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GEOGRAPHIC IMPACTS ON U.S. AGRICULTURE OF THE 2010 DIETARY NUTRITION GUIDELINES

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The thrust of the 2010 Dietary Guidelines for Americans (DGA 2010) is to substantially reduce the intake of calories and fats as part of the fight against obesity and related diseases. This goal is to be accomplished by: (1) increasing vegetable and fruit consumption; (2) increasing whole grain consumption: (3) substituting fish and nuts for red meats; and (4) substituting skim milk, soymilk, yogurt, and cottage cheese for higher fat/calorie dairy products, including full-fat milk, chocolate milk, cheese, butter, etc. To the authors' knowledge, there has been little or no quantitative analysis of potential impacts of the DGA 2010 on the geographic distribution of agricultural production or dependence on imports, which is the objective of this paper.

Analyses of the agriculture sector impacts of the 2005 Food Pyramid Guidelines were limited in scope. The first study by Jetter, Chalfant, and Sumner (2004) initially analyzed the health, consumption, trade, production, and input demand implications of the DGA 1999. Subsequently, they analyzed the implications of the DGA 2005 for six adoption scenarios (Jetter, Chalfant, and Sumner 2006). They found that even 10% increases in consumption yielded large benefits to consumers and producers. Not quantitatively analyzed were the regional implications for fruits and vegetables or the implications for other commodities. Buzby, Wells, and Vocke (2006) analyzed the agricultural implications of full adoption of the DGA 2005. They found the need for a 132% daily increase in fruit consumption, a 31% daily increase in vegetable consumption, a 66% increase in milk consumption, and a 248% increase in whole grain consumption. The 35% extrapolated decrease in consumption of starchy vegetables was much larger than that found by Jetter, Chalfant, and Sumner.

This article will evaluate the sets of commodities most directly affected by the DGA 2010. The authors realize the need for a more comprehensive macroeconomic agriculture sector model to adequately evaluate these issues. Such a model that endogenously includes the specialty crop sector does not currently exist. Yet, the publicity surrounding the DGA 2010 raises many questions regarding the nature of the potential agriculture sector impacts and their geographic distribution. Despite analytical weaknesses, this study will utilize the methodology used by Buzby, Wells, and Vocke (2006), except for meat and dairy. The complexity of the meat—including fish, and dairy issues will be explained separately. In addition, this study will assess the geographic areas most directly affected by the guidelines as deviations from baseline production patterns. Finally, it will suggest steps that could be taken to facilitate geographic and structural adjustment.

A side-by-side comparison of the DGA 2005 and 2010 are presented in Palma and Jetter in an accompanying article. The recommended portions of each food group might differ from other publications because they assume a daily calorie level of 2,594 instead of a commonly used 2,000 level. The reason for the 2,594 caloric intake assumption is that it is represents the average calorie intake by an American. In addition, the calorie level used in this analysis will more accurately indicate the potential impact on acreage, production, and trade for each food group in the United States.

Potential Impacts on Agriculture

Because the impacts are likely to differ for various classes of agricultural products, the following sections address the product sectors individually.

Fruits

Table 1

The actual and simulation results of fruit and vegetable production, imports and exports to meet the DGA's 2010 recommended amount.

	Total Domestic Production	**Total Imports**	**Total Exports**	**Change in acreage of domestic production**
Fruits				
	(million MT)	(million MT)	(million MT)	(acres)
Actual (average 2005-2010)	26.5	9.9	3.4	--------
Simulation results				
Scenario 1:(Holding exports, the share of imports constant)	34.6	12.8	3.4	891,400
Scenario 2: (Exports decrease by 10%; Share of imports increases by 10%)	29.5	17.5	3.06	334,500
Scenario 3: (Exports decrease by 20%; Share of imports increases by 20%)	27	19.7	2.72	54,800
Vegetables				
Actual (average 2005-2010	56	5	7.6	-------
Simulation results				
Scenario 4: (Holding exports, the share of imports constant)	63.8	5.6	7.6	824,000
Scenario 5: (Exports decrease by 10%; Share of imports increases by 10%)	55.4	12.3	6.8	-72,800
Scenario 6: (Exports decrease by 20%; Share of imports increases by 20%)	58.1	8.8	6.1	254,800

Because there is no actual fruit consumption data available, we used the ERS loss-adjusted food availability for the average Americans with an intake level of 2,594 as an approximation. The total availability of fruit (domestic production + imports - exports) will need to increase by 133% to meet the DGA's 2010 recommended amount. From 2005 to 2010, the average domestic utilized production of fruit was 26.5 million metric tons (MMT) a year, imports averaged 9.9 MMT, and exports averaged 3.4 MMT (Economic Research Service 2011a; Foreign Agriculture Service 2011). When this increase is allocated proportionately between domestic production and imports by holding exports constant (Scenario 1 in Table 1), we estimate that the domestic production would need to increase by 131% to 34.6 MMT. Imports would need to increase by 129% to 12.8 MMT. We estimate the fruit industry must increase its acreage by 891,400 acres to total fruit production acreage of 3.8 million acres. In addition to domestic production, fruit imports are likely to increase to meet the increase in the fruit consumption recommended by the DGA 2010. Therefore, our estimates of the increase in domestic fruit production are believed to represent an upper-bound (Buzby, Wells, and Vocke2006). We simulated another two scenarios where exports and import shares also change (Table 1). When exports decrease by 10% and the share of imports increases by 10%, the increase in the acreage of domestic production is about 334,500 acres (Scenario 2 in Table 1); when exports decrease by 20% and the share of imports increases by 15%, the increase in acreage of domestic production is very small—only about 54,800 acres (Scenario 3 in Table 1). Scenario 3 shows the case when the United States does not expand domestic production in the short run and the increase in fruit consumption would be sourced from imports and by cutting exports simultaneously.

Different states in the United States would be affected to different degrees. According to the 2007 U.S. Census of Agriculture, California accounted for approximately 60% of the non-citrus fruit acreage, followed by Washington (about 14%) and Michigan (about 5%). For citrus fruit, Florida accounted for approximately 65% of the total acreage, California ranked second (about 30%) and Texas third (about 3%). To meet the increase in consumption, these top producing states are more likely to be affected due to their favorable climate, arable land, and other favorable production characteristics. The states that mainly produce tree fruits (apples, pears, etc.) and citrus fruits would be unlikely to increase production in the short run due to the time required for these trees to bear fruit. To meet the production increase, the inputs to produce fruit such as labor, land, water, and fertilizer will likely be in greater demand, leading to higher costs in these inputs. This is especially true for labor because most fruit production is labor intensive. Increased demand, resulting in higher prices, would bring higher cost areas into production.

The United States has been a net fruit importer despite the growth in exports. Between 2005 and 2010, excluding bananas, fresh fruit imports have increased by approximately 15%. During this period, fresh fruit imports—excluding bananas—accounted for about 30% of domestic fruit consumption, which represents a slight increase compared to 2004 when it was about 25%. Increases in imports were experienced by both fruits produced domestically and nontraditional fruits, especially tropical fruits. Mexico is the largest supplier of fresh and frozen fruit to the United States, accounting for over 30% each of the volume and value of fresh and frozen fruit imports—excluding bananas. This reflects the close geographic proximity, the low transportation costs, and low tariffs on Mexican imports. Other leading fruit suppliers are Chile, Brazil, China, and Argentina (Economic Research Service 2011b).

Vegetables

The total availability of vegetables (domestic production + imports - exports) would need to increase by 114% to meet the DGA's 2010 recommended amount. But, this increase is not allocated evenly across the five subgroups. The consumption of beans and peas (legumes) and red and orange colored vegetables must increase substantially, by 257% and 233%, respectively. The consumption of dark green vegetables would have to increase by 150%, followed by starchy vegetables (80%), and other vegetables (45%).

During the 2005 to 2010 period, the average domestic production of vegetables was 56 MMT/year. Imports and exports averaged 5 MMT and 7.6 MMT, respectively (Economic Research Services 2011c; Foreign Agriculture Service 2011). When allocating the percentage increase (114%) proportionately between domestic production and imports, holding exports constant, we estimate that the domestic production and imports would both need to increase by 112%. Total acreage would have to increase by 824,000 acres to a total acreage of 7.6 million acres (Scenario 4 in Table 1). In addition to domestic production, vegetable imports are also likely to increase to meet the increase in the vegetable consumption recommended by the DGA 2010. Therefore, our estimates of the increase in domestic vegetable production represents an upper-bound. Similar to fruit, we simulated another two scenarios when exports and imports share also change (Table 1). When exports decrease by 10% and the share of imports increases by 10%, the change in the acreage of domestic production would be small—only about 72,800 acres (Scenario 5 in Table 1). When exports decrease by 20% and the share of imports increases by 5%, the acreage of domestic production would increase by about 254,800 acres (Scenario 6). Scenario 5 shows the case when the United States does not expand domestic production in the short run, so the increase in vegetable consumption would be sourced from imports and by cutting exports simultaneously.

California ranked first in terms of harvested area of vegetables, accounting for 43% of total harvested area, followed by Florida (10%), and Arizona (6.6%) (Economic Research Service 2011c). The growing conditions of vegetables are not as constrained by weather conditions as certain fruits. We expect that vegetable production would be expanded in other states, in addition to these top producing states. The price of vegetables will increase as a result of the demand increase. In contrast with fruit, many of the vegetables are not as labor intensive, so the demand for labor might not change as dramatically as that for the fruit industry and may vary across vegetable crops.

In addition to domestic production, vegetable imports are also likely to increase to meet the increase in the vegetable consumption recommended by the DGA 2010. From 2005 to 2010, vegetable imports have increased by approximately 16%. In terms of import value, Mexico and Canada have historically been the top suppliers of vegetables to the United States due to transportation and tariff advantages, followed by China, Peru, and Spain (Economic Research Service 2011d).

Grains

Crops included in the study are wheat flour, corn products, rice, oat products, rye flour, barley products, and others (Table 2). The DGA 2010 recommendations indicate that the average American is not eating enough grain-based food, particularly whole grain as opposed to refined grain. Our estimates indicate that there are 57.5 grain servings per week per person available for consumption, compared to the recommended 62.8 servings per week per person, a 9.2% deficit (For more information see Palma and Jetter in the accompanying article). However, the guidelines suggest reducing enriched or refined grains consumption by 29 % and increasing whole grain consumption by 423.3%. Due to data gaps for whole grain consumption, wheat is the commodity used for our grain analysis. Wheat accounts for 68% of total grain available for consumption (Economic Research Service 2011a).

Table 2

Weakly per capita availability of select grains in the United States, 2009.

Grain	1-ounce equivalent servings	Share of total grain servings
Wheat flour	36.00	62.6%
Corn products*	11.74	20.4%
Rice	4.58	8.0%
Oat products	0.75	1.3%
Rye flour	0.13	0.2%
Barley products	0.11	0.2%
Other**	4.20	7.3%
Total	57.51	100.0%

*Included here are corn flour, meal, and grits from field corn for human consumption. Not included is sweet corn as it is a vegetable.

** Whole grain foods missing from the ERS Loss-Adjusted Food Availability Servings, i.e. popcorn, quinoa, etc. Putnam, Allhouse, and Kantor (2002) estimated that Americans were eating at least 4.2 whole grain servings per capita per week in 2000

During the 2005 to 2010 period U.S. wheat harvested acreage averaged 50.2 million and on average 44.5% of those acres were available for food use, mainly flour, while the rest went into exports, seed, feed, and residual. In addition, during the same period, average domestic wheat flour production, both whole and refined, was 18.6 MMT, while imports and exports were 0.3 MMT and 0.2 MMT, respectively for 2005 and 2010. The total wheat flour and flour products available in the United States (domestic production + imports – exports) averaged 18.7 MMT/year. Industry estimates indicate that annual U.S. production of whole wheat flour is about 5% of total U.S. wheat milled, while the remainder goes into refined flour and products. Therefore, in order to reach the DGA 2010 recommended levels, whole wheat production needs to increase tenfold, from 5% to 50% so that half of the available wheat flour is consumed as whole wheat. Full adoption of the DGA 2010 standard would require, essentially, a reallocation of the processing of wheat from refined to whole wheat. Our study did not use the estimated 423.3% increase in whole grain consumption because that estimate is for all grains and we are only considering wheat.

The result of full compliance with the DGA 2010 would be a decrease in wheat production by around 1.8 MMT available for consumption, from 26 to 24.2 MMT. This result seems counterintuitive given that consumption of total grains should increase by 9.2% under the DGA 2010. However, given that one pound of wheat makes 0.98 pounds of whole wheat flour but only 0.74 pounds of refined flour, the net effect is a 7% decrease in total wheat available for consumption. These results vary significantly from the Buzby, Wells, and Vocke (2006) report, but the main difference is the daily calorie level used. They assumed 2,000 calories, while we assumed the average of 2,594 calories.

A decrease in wheat demand could trigger a drop in wheat prices and land allocation. The 1.8 MMT reduction due to compliance to the DGA 2010 equates to a 1.6 million fewer harvested acres needed, from 50.2 to 48.6 million acres. This drop only accounts to 3.2% of total harvested acres during the 2005-10 period, which is not large given that during the same period harvested acres ranged from 46.8 to 55.7 million acres. Nevertheless, some wheat farmers affected by this drop will likely shift acreage to other crops or other wheat varieties. An increasingly popular choice would be hard-white winter wheat for the production of whole wheat products due to some of its desirable properties similar to refined wheat products. Finally, the switch to produce more whole wheat products could affect the feed market because less wheat byproducts would be available to be used in livestock rations.

Dairy and Meat Production

In the past decade, several studies have attempted to identify land use and livestock industry impacts resulting from changes in farm and bioenergy policies, but the available literature is much less prevalent for the DGA impacts. O'Brien (1995) examined the relationship between increased adherence to the Food Pyramid and the output from production agriculture. He concluded that adherence to the Pyramid guidelines would result in increased poultry and pork production and less red meat production, with resulting declines in feed grain production because of higher feed conversions for poultry and hogs compared to sheep and cattle. Dairy production would increase under his assumptions.

Buzby, Wells, and Vocke (2006) pointed out the challenges of assessing dietary guideline impacts for the U.S. livestock/meat industry. These challenges are due mainly to the whole-animal system that includes both lean and non-lean meat production. That is, animal carcasses include both lean and higher-fat cuts of meat, and changes in consumption patterns could have corresponding impacts on the grain sector. Likewise, they discussed the challenges of differentiating "low-fat" and "non-fat" dairy products from other dairy products in their assessment of dairy consumption impacts. They concluded that total dairy production would increase, assumed that increased dairy production would occur in current top dairy-producing states, and did not analyze what would happen to the excess butterfat.

Young and Kantor (1999) briefly discussed the pressures on grain and oilseed markets and the expected impact on pastureland values from increasing dairy activity near population centers. They also discussed the trends in meat and dairy consumption and production, taking into account the increased role of chicken in U.S. diets in the 1990s and gains made in milk production per dairy cow over time. Yet, like Buzby, Wells, and Vocke (2006), they did not address how large changes in dietary intake may impact regional livestock or dairy production.

Table 3

ERS Loss-Adjusted Red Meat*, Poultry, and Egg Availability (oz/wk), 1990-2009.

Year	Red Meat*	Poultry	Eggs	Total**
1990	21.4	10.3	3.6	35.2
1991	21.2	10.6	3.5	35.4
1992	21.5	11	3.6	36.1
1993	21.1	11.3	3.6	36
1994	21.6	11.4	3.6	36.6
1995	21.6	11.3	3.5	36.5
1996	21.2	11.5	3.6	36.2
1997	20.8	11.6	3.6	35.9
1998	21.6	11.7	3.6	36.9
1999	21.9	12.3	3.8	38
2000	21.7	12.3	3.8	37.8
2001	21.2	12.3	3.8	37.4
2002	21.7	12.9	3.9	38.5
2003	21.3	12.9	3.9	38.1
2004	21.4	13.2	3.9	38.5
2005	21	13.4	3.9	38.2
2006	21	13.4	3.8	38.2
2007	21	13.4	3.7	38.1
2008	20.3	13.2	3.7	37.1
2009	20.1	12.6	3.7	36.4

*Beef, veal, pork, and lamb.

**Total of red meat, poultry, and eggs, but not including fish, shellfish, nuts, or dry beans.

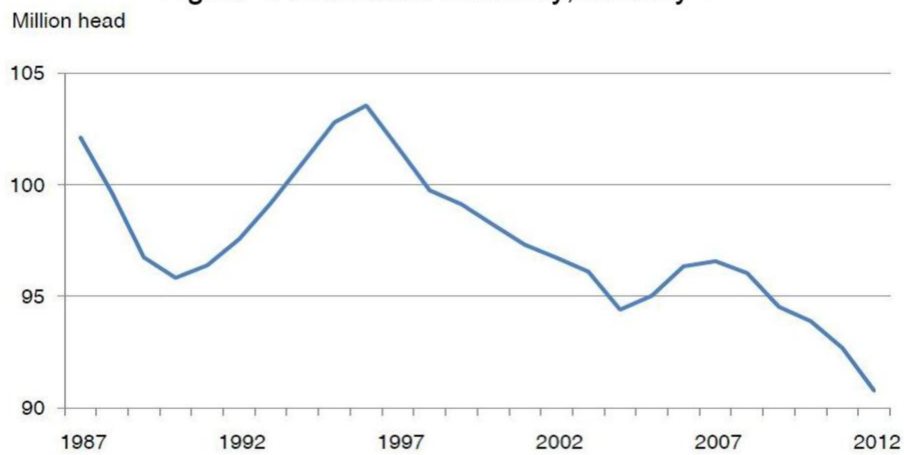
Arnoult et al. (2010) made the most recent and significant attempt to address livestock industry and land-use impacts due to greater adherence to dietary guidelines, examining the impacts of following the U.K. Department of Health's healthy eating guidelines on agricultural production and land use in England and Wales. Although not identical to the DGA, the authors note that "[t]here is no fundamental difference between the recommendations on healthy eating given by different national and international agencies." The authors found that agricultural regions with the greatest dependency on beef and sheep production would be most negatively affected by adherence to the dietary guidelines. Their model predicted that dairy production and grain crops would supplant a share of sheep and beef production in areas where the land was suitable for such alternatives. They also concluded that remote pasture-dominated regions, being less suitable for alternatives such as grain or horticultural production, would experience the greatest negative impacts due to declining demand for beef and mutton.

Compared to Arnoult et al. (2010), an examination of dietary guideline impacts on the U.S. meat and dairy industries must consider the greater geographic diversity of the U.S. livestock sector, in addition to the crossover impacts to the larger grain and oilseed markets. As pointed out by MacDonald and McBride (2009), even highly integrated and geographically-concentrated livestock systems such as hogs and poultry involve multi-location production systems including hatcheries or farrowing operations, grow-out farms, and processing facilities. For cattle the system is even more geographically dispersed. A weaned calf from a Florida cow-calf operation might end up on Oklahoma winter wheat pasture as part of a stocker cattle program before heading to a feedlot and packing plant in Texas or Kansas. Thus, the geographic impacts of changes are broader and more difficult to estimate than the England/Wales example provided by Arnoult et al. (2010).

A study of geographically-identifiable agricultural impacts must account for ongoing structural change in the livestock/meat sector, so that trends noticed prior to the DGA 2010 are distinguished from additional changes required to meet the Guidelines. The DGA 2010 recommends a 21.7% decrease in the consumption of meat, poultry, and eggs. But as pointed out by Young and Kantor (1999) and by Buzby, Wells, and Vocke (2006), long-term trends show a gradual decline in per capita red meat consumption (Table 3). However, increased export demand could mitigate some of the industry impacts resulting from adherence to the DGA 2010.

U.S. livestock numbers, especially cattle inventories (beef and dairy), show a long-term decline, even after accounting for the impacts of the 2011 drought (Figure 1). However, beef and milk production per head have improved. MacDonald and McBride (2009) and Wirsenius, Azar, and Berndes (2010) suggest that factors such as scale economies, technological advancements, complementarities among stages, and environmental regulations have been driving these changes in both livestock industry production methods and geographic locations on a national and global scale. The complementary nature of dairy and beef must also be considered, as an increase in milk production—and dairy herd levels—to meet DGA 2010 goals would necessitate an increase in beef production. In other words, spent dairy cows and most dairy bull calves are destined to become beef. Consistent with the DGA 2010, the more lean dairy animals, typically, would be leaner than beef breeds. Impacts will also be realized in both feed grain and forage production.

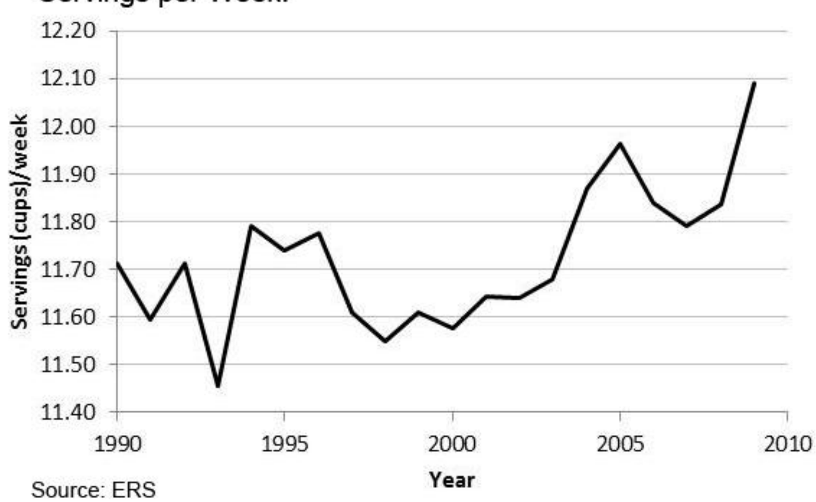
Figure 1: U.S. Cattle Inventory, January 1



Source: USDA-NASS "Cattle-January 2012"

Increasing milk production, while decreasing butter production, would be a challenge for meeting the DGA 2010. According to the Guidelines, the increase in milk production would have to be 73.6%—without the added effort of distinguishing fat content. This would require a heroic increase over historical dairy product availability (Figure 2). As noted in previous studies, the bulk and/or water content of dairy products—primarily milk—practically eliminate the feasibility of increased dairy imports to meet this increased demand and may negatively impact exports of U.S. dairy products such as cheese and whey to other countries. The option of substantially changing the pricing relationships of the fat and nonfat components of milk may have longer-run potential for dealing with this issue. Specifically, this would involve administratively increasing the price of the nonfat milk components while decreasing the price of butterfat. The geographic impacts of increasing milk production present a challenge for economists because of the movement of dairy operations in the first decade of the 21st century. Historically, dairy production has been concentrated relatively close to population centers to diminish transportation costs of the final fluid and bulk products. However, demands for land and water and environmental regulations have shifted the scale of dairy production and the locations in which dairy operations have concentrated (MacDonald et al. 2007). States such as Idaho and New Mexico, with comparably sparse populations and feed grain production capabilities, were not "Top 10" dairy states prior to 2000 (Blayney 2002). Yet according to ERS these two states now rank fourth and eighth, respectively, in dairy production. Meeting the 2010 guidelines would require increased dairy production in these or future "hot spot" dairy areas.

Figure 2: U.S. Total Dairy Products Availability, Servings per Week.



Source: ERS

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Fish/Seafood and the DGA 2010

Like the livestock sector, analyzing the DGA 2010 recommendations for increased fish consumption is a challenge for economists. It is further complicated by the distinction between edible and industrial—for example, fish meal—seafood production. Domestic production changes could come from freshwater production, U.S. territorial seas, the U.S. Exclusive Economic Zone (EEZ), or the high seas. During the 2005 -2010 period, U.S. supply and industrial fishery averaged 5.9 MMT, ranging from 15.8 to 16.5 pounds of edible meat per capita. Domestic production averaged 4.0 MMT while imports and exports averaged 5.0 and 3.1 MMT, respectively (NOAA 2011). The DGA 2010 recommends per capita consumption of 10 oz/week, while the available quantity for consumption in 2009 was 3.2 oz/week; therefore, an increase of 6.8 oz/week or 212.5% would be needed if the DGA 2010 were to be met.

The major fish/seafood producing states, by value of sales, are Washington, California, Louisiana and Mississippi. These states could benefit most from the potential increase in demand and prices. However, 85% of U.S. consumed edible and industrial fishery products are imported. Ironically, 75% of the U.S. domestic production is exported (NOAA 2011). As a consequence, the potential increase in demand due to the DGA 2010 will probably benefit imported products rather than domestic production. Clearly, the interactions between the fish and livestock sectors deserve substantially expanded attention, given the broad-based dietary recommendations to increase fish consumption, which implies reduced consumption of livestock products, and the concerns about over-fishing.

Concluding Remarks

If the DGA 2010 were successfully implemented, it would raise the consumption of products preferred by the DGA 2010, such as fruits, vegetables, and fish, while reducing the consumption of products not preferred, such as enriched refined grains and red meats, among others. These changes in demand would be expected to have the short-run effects of raising the prices of products preferred by the DGA 2010 and reducing the prices of products not preferred. The effects on food costs are less clear. These price signals would also be transmitted to producers and change production patterns. Likewise, the long-run effects on national and regional agricultural production patterns, on land utilization, and on farm structure require further analysis. It is also hypothesized that imports of commodities favored by the DGA 2010 would increase, at least in the short run, although the long-run effects are unclear. Fruits and vegetable imports are more likely to increase, as countries with lower cost of production and/or more suitable climate will take advantage of the increase in demand and prices.

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