An Economic Analysis of the Greenhouse, Nursery, and Sod Sector in the United States

Edmund M. Tavernier¹ and Robin G. Brumfield²

Department of Agricultural, Food, and Resource Economics, Cook College, Rutgers University, New Brunswick, NJ 08901-8520

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Abstract. The greenhouse, nursery, and sod (GNS) sector in the United States accounted for \$10 billion in gross sales or 5% of gross farm receipts, in 1998. Despite its significant economic contributions, the sector receives little attention from policymakers. Part of the problem lies in the absence of empirical economic analysis that addresses the impact of the sector on the U.S. economy. The absence of such analysis places the sector at a disadvantage when agricultural policies are designed to address agricultural imbalances, such as farm income problems, and hinders the ability of the sector to lobby for policies favorable to GNS producers. This study provides estimates of the economic impacts of the GNS sector on the U.S. economy and quantifies the linkages between the GNS sector and other economic sectors. The results show that the sector contributed over \$26 billion and \$17 billion in output and value added economic activity, respectively, and over 438,000 jobs.

Major policy initiatives, such as the 1996 Farm Bill, provide the framework within which agricultural commodity programs operate. In the case of the 1996 Farm Bill the programs are guided by Title 1 of the Farm Bill called the Agricultural Marketing Transition Act (AMTA), and provide important benefits to producers of traditional commodities, such as corn, sorghum, barley, oats, wheat, cotton, and rice (see Tavernier and Brumfield, 1996, FS857). While the traditional commodities make an important contribution to the agricultural economy of United States, so too does the greenhouse nursery and sod (GNS) sector. Yet this sector receives no benefits from those programs.

In 1997, for example, the total value of agricultural output was \$196.9 billion, of which crops, including nursery and greenhouse crops, accounted for \$98 billion. The GNS sector accounted for 5% of agricultural output and 11% of crop sales in that year (USDA, 1999a). Between 1988 and 1998, cash receipts from the GNS sector increased by 121%, while cash receipts from non-GNS crops decreased by 62% (USDA, 1998). During that period, the value of total agricultural output increased by 45% (USDA, 1999b). The differential suggests that the GNS sector is playing a significant role in the farm income balance sheets of U.S. agriculture.

Table 1 ranks the top 10 GNS producing states in 1992 and 1998. California and Florida

maintained their dominant positions as number 1 and 2 GNS producing states, respectively. However, their national contributions to cash receipts changed over that period. For example, between 1992 and 1998 cash receipts from GNS increased from 20% to 20.4% in California, but decreased from 10.9% to 10.6% in Florida. North Carolina moved from a number 3 ranking in 1992 to number 4 in 1998. Pennsylvania improved from number 9 to number 8, while New York dropped from number 6 to number 9. Oklahoma remained at number 10 over that period.

Although the determinants of the growth of the sector are not investigated here, suggestions have been advanced to explain its growth. In the case of Pennsylvania, the proximity to the “high traffic” markets of Philadelphia and New York City appears to provide an important stimulus to growth (NJ FARMS, 1991). The favorable climate in California, Florida, and Texas, coupled with significant population growth, may help explain their dominance in the industry. In addition to the benefits of urbanization, increased residential construction has been shown to have a positive relationship on the sale of U.S. nursery stock (Johnson and Jensen, 1992). These factors

suggest an increasingly important future role of the GNS sector in U.S. agriculture.

As the role of the sector increases, quantifying its contribution to the U.S. economy becomes more important. Such contribution is often lost in aggregate analysis and could mask important economic contributions or deficiencies in the U.S. agricultural sector. While aggregate analysis is sometimes useful, and in most cases the only analysis possible because of data limitations, its utility to policymakers is often questionable because it fails to identify sector-specific contributions, and therefore makes sector-specific policy difficult.

The following study addresses the above problem by disaggregating the agricultural sector to identify and quantify the economic linkages between the GNS sector and certain sectors in the economy in terms of employment, value added, and industry output. The examination of those linkages provides a framework within which the potential consequences of a decrease in the demand of GNS products translates into economic consequences for other agricultural and nonagricultural sectors. Such analysis is important not only to policymakers but to GNS producers. More importantly, however, the study adds to the limited body of research in that area of GNS-related economic impact research, by identifying not only the indirect effects of GNS economic activity, but also the induced effects of the sector.

Materials and Methods

The economic framework used to analyze the economic contributions of the GNS sector draws from previous work of Tavernier et al. (1995). The framework utilizes economic base theory from regional economics. The primary thesis of the theory is that there exists a relationship between export-generating (sometimes referred to as basic employment) and residentiary (sometimes called non-basic employment) activities, and between export-generating employment and population (Hoover and Giarratani, 1984; Maki, 1991). Thus, any activity that leads or determines the growth of a local economy is viewed as basic, while the non-basic activities are spill-over results or positive externalities from such growth. Exports are generally defined as any extra-regional activity that introduces “new revenues” into the local economy and helps the growth of that economy. Under that definition, a service can be viewed as an export

Table 1. Grower cash receipts for greenhouse and nursery crops, United States and top 10 states.

Region	Percent	1998	Region	Percent	1992
United States		\$12,114,886	United States		\$9,398,664
California	20.4	2,468,541	California	20.0	1,882,421
Florida	10.6	1,278,700	Florida	10.9	1,027,694
Texas	9.2	1,119,660	North Carolina	7.8	732,235
North Carolina	7.9	957,552	Texas	6.7	628,000
Oregon	4.8	579,074	Ohio	5.0	470,796
Ohio	4.5	543,897	New York	4.0	375,425
Michigan	3.9	475,323	Michigan	3.8	358,933
Pennsylvania	2.9	347,119	Oregon	3.7	345,056
New York	2.2	264,458	Pennsylvania	3.2	304,926
Oklahoma	1.4	168,336	Oklahoma	2.9	274,213
	67.8			68.0	

Source: Floriculture and Environmental Horticulture, Situation and Outlook, Oct. 1999.

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¹Associate Professor and Specialist in Agricultural Policy.

²Professor and Farm Management Specialist.

activity once it introduces new money into the local economy. The local economy may be a municipality, county, state, nation or region. Identifying the components and contributions of the economic base of the local economy should be a continuous process because the economic contributions of a sector are likely to change over time.

The input-output technique is used for the economic analysis of the GNS sector. The technique is useful for such purposes because it allows for the identification of structural linkages within an economy. The technique has undergone significant intellectual development (Isard, 1951) and has been used in many empirical applications (Chenery, 1953; Leontief, 1953). The technique has been used to examine the economic linkages of the U.S. greenhouse and nursery products industry (Harris et al., 1992). The authors conclude that the GNS sector generated \$5.5 billion of economic activity in 1977. A shortcoming of that analysis is the absence of induced or household effects from GNS-related economic activity. These effects are captured by IMPLAN (Impact analysis for PLANning). Turner and Kriesel (1995) use IMPLAN to examine the relative importance of the green industry, which includes grass seed products, greenhouse and nursery products, and landscape and horticultural services, on the U.S. agricultural economy in terms of output and employment. That analysis does not include the induced effects of household spending on the economy. IMPLAN has also been used to examine the greenhouse industry in New York State (Uva, 1999).

IMPLAN uses input-output techniques and was developed by the Forest Service of the U.S. Dept. of Agriculture (U.S. Forest Service, 1992). The greatest level of disaggregation is 528 sectors, but the sectors can be aggregated by the user as desired. IMPLAN is nonsurvey-based, using national technical coefficients derived from the 1982 U.S. input-output accounts (USDC, 1991), assumes a uniform national production technology and uses the regional purchase coefficient approach to regionalize the technical coefficients (Rickman and Schwer, 1995). Technical details about IMPLAN can be found in IMPLAN Professional Version 2. IMPLAN has been used to estimate economic impacts in the forest industry (Tavernier, 1987; Templeton and Goldman, 1996), recreation and tourism (Borden et al., 1996; Goldman et al., 1998), environmental issues (Bernow et al., 1996; Huebner, 1989), and issues pertaining to rural development (Goldman, 1997; Robison, 1997).

For this study, the 1993 IMPLAN database for the U.S. is used to calculate the economic impacts of GNS sales to final demand (demand by the ultimate consumers of the product), and the IMPLAN Professional Version 2 software is used to perform the econometric analysis. IMPLAN is a demand-driven, backward-linkage program. That version of IMPLAN generates Type I and Type II multipliers. Type I multipliers measure the direct and indirect effects of a change in economic activity. They capture the interindustry or sector effects only; that is industries buying from local industries.

In addition to capturing those two effects, Type II multipliers also include the incomes and expenditures of households. Thus for every one dollar change in final demand for a particular industry, increases occur in interindustry economic activity (as in Type I), but increases also occur in the incomes of the people employed in producing the output of the particular industry. These people spend their income on personal consumption, which leads to demands from local industries.

The GNS sector's influence on US economic activity is 3-fold. First, the GNS sector has a direct effect on the economy as businesses, households, real estate developers, and others buy GNS products. The second influence is an indirect effect as the GNS sector responds to increases for its products by purchasing inputs (e.g., labor from households, seed, and materials from business) to satisfy increases from final demand. This round of economic activity does not go on indefinitely as certain inputs are purchased outside of the local economy and are considered demand leakages. Kraybill and Dorfman (1992) suggest that 50% of such activity is generated in the first year and decline to 0% by the sixth year. The third influence is the induced consumption effect. This effect results from increased household spending as more labor is hired in response to GNS-led economic activity. The paper assumes that the influences or multiplier effects respond proportionately to expenditures in the local economy.

Results and Discussion

Type II multipliers are used to arrive at the economic contributions of the GNS sector. The contributions are analyzed in terms of total industry output, employment, and value added. Total industry output represents the value of total GNS production; employment includes both full-time and part-time workers in the sector; and value-added includes employee compensation, proprietary income, other type of income, and indirect business taxes.

According to Table 2, in 1993, the U.S. GNS sector generated almost \$10 billion in direct sales, hired over 220 thousand people, and generated over \$8 billion in value added activity. That economic activity increased indirect demand in that sector by almost \$700 million, and induced households to spend an additional \$15 million. Thus the sector alone generated over \$10.6 billion in total output activity or annual gross sales. In addition to its direct employment contribution, over 15,000 jobs were created, and a total of \$8.7 billion in value added activity was generated within the sector.

In addition to its sector-specific contributions, the GNS sector also impacts other sectors. Table 3 presents the indirect effects

of the GNS sector on agricultural services, landscape services, agricultural chemicals, retail trade, wholesale trade, and the real estate sectors. The agricultural service sector includes establishments primarily engaged in performing soil preparation services, crop services, farm labor and management services, horticultural services, among others (USOMB, 1987). The analysis suggests that significant economic linkages exist between the GNS sector and the agricultural services and wholesale trade sectors. Sales in those sectors increased by \$170 million and \$148 million, respectively. Other noteworthy linkages exist with the real estate and agricultural chemicals sectors. Sales in those sectors increased by an identical \$114.8 million.

The size of the economic linkages identified above would depend on the magnitude of the multipliers for the particular sector. Turner and Kriesel (1995) provide Type I multipliers for some of the sectors identified above. Recall that the Type I multipliers measure the direct and indirect effects of a change in economic activity and capture the interindustry or sector effects only; that is industries buying from local industries. According to Turner and Kriesel, the GNS sector has a Type I output multiplier of 2.7779. The magnitude of that multiplier suggests that a \$1 million increase in sales to final demand causes an additional \$1,777,900 in output throughout the U.S. economy.

The indirect value added and employment contributions of the GNS sector are also presented in Table 3. The agricultural services and wholesale sectors received the greatest economic benefit from the GNS sector, with \$138.6 million and \$135.6, respectively. Employment in those sectors also increased by almost 10,000 jobs and over 2400 jobs, respectively. Value added and employment contributions for the landscape services, agricultural chemicals, retail trade and real estate are also presented in Table 3.

The induced effects from household spending are presented in Table 4. From the magnitude of these effects, it is clear that the nonagricultural sectors benefited disproportionately from the activities induced by the GNS sector. For example, induced real estate sector sales totaled almost \$700 million compared to ≈\$15 million for the agricultural services sector. The real estate sector includes real estate operators, and owners and lessors of real property, as well as buyers, sellers, developers, agents, and brokers. The wholesale sector also experienced a significant increase in sales of \$460 million. That sector is primarily engaged in selling merchandise to retailers, industrial, commercial, institutional, farm, construction contractors, or professional business users among others. Other induced impacts are also presented in Table 4.

Table 2. Output, employment, and value-added contributions of greenhouse, nursery, and sod sector, United States.

Activity	Direct	Indirect	Induced	Total
Output (M\$)	9,978.4	693.7	15.4	10,687.5
Employment (#)	220,245	15,311	339	235,895
Value added (M\$)	8,152.7	566.8	12.6	8,732.1

Table 3. Indirect effects of greenhouse, nursery, and sod sector on selected sectors, United States.

Sectors	Output (M\$)	Value added (M\$)	Employment (#)
Agricultural services	169.6	138.6	9829
Landscape service	3.6	2.3	131
Agricultural chemicals	114.8	25.0	346
Retail trade	0.7	0.6	26
Wholesale trade	147.6	135.6	2408
Real estate	114.8	77.9	848

Table 4. Induced effects of greenhouse, nursery, and sod sector on selected sectors, United States.

Sectors	Output (M\$)	Value added (M\$)	Employment (#)
Agricultural services	14.6	12.0	848
Landscape service	17.7	11.1	636
Agricultural chemicals	3.8	1.5	57
Retail trade	194.2	173.8	7005
Wholesale trade	460.0	422.7	7503
Real estate	695.7	471.9	5135

Table 5. Output, value added, and employment activity generated by the greenhouse nursery and sod sector, United States.

Activity	Direct	Indirect	Induced	Total
Output (M\$)	9,978.4	2,573.3	13,622.1	26,173.8
Value added (M\$)	8,152.7	1,616.8	7,923.7	17,693.2
Employment (#)	220,245	40,643	177,846	438,733

The total economic contribution (direct, indirect, and induced) of the GNS sector on the U.S. economy in terms of output, value added and employment is presented in Table 5. The figures represent the total economic impact for the 528 sectors in IMPLAN. Thus the figures in Table 5 represent economy-wide activity and show the significant economic contribution of the sector. For example, in addition to almost \$10 billion in direct output, the GNS sector produced over \$16 billion in indirect and induced output. The value added contribution beyond the direct effect, totaled over \$9 billion, while an additional 218,488 jobs were created throughout the economy. Put differently, output increased 1.6 times beyond initial GNS activity, whereas the value added contributions of the sector increased 1.3 times. The employment contributions of the sector almost doubled. These figures clearly imply that the economic contributions of the GNS sector are very significant.

Summary and Implications

Input-output models, such as IMPLAN, are used extensively to conduct economic impact analysis. These models may provide useful insights into the economic contributions of specific sectors because they allow for various levels of aggregation or disaggregation as needed. The current study uses the 1993 IMPLAN database and IMPLAN version 2, to disaggregate the agricultural sector to specifically examine the economic contributions of the U.S. GNS sector.

The results indicate that the sector alone contributed over \$10 billion in output, almost 236 thousand jobs, and had value added activity of almost \$9 billion. The sector's total impact on the U.S. economy is significant in the size of its various contributions. Total GNS-related economic activity include over \$26 billion and \$17 billion in output and value added, respectively. Of the \$26 billion in output activity, \$16 billion are the result indirect and induced output. In that regard the study extends the work of Harris et al. (1992) and Turner and Kriesel (1995) by including the impact of induced or household effects on the economy. The economic output activity is almost 5 times greater than that found by Harris et al. (1992). In addition to the output and value added economic activity, the sector also contributed over 438,000 jobs to the U.S. economy.

The implications for the growth of the sector and its economic contributions are clear. The analysis shows that the GNS sector has significant linkages to the rest of the economy. Understanding those linkages is critical to gaining important insights into the adjustment process that the GNS sector might undergo as macroeconomic policies are instituted. For example, because of the sector's significant economic linkage to the real estate sector, the decrease in demand for housing as a result of increases in interest rates may decrease demand for GNS products. Conversely, public policies that adversely affect the GNS sector may negatively affect the sectors to which GNS activity is more closely linked.

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