale, NY
Equinox Farm – Housatonic, MA
Farm at Millers Crossing – Hudson, NY
Furnace Brook Winery/Hilltop Orchards – Richmond, MA
Gould Farm's Harvest Barn – Monterey, MA
Green River Farm – Williamstown, MA
Greenhaven Farm – Monterey, MA
Hard Rock Farm – Stamford, VT
Hemlock Farm – Williamstown, MA
Holiday Farm – Dalton, MA
Howden Farm – Sheffield, MA
Ioka Valley Farm – Hancock, MA
Jaeschke's Orchard – Adams, MA
Lakeview Orchard – Lanesboro, MA
Left Field Farm – Middlefield, MA
Lowland Farm – Monterey, MA
Markristo Farm – Hillsdale, NY
Moon in the Pond Organic Farm – Sheffield, MA
Partridge Road Farm – Pittsfield, MA
Peace Valley Farm – Williamstown, MA
Pelletier's Sugar Farm – Becket, MA
River Valley Farm – Lenox, MA

[146] Berkshire Grown 2004

Sheffield Foods – Sheffield, MA
Snow Farm – Sandisfield, MA
Taft Farms – Great Barrington, MA
Threshold Farm – Philmont, NY
A Window of Thyme – Great Barrington, MA
Woodside Orchards – Great Barrington, MA
Woven Roots Farm – Lee, MA

Dairy Products

Berkshire Blue Cheese – Lenox, MA
Berle Farm – Hoosick, NY
Bev's Homemade Ice Cream – Great Barrington, MA
Cricket Creek Farm – Williamstown, MA
Crescent Creamery – Pittsfield, MA
Gould Farm's Harvest Barn – Monterey, MA
High Lawn Farm – Lee, MA
Old Chatham Sheepherding Co. – Old Chatham, NY
Rawson Brook Farm – Monterey, MA

Eggs

The Bradley Farm – Lanesboro, MA
D&R Beefalo – Hinsdale, MA
High Lawn Farm – Lee, MA
Moderski Farms – Adams, MA
Otis Poultry Farm – Otis, MA
Snow Farm – Sandisfield, MA

Meat and Poultry

Berkshire Beef – Great Barrington, MA
The Bradley Farm – Lanesboro, MA
Cricket Creek Farm – Williamstown, MA
D&R Beefalo – Hinsdale, MA
Foggy River Farm – Great Barrington, MA
Green River Farm – Williamstown, MA
Holtzman Farm – East Chatham, NY
Ioka Valley Farm – Hancock, MA
Moderski Farms – Adams, MA
Moon in the Pond Organic Farm – Sheffield, MA
New England Heritage Breeds Conservancy – Pittsfield, MA
Otis Poultry Farm – Otis, MA
Sky Farm – Stockbridge, MA
Snow Farm – Sandisfield, MA
Stonehedge Farm – Glendale, MA
Taft Farms – Great Barrington, MA

Appendix C
Other Local Producers

During the summer of 2004, Allison Smith '07 identified many local producers as part of an internship funded jointly by the Williams College Center for Environmental Studies and Williams College Dining Services. Producers on her list that are not mentioned in Appendix B are listed below.

Fruit and Vegetables

Akaogi Farm – Brattleboro, VT
Apple Hill Orchard – Bennington, VT
Carrington Farm – Lee, MA
Darling's Produce – Pownal, VT
Great Meadow Fruits – Hadley, MA
Heleba Potatoes – Rutland, VT
MC Growers – Westfield, MA
Morin Gardens – Adams, MA
Saratoga Apples – Saratoga, NY
Smith's Little River Farm – Livingston, NY
West Branch Farm Products – Chester, VT

Dairy Products

Hillman Farm – Colrain, MA
Pomeroy Farm – Weston, VT
Rustling Wind Creamery – Falls Village, CT
Smith's Country Cheese – Winchendon, MA
Vermont Quality Dairies – East Wallingford, VT
Woodcock Farm – Weston, VT

Meat and Poultry

Hemlock Farm – Williamstown, MA
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