Appendix T. Downstream Effects to Organic Production and Marketing of Deregulation of Glyphosate-Tolerant Alfalfa

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Downstream Effects to Organic Production and Marketing of Deregulation of Glyphosate-Tolerant Alfalfa

Executive Summary

There is a trend of moderate overall growth in downstream markets for conventional alfalfa and stronger growth in organic downstream markets.

The deregulation of glyphosate-tolerant (GT) alfalfa could affect organic and conventional dairy, meat, livestock, and pet food domestic markets in two ways: a) through reduced demand; b) through reduced costs/ improved quality of feed. The latter could have impacts on the price differential between organic and conventional dairy and meat products, since organic production cannot make use of improved quality GT alfalfa.

Although there is some evidence of consumer preference for foods free of genetically engineered organisms in the United States, deregulation of GT alfalfa might not translate into a reduced demand for organic products in downstream markets. There is actually a possibility that the demand for organic foods could increase as consumers concerned with genetically engineered foods could switch to organic products.

Expected lower prices/higher quality of alfalfa hay would likely benefit dairy farmers and to a lesser degree cow-calf production.

The reduced costs in dairy farming and cow-calf production would likely not be transmitted to dairy and meat products, however, because of price regulation in dairy markets and the low share of alfalfa production costs in the case of meat production.

1.0 Introduction

1.1 Scope of Report

This report analyzes the potential impact on downstream markets of the deregulation of GT alfalfa. Main downstream markets are those for diary, meat, livestock, and pet food. The report is limited to domestic downstream markets, and impacts on foreign markets are left for the Technical Report *Impacts on United States Trade of Deregulation of Glyphosate-Tolerant Alfalfa* (appendix R).

Below we explain the methodology upon which this analysis is based. In section 2 we focus on the impact of GT deregulation through GT sensitivity of demand in downstream markets. In section 3 we focus on the impact of GT deregulation through reduced production costs and substitution effects.

1.2 Methodology

Some alfalfa is produced for human consumption. In our Technical Report *Economic and Social Impacts on Conventional and Organic Farmers of Deregulation of Glyphosate-Tolerant Alfalfa* (appendix S) we argue that alfalfa for human consumption, whether for sprouts or in the form of leaves for dietary supplements, is likely a very small portion of total demand for alfalfa and thus is not included in the analysis.

Honey is also produced from alfalfa fields. However, in our Technical Report *Economic and Social Impacts on Conventional and Organic Farmers of Deregulation of Glyphosate-Tolerant Alfalfa* (appendix S) we argue that honey production does not generate an actual "demand" for alfalfa to the extent that alfalfa producers pay honey producers for use of honeybees in alfalfa pollination and not the other way around. This suggests any impact of alfalfa on honey producers could have a small effect on honey production and that producers are likely to have access to good substitutes for alfalfa as a sources of nectar for honeybees[1]. We thus also do not include any analysis of honey markets in this report. However, our Report *Economic and Social Impacts on Conventional and Organic Farmers of Deregulation of Glyphosate-Tolerant Alfalfa* (appendix S) does discuss impacts on honey producers and providers of pollination services, as part of the discussion of impacts on the seed industry.

Alfalfa downstream markets are mainly those for dairy, beef, livestock and pet food, and alfalfa is by far mainly used for forage, whether in the form of hay or haylage, as well as processed in meal and pellets for animal feed. We thus focus on the dairy, beef, livestock, and pet food downstream markets. Alfalfa processors are not treated as a separate market to the extent that they are intermediaries between alfalfa producers and dairy, beef, or livestock producers.

[1] Although there may be some impact on the income of honey producers to the extent that these producers count on pollination as a source of income.

1.2.1 Assumptions

GT alfalfa production is assumed to potentially affect organic and conventional dairy, meat, livestock, and pet food domestic markets in two ways[2]:

1. To the extent that the domestic demand for downstream products is sensitive to the presence of genetically engineered (GE) organisms and to the extent that there is a perception of presence of GE content in downstream products, the domestic GE-sensitive demand for dairy, meat, livestock and pet food would be affected;
2. Reduction in costs/improvements in quality of alfalfa through the adoption of GT alfalfa would affect downstream markets to the extent that alfalfa production cost changes are transferred to the price of alfalfa. Production costs of some downstream market segments utilizing alfalfa would decrease (those segments adopting GT alfalfa). This would have two possible impacts:
    a. The supply curve of dairy, beef, livestock and pet food would shift outwards, with potential increases in quantities produced and decreases in prices.
    b. To the extent that decreases in production costs of some downstream market segments are reflected in decreased prices, consumers would substitute dairy, meat, livestock and pet food produced at lower prices for diary, meat, livestock, and pet food produced at higher costs.

These assumptions are illustrated in figure T-1 below:

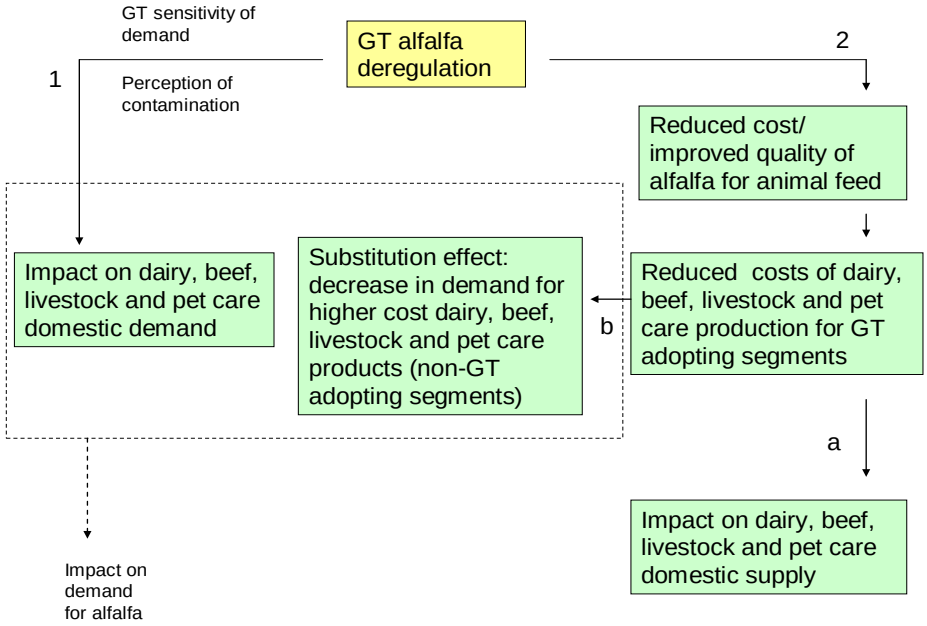

Figure T-1: Deregulation impact on downstream markets

[2] In this report, conventional dairy, meat, livestock and pet food products are those produced with conventional or GT alfalfa. Organic dairy, meat, livestock and pet food products are those where any alfalfa used is organic. When a distinction is needed in conventional downstream markets, among production systems using or not GT alfalfa, this distinction will be made explicit by expressions such as “GT adopting segments, ” or “GMO free” products.

The dashed lines represent the downstream impacts that would affect the demand for alfalfa. These impacts were incorporated in the analysis done in the Technical Report *Economic and Social Impacts on Conventional and Organic Farmers of Deregulation of Glyphosate-Tolerant Alfalfa* (appendix S).

In section 2 we focus on the impact of GT deregulation through GT sensitivity of demand in downstream markets (labeled "1" in the figure above). In section 3 we focus on the impact of GT deregulation through reduced production costs and substitution effects (labeled "2" in the figure above).

1.2.2 Data and Information Sources

Our basic data were obtained from the United States Department of Agriculture (USDA) sources, under the assumption that these are the best quality agriculture statistics available. These data were complemented with information obtained from articles, typically of an academic nature and peer-reviewed whenever possible, under the assumption that these documents are subject to standards that should help reduce if not eliminate any intentional bias.

2.0 Impacts of Sensitivity to GE Organisms

Demand in downstream markets would be affected by deregulation of GT alfalfa to the extent that some consumers would seek to avoid consumption of dairy and meat (and egg products) from animals fed GT alfalfa, or to avoid feeding livestock and pets with GT alfalfa. The result could be a reduction in demand for dairy, meat and livestock and pet feed that is perceived as having been produced with GT alfalfa. This could result in an increase in demand for similar goods believed to be largely or completely free of GE content. This could take various forms.

One form could be a shift toward organic production if this is perceived as at least free of intentional use of GT alfalfa. The demand for organic products in downstream markets, however, could also be negatively affected if the possibility of low-level presence (LLP) of GT alfalfa content in organic alfalfa is sufficient to drive consumers away from downstream products such as organic dairy and organic meat.

A second form would be an increase in imports from countries where GT alfalfa is not used. A third possibility would be the growth of markets exploring privately developed certification standards and labeling for foods free of any GE content. This type of market is more likely to grow:

a) the more costly it is to shift to other substitutes (e.g., other forms of animal feed) that do not have GE content;
b) the less costly it is to produce equivalent goods that are completely or largely free of GE content, whether through domestic production or through imports.

If both a) and b) are costly, consumers sensitive to GE products could still find themselves reluctantly consuming GE products.

In section 2.1 we consider current trends in alfalfa downstream markets. In section 2.2 we consider the possible impacts, as outlined above.

2.1 Trends in Downstream Demand

2.1.1 Dairy

Consumption of dairy products in the United States has grown steadily in the past 20 to 30 years at rates above population growth thanks to increases in per capita consumption (LaDue et al., 2003). There has been actually a decrease in per capita consumption of fluid milk, more than compensated by an increase in per capita consumption of cheese.

U.S. per-capita consumption data for all dairy products (calculated on a milk equivalent basis) are given in table T-1 below.

Table T-1. Trends in U.S. Per-Capita Consumption of All Dairy Products

Year	Pounds, Milk equivalent, Milkfat basis	Year	Pounds, Milk equivalent, Milkfat basis
1977	540	1993	569
1978	544	1994	580
1979	548	1995	576
1980	543	1996	566
1981	541	1997	567
1982	555	1998	572
1983	573	1999	584
1984	582	2000	592
1985	594	2001	586
1986	592	2002	587
1987	601	2003	596
1988	583	2004	592
1989	564	2005	599
1990	568	2006	607
1991	564	2007	608
1992	563	2008*	604

Source: USDA ERS, 2010a; * Preliminary

The data in table T-1 above includes fluid milk as well as milk used in the manufacture of products such as butter, cheese, yoghurt, ice cream, and powdered milk. The data in the table above indicate a relatively slow annual average growth rate of 0.36 percent in per-capita consumption of all dairy products in the United States. Much of that increase in per-capita consumption seems to have happened in the early to mid 80s.

Milk production grew in the United States from approximately 147.7 billion pounds in 1990 to an estimated 189.3 billion pounds in 2009 (USDA ERS, 2010a). This growth has been relatively continuous and reflects growth in productivity rather than growth in the number of milk cows. The number of milk cows has actually fallen from an average of roughly 10 million in 1990 to less than 9.2 million in 2009 (USDA ERS, 2010a). USDA data on the past 10 years of total milk production and average prices are shown in table T-2.

Table T-2. Production and Prices for All Milk

Year	Production (billions of lbs)	Price ($/cwt)
1999	162.6	14.38
2000	167.4	12.40
2001	165.3	15.04
2002	170.1	12.18
2003	170.4	12.55
2004	170.9	16.13
2005	177.0	15.15
2006	181.8	12.96
2007	185.7	19.13
2008	190.0	18.32
2009	189.3	12.81

Source: USDA ERS, 2010a

USDA Economic Research Service (ERS) production and price projections through 2019 are shown in table T-3 below. The USDA ERS production forecasts through 2019 are based on an annual average production growth rate of approximately 1 percent. This forecast is consistent with La Due et al. (2003), who argue that the main driver of dairy demand growth in the United States is likely to be overall population growth.

Table T-3. Projected U.S. Production and Prices for All Milk

Year	Production (billions of lbs)	Price ($/cwt)
2010	187.7	16.50
2011	192.1	15.60
2012	193.6	16.85
2013	195.8	17.05
2014	197.9	17.40
2015	200.2	17.65
2016	203.1	17.90
2017	205.0	18.10
2018	207.7	18.35
2019	210.4	18.50

Source: USDA ERS, 2010b

California, Wisconsin, New York, Pennsylvania and Minnesota have been the top five dairy producing states in country for over 30 years, although not always in that order and with a growing importance of Western states among the top diary producers, including Idaho, New Mexico, and Washington State (Short, 2004).

2.1.2 Meat

Beef production is another important source of demand for alfalfa hay. Table T-4 below provides trend beef consumption data for the United States.

Table T-4. US Domestic Beef Consumption

Year	Millions of Pounds
1999	27,172
2000	27,562
2001	27,229
2002	28,080
2003	27,205
2004	27,926
2005	27,919
2006	28,292
2007	28,283
2008	27,452
2009	27,046
2010	26,632

Source: USDA FAS, 2010

Total U.S. domestic beef consumption has fluctuated slightly since 1999. Looking back even further to 1989, the trend annual average growth rate in U.S. domestic beef consumption from 1989 to the current year is about 0.4 percent a year, comparable to that for all dairy products.

Beef cows represent a much larger portion of total cattle in the United States than do milk cows. As of January 2010, there were 93.7 million cattle in the United States and just less than ten percent were dairy cows. About 31.4 million were considered beef cows. Only female cattle that have already calved are counted as beef or dairy cows. Male cattle and females who have not calved are not included. Some of these cattle could be used for beef, but their purposes are not designated by the USDA. There were 53.2 million "other" cattle in the United States as of January 2010 (USDA NASS, 2010)

The population growth of beef cows has been negative over the past decade. The average annual population growth rate from 2000 to 2010 was -0.65 percent. Early in the decade, growth hovered between -1 percent and +1 percent. After a positive spike in 2005 and 2006, beef cow population growth rates have taken a dive in the past four years, bottoming out at -2.76 percent in 2009, and recovering slightly to -0.95 percent in 2010. Other non-milk cattle also have demonstrated a negative long term trend, with a -0.39 percent average annual growth rate, but with more frequent large ups and downs. The population growth rate of these cattle has followed a similar recent pattern to that of beef cattle, bottoming out in 2009 with a growth rate of -2.51 percent, and recovering slightly to -0.51 percent in 2010. The 2010 combined growth rate for all non-dairy cattle was -0.67 percent, indicating a slight negative population trend at present (USDA NASS, 2010).

Prior to 2009, meat production had increased steadily despite the decreasing trend in the population of beef cattle. However beef production decreased by 2.25 percent in 2009 and decreased by 0.84 percent in 2010 (USDA ERS, 2010a). Table T-5 below provides data on the percentage change of beef production each year in the United States from 2005 to 2010.

Table T-5. Beef Production

Year	2005	2006	2007	2008	2009	2010
Beef (Million Pounds)	24,683	26,153	26,421	26,561	25,963	25,645
% Change	n/a	5.96%	1.02%	0.53%	-2.25%	-1.22%

Source: USDA ERS, 2010a

2.1.3 Livestock and Pet Food

Alfalfa hay is also used to feed horses and other domestic equids (domestic equids include horses, ponies, mules, burros, and donkeys). Of the total U.S. equine population in January 1998, 88 percent were horses, 5 percent were ponies, and about 6 percent were mules, donkeys, burros, or miniature horses (USDA APHIS, 2008). Table T-6 below provides information on the U.S. on-farm horse inventory.

Table T-6. On-Farm U.S. Horse and Pony Inventory

Year	Number
1987	2,456,951
1992	2,049,522
1997 (1)	2,427,277
1997 (2)	3,020,117
2002	3,644,278
2007	4,028,827

Source: 1987, 1992, 1997(1): USDA 1997 Census of Agriculture; 1997 (2), 2002: USDA 2002 Agricultural Census, USDA 2007 Census of Agriculture

There is no single consistent source that provides trend U.S. on-farm horse inventory information going back to 1987. While the Census of Agriculture data show little to no horse inventory growth between 1987 and 1997, the USDA 2002 Agricultural Census data shows a consistent increasing growth rate between 1997 and 2007. Moreover, there is no accurate estimate of the current total number of equids in the United States because a count of equids on nonfarm operations does not exist (USDA, APHIS 2007).

There are several other categories of livestock and pets that consume alfalfa hay, haylage, meal, or pellets. Table T-7 shows trend U.S. domestic broiler chicken consumption.

Table T-7. U.S. Domestic Broiler Chicken Consumption

Year	Million Pounds
1999	24,804
2000	25,296
2001	25,481
2002	27,049
2003	27,657
2004	28,839
2005	29,608
2006	30,139
2007	29,943
2008	29,604
2009	28,512
2010	30,117

Source: USDA FAS, 2010

Domestic broiler chicken consumption is growing at a relatively rapid rate. Looking back even further to 1989, the trend annual average growth rate in broiler chicken consumption is about 2.93 percent. Alfalfa meal and pellets can be included in chicken feed mix, but as there is likely a wide variety of feed substitutes, it is not clear that alfalfa plays as central a role in chicken feed mixes as in hay feed to cattle and horses.

According to Nelson (2008), alfalfa meal and pellets for livestock and pet feed is primarily supplied by mills in Nebraska, Kansas, and Ohio. Nelson reports that there is no publicly available dataset on meal and pellet production. She estimates that the alfalfa meal and pellet market totals approximately 110,000 tons. Nelson notes that even if these estimates were off by a factor of 2, these niche markets would represent far less than 1 percent of total U.S. alfalfa hay production.

Nelson (2008) also argues that the alfalfa nutritional supplement market (for human consumption) is far smaller than the meal and pellet market, and that likewise no publicly available dataset exists. She reports an estimate that the total U.S. alfalfa supplement market could be satisfied with 10 tons of alfalfa hay production, which could be produced on 1-2 acres.

2.1.4 The Organic Segment

The organic sector is rapidly growing both in the European Union (EU) and the United States (Dimitri and Oberholtzer, 2005). Together, consumer purchases in these two regions made up 95

percent of the $25 billion in estimated world retail sales of organic food products in 2003 (Willer and Geier, 2005). In reporting the results of their annual manufacturer survey, the Organic Trade Association (2007) reports that U.S. organic food sales were estimated to be $16.67 billion in 2006, up 22 percent from 2005 (table T-8).

The Organic Trade Association (2007) goes on to note that organic foods have shown consistent annual growth rates of 15 percent to 21 percent since 1997, when fairly comprehensive data were first available. Moreover, they report growth rate data based on historical surveys and interviews with long-time participants in the organic foods business in a similar range of nearly 20 percent annually since 1990. Organic food sales were projected to continue growing at a similar pace through 2010 (table T-8).

Table T-8. U.S. Organic Food Sales and Sales Growth Forecasts

Category of Food	Sales (Millions of $)			Annual Sales Growth Rates (%)		
	2004	2005	2006	2004-2005	2005-2006	Forecasted Annual 2007-2010
Organic Dairy	1,731	2,140	2,668	24	25	20
Organic Meat	195	256	334	31	30	27
All Organic	12,460	13,831	16,673	11	22	18

Source: For 2005-2006, Organic Trade Association Manufacturers Survey (2007); For 2004, Organic Trade Association Manufacturers Survey (2006). Data rounded to the nearest integer value.

Of total 2006 organic food sales reported by the Organic Trade Association (2007), 16 percent was made up of organic dairy products, while another 2 percent came from organic meat. Moreover, organic dairy product sales in 2006 were reported to represent an increase of 25 percent over 2005 levels (table T-8). Table T-8 also provides recent trend sales data for organic meat, indicating an even faster growth rate than organic dairy products, though from a much lower base sales level. The Organic Trade Association (2007) notes that overall consumer purchases of organic foods in 2006 represented only 2.79 percent of total U.S. food sales, though this figure is up from 0.81 percent in 1997. The Organic Trade Association (2008) reports that while organic dairy sales in the United States represented 0.79 percent of all dairy sales in 1997, by 2006 that figure had increased to 4 percent of all dairy sales.

Organic production could be somewhat lagging in comparison to the growth in demand or organic products – the Organic Trade Association (2006) indicated that 52 percent of respondent firms reported that a lack of dependable supply of organic raw materials has restricted their company from generating more sales of organic products. Willer et al. (2008) report that organic agricultural land represented 0.5 percent of all agricultural land in the United States in 2006, somewhat below the worldwide average.

There is evidence that perceptions of higher organic food safety could be an important driver for consumer substitution of organic for conventionally produced food. In particular, Dimitri and Oberholtzer (2005) argue that changes in organic and conventional food demand are driven in part by “food scares.” They note, for example, that mad cow disease (Bovine Spongiform Encephalopathy – BSE) considerably affected the European organic livestock and dairy industry.

Dimitri and Oberholtzer (2005) report that in response to news reports on BSE, many consumers substituted organic dairy and meat products (which European consumers perceived as safer) for conventionally raised dairy and meat products. For example, they report that organic food sales in Germany increased by 30 percent in 2001 as a result of BSE.

Moreover, Dimitri and Oberholtzer (2005) report that other food scares that caused European consumers to substitute organic for conventionally produced food include episodes of contaminated chicken feed in Belgium in 1999, feed contaminated by dioxin in 2004, and more recently, carcinogenic food dyes in TV dinners in Ireland in 2005. It is interesting to note, however, that Dimitri and Oberholtzer (2005) do not find evidence that U.S. consumers are as strongly affected by food scares.

2.2 Consumer Sensitivity to Genetically Engineered Content in Food

Most U.S. consumers are unaware of the prevalence of GE products in the U.S. food supply (Anderson et al., 2006; Hallman and Hebden, 2005; Thomson and Dininni, 2005). Hallman et al. (2003) found that only one-fourth of U.S. residents believed that they had ever consumed food containing GE ingredients. There seems to be no estimate available of consumer demand for GE-free food products (Noussair et al. 2004).

However, in the past decade, there has been a considerable number of attempts to identify consumer preferences regarding GE foods, in and outside the United States, most of them based on consumer surveys, done under various conditions, asking consumers to express their preferences under hypothetical situations. The results overwhelmingly show lack of information regarding GE foods and considerable resistance toward their consumption (Hallman and Aquino, 2003).

For example, various Eurobarometer[3] surveys have reported that most Europeans are not able to correctly answer whether the phrase "ordinary tomatoes do not contain genes, while genetically modified tomatoes do" is true or false (Rigby et al., 2004). Anderson et al. (2006) argue that while the specifics differ, in general the literature indicates that U.S. consumers have relatively little knowledge of biotechnology.

Many contingent valuation studies exist for Europe, United States, Japan, and Australia reporting that consumers are typically willing to pay a higher price for GE-free foods, and various articles review this literature (Lusk et al., 2004; Rigby et al., 2004).

Contingent valuation studies and surveys based on hypothetical situations are known to be very poor predictors of actual behavior in the market (Noussair et al., 2004; Fernandez-Cornejo and Caswell, 2006). To address this deficiency, a number of studies have implemented experiments, in which consumers actually get to choose among products and benefit from their choices. Lusk et al. (2004) develop a meta-analysis of 25 studies including 57 valuations of GE foods. Most of the studies analyzed are for the United States, and one-third are for Europe; other studies include Asia, Canada, and Australia. Seventeen of the studies are based on consumer surveys while

[3] Surveys conducted on a regular basis for the European Commission, executive branch of the European Union

eight are based on experiments. They find that the willingness to pay for GE-free foods was lower in experimental studies, although still positive.

A number of other studies have investigated whether the resistance to GE foods and the lack of information regarding biotechnology are correlated. Chern and Rickertsen (2002) conducted a student survey in four countries (United States, Japan, Norway, and Taiwan) and a national phone survey in the United States and Norway. Willingness to consume GE foods increased when it was explained that GE foods could include benefits such as the reduced use of pesticides. Bertolini at al. (2003) compared attitudes toward GM foods in the United States, Japan, and Italy in random surveys of food shoppers. They also found a positive impact of familiarity with GE products on acceptance. On the other hand, Hallman and Aquino (2003) conducted a survey of a random sample of U.S. households and found out that improved information on GE foods did not necessarily mean increased approval. Those most knowledgeable about genetic engineering tended to have more extreme opinions, in favor or against, than those less knowledgeable. Noussair et al. (2004) also found that prior beliefs regarding GE foods had a stronger influence on consumer choice than information.

Studies also exist investigating how consumers value varying levels of content of GE products in their foods. In an experiment in France, where consumer surveys reveal very strong resistance to GE products, Noussair et al. (2004) found that 89 percent of consumers were willing to purchase a product with up to 1 percent GE content and 96 percent with up to 0.1 percent GE content. They also found that consumers differentiated between GE-free and 0.1 percent of GE content. Rigby et al. (2004), on the other hand, in a nationwide study of the United Kingdom found that consumers did not distinguish between 0 percent and 0.5 percent GE levels and did not place a value in having products with 0 percent GE content as opposed to 0.5 percent.

In response to consumer concerns, over forty countries have adopted labeling regulations for GE products (Guère et al., 2007)[4]. In Europe, the main impact of labeling requirements has been the virtual disappearance of many GE products, given that the cost differentials in production are small (since often GE ingredients are a minor share of total ingredients in products) and the risk of loss of market share is high given the perceived consumer resistance (Guère et al., 2007). In addition, to the extent that labeling requirements require segregation of GE and non-GE products throughout the production process, labeling could imply considerable costs (Noussair et al., 2004).

2.2.1 United States

There is relatively little literature specifically assessing purchase motivations associated with genetically engineered foods in the United States, which Anderson et al. (2006) attribute in part to the current lack of genetically engineered content labeling. In their summary of 25 valuation studies relating to GE food, Lusk et al. (2005) found that U.S. consumers are more receptive to GE foods than their European counterparts, although a preference for non-GE foods remains, suggested by various estimates of willingness to pay for GE-free foods.

[4] Some of these regulations have not yet been implemented or only partially so.

Lusk and Rozan (2005) attribute differences in GE product receptivity by consumers in France and the United States, partially to differences in information about GE foods and partially to different levels of trust in the sources providing information. While the United States showed greater knowledge of GE foods, there was also greater trust in the institutions delivering the information (food regulatory agencies, universities, and agribusiness). Rigby et al. (2004) find similar results for the United Kingdom as Lusk and Rosan (2005) find for France regarding the lack of trust of consumers toward institutions concerning information about GE products. The only institutions that more than 10 percent of consumers were willing to trust for information were universities/educational organizations.

There is some evidence that consumers support genetic engineering for use in crops to a greater extent than in animals from which dairy, meat, and other food products derive (Ganiere et al., 2006). Hallman et al. (2003) reported that one-half of U.S. residents surveyed approved of plant-based genetic engineering, while only one-quarter approved of it for use in animal agriculture.

Lusk et al. (2003) developed a mail survey sent to consumers in France, Germany, the United Kingdom, and the United States concerning preferences relating to the use of growth hormones and GE corn feed in cattle from which ribeye steaks were produced. The survey contained a choice experiment in which consumers made choices between ribeye steaks with varying levels of price, marbling (intramuscular fat), tenderness, and use/ non-use of growth hormones and genetically engineered corn in livestock production. Lusk et al. (2003) found that European consumers were more concerned about the use of genetic engineering and biotechnology than consumers in the United States. On a scale of 1 (not at all concerned) to 5 (very concerned), Lusk et al. (2003) found that consumers in France, Germany, and the United Kingdom reported average levels of concern of 4.73, 4.53, and 4.24, whereas the average U.S. level of concern was 4.00. They also found that U.S. consumers are more averse to hormone use than use of GE animal feed.

Fernandez-Cornejo and Caswell (2006) argue that there are many products in the United States that contain GE ingredients, and that the demand for these products apparently has been unaffected by negative opinions about biotechnology expressed in surveys. Putnam (2005) makes this same point, arguing that GE crops such as corn and soybeans have been used as animal feed for years with no perceptible impact on the marketing of beef. He observes beef consumers are more concerned with hormones and antibiotics or diseases such as BSE.

The evidence so far suggests that although U.S. consumers prefer to avoid GE foods, they are less concerned than their European counterparts. Other GE crops (e.g., corn, soybeans, and canola) have been deregulated in the United States for a number of years with no substantial drop in demand for conventionally produced dairy products or meat.

There is some debate on whether the absence of mandatory labeling for GE content in foods in the United States leaves the consumer less informed about the available choices than the current system of voluntary labeling, with some authors suggesting this is not the case (Bansal and Ramaswami 2007, Huffman et al. 2002).

Others suggest, however, that preference for GE-free foods could be correlated with the growth of organic foods. One of the unique attributes of organic foods, and one reason consumer demand for organic foods is increasing, is the intended absence of GE ingredients in the process of producing them (Anderson et al., 2006; Dhar and Foltz, 2005; Larue et al., 2004). Anderson et al. (2006) argue that along with ethical considerations, the potential motivators for GE-free foods would likely mirror those of the organic industry, linking acceptance to perceptions of the benefits and risks associated with human health, safety, ethics, and the environment (Larue et al., 2004; Onyango and Nayga, 2004). Much of the information that U.S. consumers currently have regarding purposeful GE content in the foods they eat comes from the presence or absence of organic labels (Ganiere et al., 2006). There is some evidence that attitudes about organic foods can be a useful indicator of attitudes about foods with GE content, at least outside of the United States (Burton et al., 2001). There is some evidence of higher levels of consumer confidence in organic foods, particularly in comparison to conventionally produced foods made in the absence of restrictions or content labels indicating GE content (e.g., Anderson et al., 2006; Owen et al., 2005).

The USDA National Organic Program (NOP) standards currently require that goods labeled “100 percent organic,” “organic” or “made with organic (specified ingredients or food group(s))” must be produced and handled without the use of excluded methods, one of which is the form of genetic engineering used to produce GT alfalfa cultivars. Livestock standards applied to animals used for meat, milk, eggs, and other animal products call for animals to be fed 100 percent organic feed, with vitamin and mineral supplements excepted (USDA NOP, 2008). However, the 2000 preamble to the NOP (65 FR 80548) states that the standard is based on process, not product, that other terms (such as GM-free) should not be used as replacement for the term organic, and, that the presence of a detectable residue of a product of excluded methods alone does not necessarily constitute a violation of this regulation.

> *The emphasis and basis of these standards is on process, not product. We have specifically structured the provisions relating to excluded methods to refer to the use of methods. Including the products of excluded methods in the definition would not be consistent with this approach to organic standards as a process-based system. (65 FR 80549)*
>
> *As was also discussed in the proposed rule, these regulations do not establish a "zero tolerance" standard. As with other substances not approved for use in organic production systems, a positive detection of a product of excluded methods would trigger an investigation by the certifying agent to determine if a violation of organic production or handling standards occurred. The presence of a detectable residue alone does not necessarily indicate use of a product of excluded methods that would constitute a violation of the standards. (65 FR 80632)*
>
> *Other terms were suggested by commenters as alternatives to the term, "organic," including "grown by age-old, natural methods," "grown without chemical input," and "residue Free." These phrases may be consumer friendly but clearly do not convey the extensive and complex nature of contemporary organic agriculture. These phrases may be used as additional, eco-labels, provided they are truthful labeling statements. They are not permitted as replacements for the term, "organic." (65 FR 80585)*

This policy has been reiterated and clarified in subsequent policy statements:

> *The presence of a detectable residue of a product of excluded methods alone does not necessarily constitute a violation of this regulation. As long as an organic operation has not used excluded methods and takes reasonable steps to avoid contact with the products of excluded methods as detailed in their approved organic system plan, the unintentional presence of the products of excluded methods will not affect the status of the organic operation. (USDA 2004)*
>
> *In the preamble of the National Organic final regulations, we stated that organic is not synonymous with "GM-free," when we said: "These phrases may…be used as additional, eco-labels, provided they are truthful statements…[but] they are not permitted as replacements for the term 'organic.'"(USDA 2004)*

By way of comparison, the NOP has a content threshold for synthetic pesticide residues equal to 5 percent of the EPA specific tolerance level for each type of pesticide residue detected (Ronald and Fouche, 2006). The organic standard is broader than the absence of genetically engineered content, involving the prohibition of many substances commonly used in conventional agriculture and specific processes and procedures. Simultaneously, it is narrower than a GE-free concept, in the sense that is does not guarantee the absence of LLP of genetically engineered content when such presence is unintentional.

Recognizing the limitations of organic standards with regard to genetically engineered content in foods, private certification standards have been developed in the United States to explore the potential demand for products free from genetically engineered content. The Non-Genetically Modified Organism (GMO) Project "is a non-profit collaboration of manufacturers, retailers, processors, distributors, farmers, seed companies and consumers" and offers "North America's first consensus-based Standard, third-party Product Verification Program, and uniform Seal for products made following best practices of GMO avoidance." (Non-GMO Project, 2010a). Although the standard is process based, it does require testing for a list of ingredients potentially carrying genetically modified content at specific points in the production chain, in contrast with NOP standards (Non-GMO Project, 2010b).

2.3 Discussion

The evidence above suggests a preference for GE-free foods among U.S. consumers is often detected in consumer surveys. This preference could be correlated with the growth of organic markets and has led to the private development of standards and labeling for food free of genetically engineered content.

The extent to which this preference would translate to decreased demand for organic alfalfa in a scenario of GT alfalfa deregulation is uncertain. Successful marketing of NOP certified foods has had to contend with the risk of GE content accidentally spreading from deregulated cultivars of soybeans, corn, and canola to organic crops. Despite the potential for unintended presence of

GE content, however, the evidence cited above indicates that organic food sales in the United States continue to grow at a rapid rate. While there is the potential that organic food sales would have grown even more rapidly in the absence of this risk, no published studies have been found that document or estimate this effect. Putnam (2006) suggests that "the presence of GE alfalfa may actually increase the demand for non-GE alfalfa or organic alfalfa, sharpening the need for product identity, trait stewardship, and coexistence on farms and in markets."

To the extent that a reduction in the domestic demand for dairy, meat and livestock and pet feed that is perceived as having been produced with GT alfalfa does occur, and to the extent that organic markets are unable to retain confidence of consumers in existing process based standards, a shift toward similar goods believed to be completely free of GE content could occur. This could either lead to an increase in imports of similar products from countries where GT alfalfa is not deregulated, or could lead to increased demand for testing, as reflected in existing standards and labels for food free of genetically engineered content.

2.4 Summary of Findings

There is evidence of moderate overall growth in key downstream markets for alfalfa. There is also evidence of some consumer preference for GE-free foods in the United States. Growth trends in downstream markets, however, occurred in the context of the United States deregulation of other GE feed crops such as corn and soybeans. There is no evidence on whether these trends would have been higher or lower in the absence of GE feed.

Consumer preference for GE-free foods could have contributed to strong growth in the organic sector. There is no evidence to suggest that deregulation of GT alfalfa would reduce demand for organic foods. The evidence presented indicates that consumer preferences for organic over GE foods are influenced in part by ethical and environmental factors that are likely unrelated to minor unintended presence of GE content in feed crops. The evidence presented above suggests that there is the possibility that deregulation of GT alfalfa could in fact increase demand for organic foods as consumers concerned with GE foods could switch to organic products.

To the extent that a reduction in the domestic demand for dairy, meat and livestock and pet feed that is perceived as having been produced with GT alfalfa does occur, and to the extent that organic markets are unable to retain confidence of consumers in existing process based standards, the result could be an increase in imports or increased demand for testing, as reflected in existing standards and labels for food free of genetically engineered content.

3.0 Impacts of Changes in Production Costs

3.1 The Role of Alfalfa Feed Costs in Downstream Production

3.1.1 Dairy

USDA estimated production costs for dairy farms in the United States based on the 2005 Agricultural Resources Management Survey (ARMS). According to these data, feed corresponds to 30 percent -60 percent of total production costs per hundredweight (100 pounds)

sold. The weight of feed on total costs is lower for smaller farms given the relatively larger overheads. As farmers can choose to attribute overhead costs to other farm products or abdicate from covering them for short periods of time, it is relevant to also look at the share feed costs represent on operational costs: roughly 70-80 percent. This suggests the price of feed is a major determinant of the cost of dairy production for dairy farms.

Table T-9. Weight of Feed Costs in Dairy Farms

Farm Type	Feed costs/ Operational costs	Feed costs/ Total costs
Conventional U.S.	73.3%	44.1%
Conventional California	79.7%	57.8%
Conventional Wisconsin	72.0%	40.4%
Conventional <50 cows	73.4%	30.0%
Conventional 1000 cows or more	76.7%	55.0%
Organic U.S.	77.8%	41.9%
Organic <50 cows	76.9%	33.7%
Organic 200 cows or more	79.6%	52.7%

Source: USDA ERS, 2005

Alfalfa is likely a considerable share of feed costs. Short (2004) reports hay and straw, presumably mostly alfalfa, represent roughly a third of feed costs. Alfalfa can additionally be used in cubes or pellets. In some regions (Wisconsin, Minnesota) haylage is also a significant share of feed.

In our Technical Report *Changes in the Economics of Alfalfa Farming with the Deregulation of Glyphosate-Tolerant Alfalfa* (appendix K) we argued that adoption of GT alfalfa is likely to increase the quality of alfalfa for forage without an increase in costs. This should increase productivity of dairy farms and allow for an increase in production without an increase in costs. We argued that this would correspond to a shift downwards (increased production at lower prices) in the supply curve of alfalfa for forage.

The impact on dairy farms would be to increase the feasibility of operations. MacDonald et al. (2007) report that currently many small dairy farms are operating with incomes above operational costs but below total costs (they are not covering overhead and capital recovery costs). The impact on reduced costs would, however, impact farms of all sizes, since feed seems to be of similar importance to all farms. If GT alfalfa requires less household labor, this could come to the advantage of smaller farms where household labor is a greater share of costs.

Whether decreased dairy farm production costs and a potential increase in production would reflect in reduced prices for dairy is not clear. A report by the United States General Accounting Office (2001) studied the factors influencing farm and retail dairy prices. The report notes that changes in milk production costs do not necessarily reflect in changes in retail prices of dairy. Farmer milk prices represent roughly 40 percent of retail milk prices and are affected by federal and state programs establishing minimum prices. The process of transmission of dairy farms costs to prices is not a simple one to determine.

3.1.2 Meat

USDA ERS produces cost estimates annually for a variety of farm products. According to the latest estimates (2005-2006), feed corresponds to an average of 70.5 percent of operational costs and 29.6 percent of total costs of cow-calf production (USDA ERS, updated 2010). Harvested forages correspond to almost half of feed costs (46.5 percent). Short (2001) reports somewhat lower figures: 35 percent of operational costs and 20.8 percent of operational and ownership

costs (capital recovery, taxes insurance) are attributes to feed and only between 10-20 percent of feed costs would correspond to purchased harvested forages.

Alfalfa is likely a lower share of feed costs in cow-calf production than it is in dairy production since the main source of feed is grazing (Short, 2001). As cattle move on to feedlots (sometime through stocker operators) feed becomes mostly grain based ration.

The impact of potentially reduced alfalfa costs on meat production could be important for cow-calf production, particularly in areas where supplementary feeding is more important in winter, such as the North Central region – Iowa, Illinois, Missouri (Short, 2001). If the alfalfa used is often of lower quality (Klonsky et al., 2007) this impact would depend on the extent to which reduction in prices of high quality alfalfa also brings down that of lower quality alfalfa.

Short (2001) argues that prices paid for cattle tend to be similar across the country, despite differences in cow-calf production costs because cattle are routinely transported. This suggests that any transfer of cost changes to prices down the chain is unlikely.

3.1.3 Livestock and Pet Food

Of the remaining potential sources of demand for alfalfa hay, the most important is likely horses. Putnam (2005) estimates that horses could consume between 5 percent and 15 percent of alfalfa hay in California. He also, however, describes the horse market for alfalfa hay as idiosyncratic, subjective, and supplied by alternative hay such as timothy and grass. We have not found sufficient reliable information – budgets and potential substitutability within horse feed – to generate an informed analysis of the impact of GT alfalfa deregulation on the horse market.

3.2 Substitution Effects

One reason why the extent to which potentially reduced alfalfa costs affect downstream market prices is important is that it could cause substitution of products produced with lower cost/ higher quality alfalfa for product produced with higher cost/lower quality alfalfa. As an example, if lower GT alfalfa costs translated into lower conventional dairy prices, the price differential between organic dairy products and conventional dairy products would increase, reducing the number of consumers willing to pay higher prices for organic dairy. This would trickle back to organic alfalfa farmers that would face reduced demand for organic alfalfa.

In the case of dairy products there could be a shift toward the use of GT alfalfa as forage and a shift toward higher quality alfalfa hay, as argued in our Technical Report *Economic and Social Impacts on Conventional and Organic Farmers of Deregulation of Glyphosate-Tolerant Alfalfa* (appendix S). To the extent that alfalfa and other forms of feed are substitutes, there could also be some shift toward alfalfa based feed. However, beyond the farm gate, we are unable to tell whether there would be any transmission of lower costs to dairy prices. As previously explained, the establishment of milk prices is regulated by federal and state programs and its response to shifts in costs, as well as to changes in supply and demand is not clear.

To the extent that any increases in milk production are allowed by decreased feed costs, and to the extent that dairy prices response to shifts in milk production, there could presumably be some

pressure downwards in dairy retail prices. However, as previously noted, dairy retail prices suffer a greater influence from other factors.

In the case of meat, we found little reason to believe changes in costs would be transmitted down the production chain such as to significantly impact meat prices.

Impacts of decreased costs of alfalfa on downstream markets for livestock and pet food would likely not significantly reflect back on the demand for alfalfa hay, given the minor share of these downstream markets in overall demand for alfalfa.

3.3 Summary of Findings

Expected lower prices/higher quality of alfalfa hay would likely benefit dairy farmers and to a lesser degree cow-calf production.

It is possible that the reduced costs in dairy and meat farming would not be transmitted to diary and meat products. In the case of dairy, this is because of dairy price regulation. In the case of meat, this is because of the relatively minor share of alfalfa in total costs. The result is that price differentials between organic and conventional dairy and meat products would likely not be affected by the increased supply of high quality alfalfa hay expected with GT alfalfa deregulation.

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Appendix T-2. Literature Search

1.0 Literature Search Strategy

For data on downstream markets, we searched mostly USDA sources.

For the literature on GE sensitivity of demand, the search started with general internet searches and then snowballed from references found in various papers. Most of the references come from academic journals and conferences.

Cost studies for dairy and meat production were found with USDA's Economic Research Service using information from the Agricultural Resources Management Surveys.