The Relative Importance of the Green Industry in the U.S. Agricultural Economy

Steven C. Turner and Warren Kriesel

Abstract: This article describes the relative size of the green industry within the U.S. economy and how it is linked to supporting industries through the volume of transactions and economic impact multipliers. This analysis was based on IMPLAN, an input-output model developed by the U.S. Forest Service. In terms of 1990 employment, the green industry was the second leading employer in United States production agriculture. In terms of output, the greenhouse and products sector ranked sixth within production agriculture, behind cattle, other livestock, grains, other crops and oil bearing crops.

Key words and Phrases: *Green industry, Input-output model, Multiplier, Greenhouse and nursery products.*

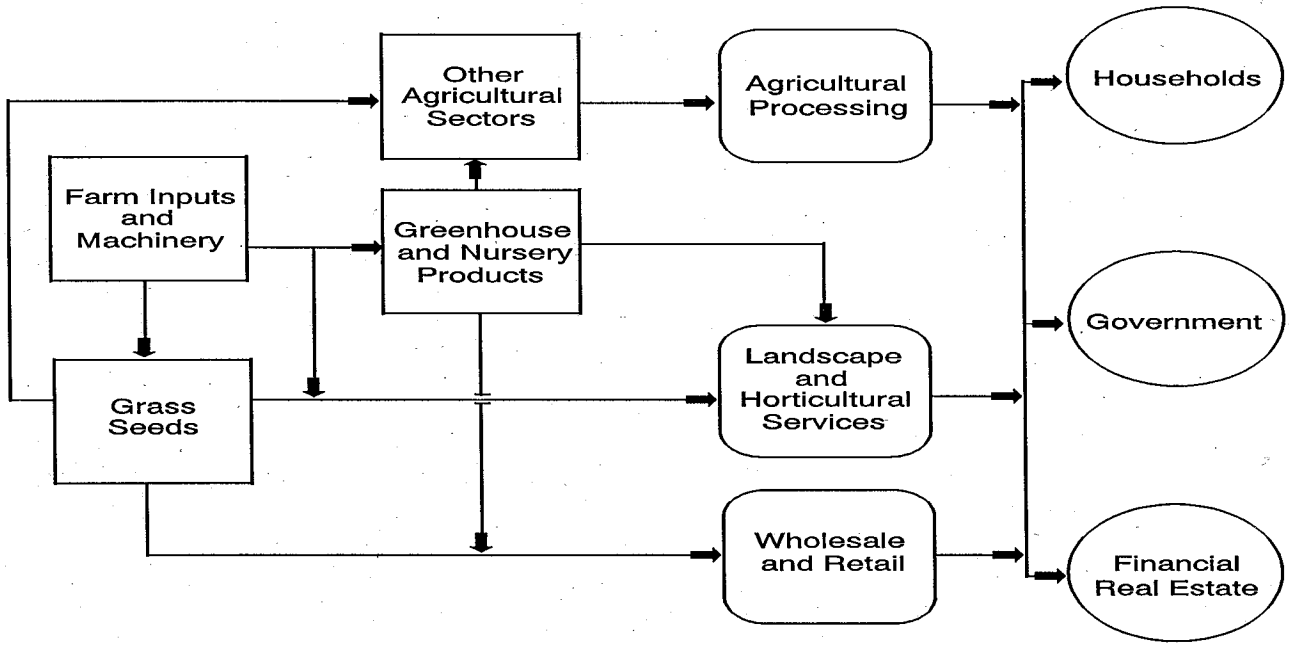
The U.S. agricultural economy is diverse and large. In the 1980s, the green industry, which includes grass seed products, greenhouse and nursery products, and landscape and horticultural services, became a noticeable and growing sector in the agricultural economy (Johnson). As the green industry continues to grow in importance, it is crucial that its impact on the overall economy be periodically examined and understood. Industry leaders, policymakers and university administrators need information on the importance of the green industry in order to plan research and outreach support. Providing this information is the objective of this article.

The flow of products and services from the green industry to final demand sectors through the wholesale and retail sectors and the landscape and horticultural services sectors is shown in Figure 1. The delivery of economic goods directly to the final demand sectors by the landscape and horticultural service sectors is unique in the agriculture sector. Another differentiating characteristic of the green industry is the lack of processing that occurs after the product leaves the farm.

Harris, Rader and Johnson (HRJ) used input-output analysis to derive backward and forward linkages of the greenhouse and nursery products sector for 1977. They concluded the greenhouse and nursery products

Journal of Agribusiness 13,1 (Spring 1995): 51-62

Figure 1.
Linkages Among the Green Industry and Other Sectors in the United States



sector derived equal levels of economic activity from input purchases (backward linkages) and from processing and distribution of output (forward linkages), and that it accounted for $5.5 billion dollars in economic activity. The HRJ study is the only known input-output examination of the U.S. green industry. However, their analysis needs to be updated since the green industry has experienced considerable growth since 1977 (Johnson). Furthermore, a more complete analysis of the green industry is needed because of the importance of the services that the industry's firms provide in addition to the plants sold. Therefore this study also includes the landscape and horticultural service sector plus the grass seeds production sector.

This article examines the impact of the green industry on the U.S. economy in 1990. The purpose of this article is to describe the relative size of the green industry within the U.S. economy and how it is linked to supporting industries through the volume of transactions and economic impact multipliers. Resources devoted to specific agricultural production and marketing industries continue to change, depending on the relative awareness of policymakers, business persons, researchers and educators. For instance, the U.S. Department of Agriculture (USDA) has historically allocated almost no resources to the economic analysis of the green industry. This is in contrast to other commodities with significantly less economic impact than the green industry. Thus, illustrating the relative economic importance of the U.S. green industry is necessary for efficient allocation of scarce government, research and business resources.

This analysis is based on IMPLAN, an input-output model developed by the U.S. Forest Service (Alward et al.) and is an extension of a study of the Georgia economy by Kriesel. IMPLAN uses the standard input-output technique of accounting for the flow of transactions between the various economic sectors within the United States. Thus, IMPLAN presents a snapshot of the U.S. economic structure.

IMPLAN has the capability to analyze 528 industrial sectors and contains data for all states and counties in the United States. For this analysis, these 528 sectors were aggregated into forty-four sectors, of which twenty-six were food and fiber and eighteen represented the rest of the economy. The green industry comprised three of the twenty-six food and fiber sectors. Two basic measures generated by IMPLAN are employment and output of a sector. The transactions matrix generated by IMPLAN presents the annual sales (in producer prices) of each sector to the other sectors. This transactions matrix is also used to derive multipliers used to measure secondary, or "ripple," effects that spread through the economy when an industry experiences an increase in sales to a final demand sector

(that is, to households or export markets) or employment. This study focuses on two types of multipliers: employment and output.

This article is organized as follows. First, an evaluation of the green industry's impact on the economy is performed in terms of employment and output. Second, the linkages between the green industry and other sectors of the United States economy are examined. Finally, economic impact multipliers are presented.

Employment and Output for the Green Industry

The latest available IMPLAN data (1990) for the United States were used to complete this analysis. The primary data source for IMPLAN was *County Business Patterns* (1990) published by the U.S. Commerce Department. Tables 1a and 1b present two measures of importance—employment and output—for each of the forty-four U.S. economic sectors. The total employment and output by the U.S. food and fiber system are presented in Table 1a, while the same statistics for the non-food and fiber sectors are presented in Table 1b. Three separate sectors comprised the green industry: grass seeds, greenhouse and nursery products, and landscape and horticultural services (Table 1a).

In 1990, the food and fiber system employed 13.67 percent (18,565,623 out of 135,776,172 person years) of the total U.S. employment. A person year is defined as forty hours of labor per week for one year. In the food and fiber sectors, the green industry sector accounted for 911,403 person years out of a total of 18,565,623 (4.9%). For comparison, the food service sector accounted for 7,011,688 person years (37.78%), food wholesale and retail accounted for 3,514,577 person years (18.93%), wood and paper processing accounted for 1,547,942 person years (8.33%), while miscellaneous food processing accounted for 814,781 (4.38%) person years. Within production agriculture, the green industry sector ranked second behind other crops (1,462,742 person years) and significantly ahead of agriculture/forestry/fishing services (572,246 person years) and cattle (342,219 person years). Thus, in terms of 1990 employment, the green industry is the second leading employer in U.S. production agriculture. Within the green industry, it is important to note that landscape and horticultural services employ 58 percent, while greenhouse and nursery products sector employs 41 percent of the total.

Output is defined as the total value of all production for a sector during the year. In layman's terms, output can also be thought of as annual gross sales. In 1990, the green industry sectors generated $32.61 billion out of

Table 1a.
United States Employment and Output by Food and Fiber Sectors, 1990

Sector	Employment	Output
	(person years)	*(million $)*
Grass seeds	361	86
Greenhouse & nursery products	381,128	8,451
Landscape & horticultural services	529,914	24,070
Total Green Industry	911,403	32,607
Dairy farm products	170,340	6,903
Poultry & eggs	101,651	7,135
Cattle	342,219	44,280
Other livestock	232,280	8,472
Hogs, pigs & swine	62,481	8,085
Cotton	95,886	5,653
Grains	141,453	28,782
Other crops	1,462,742	29,073
Tobacco	33,583	2,960
Oil bearing crops	65,970	13,530
Forest products	47,044	5,517
Ag/forest/fishing services	575,246	16,244
Processed meat/eggs	426,959	90,907
Dairy processing	157,175	51,126
Misc. food processing	814,781	161,437
Grain/flour milling	66,188	18,061
Farm inputs & machinery	232,029	50,815
Fats & oils processing	31,596	19,631
Soft drinks & liquor	190,129	52,333
Fabric mills & leather	330,261	27,837
Wood & paper processing	1,547,942	206,662
Food wholesale & retail	3,514,577	98,097
Food service	7,011,688	118,585
Total Food, Fiber and Related Sectors	18,565,623	1,104,732
Total U.S.	135,776,172	9,502,673

Table 1b.
United States Employment and Output by Non-Food and Fiber Sectors, 1990

Sector	Employment	Output
	(person years)	*(million $)*
Mining	865,007	290,197
Construction	9,257,359	722,492
Misc. manufacturing	4,303,844	350,350
Petroleum & chemicals	2,077,724	549,289
Glass, stone & clay	625,239	63,865
Metal industries	2,188,765	308,341
Machinery & equipment	2,517,808	283,414
Technology industries	2,325,189	296,457
Transportation equipment	1,859,981	345,784
Transp. & comm. services	5,276,202	490,771
Utility services	795,991	247,322
Wholesale & retail trade	18,767,950	709,590
Financial/real estate	9,514,894	1,282,829
Misc. services	22,574,510	1,037,005
Recreation & amusement	2,475,441	84,053
Health services	9,056,919	496,628
Education	7,278,426	186,947
Government	15,449,300	631,928
Balance		20,678
Total Non-Food and Fiber Sectors	117,210,549	8,397,941
Total U.S.	135,776,172	9,502,673

a total output of $9.5 trillion for the United States, which was 0.34 percent of the total. Within the food and fiber sectors, the green industry sector ranked tenth in terms of output. Within production agriculture, the greenhouse and nursery products sector ranked sixth behind cattle, other livestock, grains, other crops and oil bearing crops. In terms of 1990 output, landscape and horticultural services generated almost three times the output of greenhouse and nursery production.

Linkages Between the Green Industry and the U.S. Economy

The linkages between the green industry sectors and the other sectors of the U.S. economy are examined within the context of a transactions matrix. This matrix reports a sector's gross sales to other sectors of the economy and a sector's purchases from other sectors. The transaction matrix used in this analysis was similar to the one found in Kriesel's study, albeit for the U.S. economy rather than Georgia's. For purposes of clarity, the three sectors that compose the green industry are examined separately in the context of linkages.

Grass Seeds. The grass seeds sector had gross sales to twenty of the forty-four included sectors. Of the $86 million gross sales by the grass seed sector, $19 million (22%) was to the aggregate grain sector, $4 million (4.6%) was to the other grain sectors, $3 million (3.9%) was to the grass seed sector itself, $34 million (39%) was to the landscape and horticultural services sector, while $24 million (26.6%) was to the government sector.

Concerning the purchases by the grass seeds sector, the three primary input sectors were aggregate petroleum and chemicals ($9 million), aggregate farm inputs and machinery ($7 million), and aggregate transportation and communication services ($5 million). These three sectors comprised 44.83 percent of all purchases by the grass seeds sector in 1990. Other sectors that contributed 5 percent or more to the grass seed sectors inputs were the grass seed sector itself ($3 million), aggregate agriculture/forestry/fishing service sector ($2 million), aggregate wood and paper sector ($3 million), aggregate utility service sector ($3 million), aggregate wholesale and retail trade ($3 million), and aggregate financial and real estate service sector ($3 million).

Greenhouse and Nursery Products Sector. The greenhouse and nursery products sector had gross sales to twenty-five of the forty-four included sectors. Of the $8.45 billion gross sales by the greenhouse and nursery products sector, $1.06 billion (12.6%) was to the aggregate other crops sector, $1.57 billion (18.6%) was to itself, $3.9 billion (46%) was to the landscape and horticultural services sector, while $805.6 million (9.5%) was to the aggregate agriculture/forestry/fishing service sector.

Concerning the purchases by the greenhouse and nursery products sector, the primary input sectors were aggregate petroleum and chemicals ($1.2 billion); the greenhouse and nursery sector itself ($1.5 billion); aggregate farm inputs and machinery ($688 million); aggregate utility service ($760 million); aggregate financial/real estate sector ($670 million); aggregate agriculture/forestry/fishing service sector ($463 million); and aggregate wholesale and retail trade sector ($428 million). These seven

sectors comprised almost 70 percent of all purchases by the greenhouse and nursery products sector in 1990.

Landscape and Horticultural Services Sector. The landscape and horticultural services sector had gross sales to thirty-one of the forty-four included sectors. Of the $24.07 billion gross sales by the landscape and horticultural services sector, $16.3 billion (67.7%) was to the aggregate financial/real estate sector; $2.5 billion (10.3%) was to the aggregate construction sector; $1.1 billion (4.57%) was to the aggregate miscellaneous service sector; while $808 million (3.35%) was to the aggregate recreation and amusement sector; $676 million (2.8%) was to the aggregate education sector; and $530 million (2.2%) was to the aggregate health service sector.

Regarding purchases by the landscape and horticultural services sector, the primary input sectors were the greenhouse and nursery products sector ($3.9 billion, or 28.4%); aggregate miscellaneous service sector ($2.4 billion, or 17.8%); aggregate petroleum and chemicals ($1.4 billion, or 10%); aggregate financial/real estate sector ($1.2 billion, or 8.8%); and aggregate farm inputs and machinery sector ($1.6 billion, or 11.5%). These five sectors comprised more than 75 percent of all purchases by the landscape and horticultural services sector in 1990.

Exports. Foreign exports comprise a minuscule part of the green industry's total output. In 1990, only the grass seed sector ($1.3 million) and the greenhouse and nursery products sector ($6.376 million) had exports. This comprised about 0.03 percent of the total industry output. In fact, foreign imports in 1990 were $791.96 million for the green industry, ten times the size of exports.

Economic Impact Multipliers

Multipliers are used to measure the secondary effects that spread through the economy when an industry experiences an increase in sales to a final demand sector such as households, businesses or export markets. A change in sales sets off a series of chain reactions in an economy as production sectors buy and sell goods and services from one another in order to meet the increased demand. The chain reactions cause the total economic effect to be larger than the initial change in final demand. These ripple effects take time to develop. Research indicates 50 percent of the ripple effects occur in the first year and decline to 0 percent by the sixth year (Kraybill and Dorfman).

It is important to note that multipliers say nothing about the forward linkages that a sector has through the processing and marketing sectors—multipliers are only concerned with a sector's suppliers. Thus, the ratio of the total economic change to the initial change is the multiplier effect (Coughlin and Mandelbaum). This article reports on two multipliers: output and employment.

Output Multiplier. Only Type I multipliers for the three components of the green industry and the related sectors in the U.S. food and fiber system are presented in this study (Table 2). A Type I multiplier measures the indirect effects that spread through the economy when an industry experiences an increase in its final demand, i.e. an increase in sales. The Type I multiplier is calculated without households included in the interindustry transactions.

Table 2 shows that the Type I output multiplier for the grass seed sector is 2.0504. This means that a $1 million increase in sales causes an additional $1,050,400 in output throughout the United States economy for a total effect of $2,050,400. An equivalent way to state this is that each million dollars of sales causes a total change of $2,050,400 of output throughout the economy.

The Type I output multipliers for the greenhouse and nursery products sector and the landscape and horticultural services sector are 2.7779 and 2.1163, respectively. Within production agriculture, only the aggregate forest product sector (2.8814) has a higher Type I output multiplier than the greenhouse and nursery products sector. However, it should be noted that the magnitude of a sector's multiplier does not indicate its relative importance but rather the strength of its backward linkages.

Employment Multiplier. In addition to the output multipliers, Type I employment multipliers are also presented in Table 2. These multipliers measure how many jobs are created in response to a given change in employment in a sector without considering the effects from consumer spending.

Concerning the grass seeds sector, the Type I employment multiplier is 3.5503. This contrasts with the multipliers for the greenhouse and nursery products sector (1.5974) and the landscape and horticultural services sector (1.8969). These employment multipliers indicate, for instance, that if the greenhouse and nursery products sector employed one hundred more workers, then fifty-nine jobs would be created indirectly so there would be a total of one hundred fifty-nine new jobs.

Table 2.
Estimated Employment and Output Multipliers for U.S. Food, Fiber and Related Sectors, 1990

Sector	Type I Multipliers	
	Output	Employment
Grass seeds	2.0504	3.5503
Greenhouse & nursery products	2.7779	1.5974
Landscape & horticultural services	2.1163	1.8969
Dairy farm products	2.3288	3.5450
Poultry & eggs	2.7303	4.3634
Cattle	1.8206	2.1510
Other livestock	2.2129	1.5005
Hogs, pigs & swine	1.8207	2.1511
Cotton	2.3533	2.1214
Grains	1.7261	2.5967
Other crops	2.7004	1.4948
Tobacco	2.5752	2.6241
Oil bearing crops	2.6564	4.5348
Forest products	2.8814	4.6783
Ag/forest/fishing services	2.7428	1.6134
Processed meat/eggs	2.7384	4.6729
Dairy processing	2.8717	6.8240
Misc. food processing	2.1586	4.3574
Grain/flour milling	2.2163	4.6951
Farm inputs & machinery	2.2462	3.3186
Fats & oils processing	3.1518	12.5797[a]
Soft drinks & liquor	1.9324	3.8770
Fabric mills & leather	2.1135	2.1005
Wood & paper processing	2.1130	2.4753
Food wholesale & retail	1.3500	1.1346
Food service	1.7537	1.1467

[a]This large Type I employment multiplier is probably due to an underestimation of employment in this sector.

Implications

The green industry is an important component in the United States' economy, in terms of output and employment. This study has documented the relative size and linkages of this industry to other economic sectors of the United States. Landscape and horticultural services are major components of the green industry. The green industry's service sector employs more people than the industry's two production sectors. It will be interesting to see if this service sector continues to grow in the future.

Within production agriculture, the green industry sector ranks second behind the cattle sector in terms of 1990 output. Even without landscape and horticultural services, the greenhouse and nursery products sector produces more dollar output than the poultry and eggs sector; the dairy farm products sector; and the hogs, pigs and swine sector. The green industry is also a major employer relative to other agricultural sectors. Only the other crops sector, which includes vegetables, fruits, tree nuts, and hay and pasture, employed more person years in 1990.

The increasing significance of the U.S. green industry does not appear to be affected by recent international trade agreements. The greenhouse and nursery products sector appears to be relatively safe from imports due to restrictions on the importation of soil. Since the landscape and horticultural service sector is labor intensive at the local level, any economic adjustments due to trade agreements would result from changes in immigration policies. The current importance of the green industry has occurred without price support programs and minimal research dollars from federal funding. It appears the green industry will remain an important sector in U.S. agriculture.

Notes

Steven C. Turner and Warren Kriesel are Associate Professors in the Agricultural and Applied Economics Department at the University of Georgia, Athens, Georgia.

References

Alward, Greg, Carol Taylor, Susan Winter, Eric Siverts, Doug Olsen, Scott Lindall, and Wilbur Maki. Micro IMPLAN User's Guide, vol. 91-f. St. Paul, MN: University of Minnesota Agr. and App. Econ. Dept., Jan. 1993.

Coughlin, Cetus C., and Thomas B. Mandelbaum. "A Consumer's Guide to Regional Economic Multipliers," pp. 19-32. St. Louis, MO: Federal Reserve Bank of St. Louis, Jan. 1991.

Harris, Thomas R., Libby J. Rader, and Wayne S. Johnson. "Economic Linkages of the U.S. Greenhouse and Nursery Products Industry." *J. Env. Hort.* 10(1992):4-7.

Johnson, Doyle. "Floriculture—A Growth Industry." *Agricultural Outlook*, pp. 25-27. Washington, DC: USDA, Jan.-Feb., 1992.

Kraybill, David S., and Jeffrey H. Dorfman. "A Dynamic Intersectoral Model of Regional Economic Growth." *J. Reg. Sci.* 32(1992):1-17.

Kriesel, Warren. "The Relative Importance of Food and Fiber Sectors in the Georgia State Economy." Univ. of Georgia-Athens Exp. Sta. Res. Bull. 416, July, 1994.