

# **An Economic Impact Assessment of the Green Industry of Virginia**

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## **Abstract**

An analysis of the green industry of Virginia was completed in the year 2002 using a mail survey sent to industry participants. The survey was conducted by the Virginia Agricultural Statistics Service (VASS). This data was used to run an economic impact analysis of the industry using IMPLAN Professional software. Additionally, the software was used to determine the approximate affects of drought and water restrictions on the green industry. VASS received a total of 1,146 surveys for a response rate of approximately 27%. Of these responses, 42 surveys indicated that they plan to have future green industry sales but were not presently involved in the business. Another 525 responses claimed to be no longer actively involved in the industry. Therefore, the actual response rate was much closer to 15%. This necessitated the use of numerous alternative data sources to create a more complete model representation of the green industry as a whole. Two separate model scenarios were created, the first using purely survey response data, the second including data from additional sources and factoring out for possible double-counting errors. Direct employment generated from the industry was predicted to be between 29 and 36 thousand jobs, depending on which model scenario is consulted. The total economic impacts predicted from the different models are \$2.03 billion and \$2.41 billion, respectively. The analysis of the affects of drought and water restrictions predicted a decrease in overall impacts by 33% and 23%, respectively.

## ***DEDICATION***

I dedicate this work to my grandparents, Peter and Paula Coppedge, and memory of my great-grandmother, Helen Brower. These people have shaped and influenced my life in countless memorable ways. Without their constant love, encouragement, and support, I could not be who I am today.

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# Chapter I – The Green Industry

## Background

The green industry is generally defined as those businesses and industries involved in the growth, sale, installation, and maintenance care for plants and landscapes. These plants and services are most commonly used to enhance the interior and or exterior aesthetic appeal of an area, but there are additional benefits as well. Examples of such businesses include producers of green industry goods such as nurseries and greenhouses, firms that provide landscaping services, landscape architects, nurseries, plant and seed distribution centers, and finally, plant retailers. The green industry is also commonly referred to as the ornamental horticulture industry, and the benefits attributed to it, both public and private, are numerous. They include the creation of recreation areas, safer playing surfaces and roadsides, lower cooling and heating expenses, and increases in property values. Because of the rapid increases in demand for these goods and services, over recent years the green industry and ornamental horticulture has been emerging as increasingly important in the United States agricultural economy.

According to the Department of Agriculture, the nursery and greenhouse crops are one of the fastest growing components of US agriculture. Throughout the last decade, the agriculture industry of the United States has undergone massive changes. In recent years, agriculture has consolidated itself into fewer, much larger corporate entities. These larger farms have the ability to produce at lower costs and lower consumer prices, and because of this many of the smaller farms become unprofitable and withdraw from the market entirely. Statistics show the numbers of US farms of all kinds declining over the last few decades, which is a cause of concern for the government. In contrast, the numbers of nurseries and greenhouses have increased nationwide. Revenues in the industry are increasing as well. In 1998 alone, grower cash receipts increased 5% to \$12 billion. These sales accounted for more than one-tenth of total US cash crop

receipts in 1998. The industry's retail sales total between \$100 and \$200 per capita, with total sales exceeding \$54 billion industry-wide<sup>1</sup>. From the consumer standpoint, demand for horticultural products is increasing as well. In 1980, consumers spent an average of \$15 on horticultural products. By 2002, the average per-capita consumer spending was around \$51 a year.<sup>2</sup>

The green industry in Virginia is experiencing these same trends. The number of nurseries and farms growing ornamental plants has increased greatly within Virginia. From 1992 to 1997, glass-enclosed nurseries grew from 592 to 661, over a 10% increase. The number of open farms of this industry almost doubled from 681 farms in 1992 to 1255 farms in 1997<sup>3</sup>. From 1993 to 2000, cash receipts for greenhouse, nursery, and forest products increased from \$100 million to \$179 million. Ornamental horticulture crops have displaced tobacco as the most valuable cash crop in Virginia, accounting for 24.5% of all crop cash receipts compared to 18% for tobacco in 2000.<sup>4</sup>

The rapid growth of this industry is cause for excitement and concern. The growth of any industry is an economic plus, increasing both available employment and economic output of an area. However, growth and cultivation of ornamental plants often involves the introduction of foreign plant species to a different soil environment. This introduction can be demanding in terms of resources, often requiring use of chemicals and machinery and the modification of landscapes to suit the needs of the plants. Water use can be intense, creating a source of waste and runoff pollution. Because this waste can negatively affect both the environment and human health, it is likely that these resources will be subject to additional regulations and restrictions in coming years. Changes in policies, such as zoning, tax, and labor laws have the ability to hinder the

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<sup>1</sup> American Nursery and Landscape Association, WEBSITE: [www.anla.org](http://www.anla.org)

<sup>2</sup>Market and Trade Economics Division, Economic Research Service. *Floriculture and Nursery Crops Situation and Outlook Yearbook*: U.S. Department of Agriculture, FLO-2003, June 2003.

<sup>3</sup> United States Census of Agriculture, Year 1997

<sup>4</sup> Virginia Agricultural Statistics Service (VASS). *Virginia Agricultural Statistics Bulletin and Resource Directory*, No. 75. Richmond, VA, 2001.

industry. To prevent any unnecessary hindrances to the industry, it is important to determine its size and scope, its strengths and limitations, as well as its economic contributions to the Commonwealth of Virginia. Such a study would enable politicians and lobbyists to prioritize which agricultural sectors are most beneficial to the economy and make educated and fair rulings with respect to political and environmental issues. Public support in the form of agricultural research and extension depends on the political strength of an industry. If the economic reach of an industry is well-understood, that industry has a more competitive edge for public research and extension funds.

Another issue that has plagued the green industry in the recent past is the enforcement of water-restrictive mandates during times of severe drought or water shortage. Although these mandates are often necessary evils, they affect the green industry to a much greater extent than the general population. When these restrictive policies are effective, residents of a community are forbidden to do such things as wash cars, fill swimming pools, and water lawns. When people are forbidden to care for an investment like a healthy lawn because of government restrictions, it tends to discourage future investment. These restrictions, in combination with the drought conditions, often cause landscaping industries to lose substantial business, in some cases causing bankruptcy. Additionally, nurseries and greenhouses are often forced to close their doors due to the unpredicted drop in sales from which they often cannot recover. If more attention was given to the effects of these restrictions, perhaps more leeway could be given to water control techniques.

### **Problem Statement**

It is apparent that the green industry has sizeable economic impacts in Virginia. However, this industry's economic impacts have never been comprehensively measured. Landscaping and horticultural services, the sector of the green industry involved with installation and maintenance of horticultural products, has never been adequately considered in existing analyses. Therefore, the extent of

the industry's effects are yet unknown. Because recent statistics have implied a rapid growth in production, researchers are led to believe that the industry may have considerable influence in the marketplace. To date, no prior studies have measured the size of this industry in the Commonwealth of Virginia.

## **Objectives**

The main objective of this study is to assess and quantify the economic impact of the green industry on the economy in the Commonwealth of Virginia. Total impact includes direct industry expenditures, such as incomes of employees of the industry, owners of capital, and total output and sales. Indirect impacts in the form of purchases of inputs and their associated effects on employment and incomes are also important. The induced effects of expenditures created by these earnings and incomes should also be measured. To achieve this general objective, several specific objectives must be met.

- 1) To define what constitutes the green industry in the Commonwealth of Virginia, and assess the size and scope.
- 2) To measure and describe the direct impacts of the industry, focusing on sales, employment, value added, payroll, and tax revenue directly generated through the green industry itself.
- 3) To measure and describe the indirect impacts, defined as input purchases used to create outputs, and the induced impacts, defined as those economic impacts resulting from rounds of spending of incomes and profits caused by the direct and indirect impacts.
- 4) To model the effects of drought and water-restrictive legislation on the green industry.

## **Methods and Procedures**

We begin by measuring the size of the green industry, which entails gathering information on the number of firms, their total sales, and their generated employment. Information regarding the costs, sales, and employment of industry

participants was gathered directly via a written survey. Unfortunately, there are numerous problems with this methodology. Certain sectors are underrepresented in the sample. For example, landscaping firms frequently pay employees under the table, or without taxation, to avoid the hassle of paperwork. Because of this, these businesses are hesitant to answer questions pertaining to their operations and are assumed to be under-represented survey responses. This creates the issue of the sample not being representative of the whole. Because completion of the survey was voluntary and the incentives for completion differ between industry sectors and firms, there is no guarantee that the sample obtained was an accurate representation of the whole.

Therefore, the actual size of the green industry is determined by a combination of several data sources. Available data pertinent to labor can be found through County Business Patterns, or CBP, an annual compilation of the United States Census Bureau. For data on sales, The U.S. Census of Agriculture and the U.S. Census of Horticultural Specialties, both published by the United States Department of Agriculture, will be used. Additionally, the Floriculture and Nursery Crops Situation and Outlook Yearbook, an annual publication of the Economic Research Service, will be used to gain insight into the national green industry and Virginia's relative rank and position. For retail sales, a private publication entitled Nursery Retailer provides relevant data. These sources were combined in a manner that avoids problems of double-counting.

Once the direct impacts have been measured, an input-output model must be constructed to determine the indirect and induced effects. Data will be analyzed using an IMPLAN (impact analysis for planning) input-output model. Input-output analysis is a technique used to define the interdependencies between sectors of an economy at one point in time. Data will be defined according to industrial sector and organized to determine the impact of direct expenditures, employment, and wages. To determine the effects of water restrictions, the overall direct impacts will be modified to account for lost revenues, and the model

will be run again. Input-output modeling uses a matrix framework. The direct impacts of an industry are organized into this matrix by economic sector. Algebraic manipulation of this matrix yields the indirect and induced impacts. This will be explained more thoroughly in Chapter 2.

### **Summary**

This chapter contains an overview of this project and why it is being completed. It highlights the background analysis, problem statement, objectives, and methods and procedures. Subsequent chapters of this analysis will build on the each of these highlights. Chapter 2 will be a more thorough background investigation. Different data sources used in this project will be described in moderate detail. The conceptual framework behind input-output modeling will be explained thoroughly. In Chapter 3, the methods and procedures for structuring the input-output model will be explained in moderate detail. Double-counting issues will be assessed and addressed. Chapter 4 will contain the results of the impact analyses and related discussion.

## Chapter II – Background and Conceptual Framework

### Chapter Overview

The previous chapter contained the research proposal for this study. This chapter builds on the problem statement, background information, and further defines the conceptual framework behind the analysis. In order to understand why an analysis of the green industry in Virginia is needed, it is first important to look at the national green industry using various governmental resources to gain an accurate picture. From there, a specific look at trends within Virginia will help to further understand the major issues analyzed. This chapter also explains how the first objective, defining the green industry, is achieved. An in-depth look at the conceptual framework behind impact analysis and input-output modeling will close the chapter.

### The National Green Industry

The green industry is rapidly expanding at the national level. Perhaps one of the most obvious and easily viewed expansions is the increased prevalence of home and garden centers throughout the country. Within the past decade, stores that retail horticultural goods such as Lowe's, Inc., Home Depot, and Wal-Mart have been erected throughout the United States. In the last year, Home Depot opened over 350 additional stores, Wal-Mart constructed almost 200, and Lowe's opened close to 100 new locations nationwide.<sup>5</sup> Many horticultural products, such as flowers, small plants, trees, shrubs, and other related goods are no longer only sold in nurseries and garden centers, but can also be found in grocery, hardware, convenience, and general merchandising stores, as well as through mail order catalogues, online web services, and roadside stands. Even the numbers of magazines published about gardening and horticulture have doubled since 1997.<sup>6</sup> Gardening has always been a popular hobby and escape, but with cable televisions present in just about every household, interest in this

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<sup>5</sup> Nursery Retailer. *2001 and 2002 Nursery Retailer 100, Ranking of America's Largest Nursery Retailers*

<sup>6</sup> Penn State College of Agricultural Sciences. *Pennsylvania's Green Industry, Its Nature and Contribution to the State's Economy*: Harrisburg, PA, 2002.

activity is at an all-time high. Now we have cable television stations, such as Home and Garden Television (HGTV), and programs such as Martha Stewart Living that focus on gardening and gardening-related activities. With easy access to these programs, as well as the numerous and growing numbers of home and garden magazines, everyone has the ability to learn gardening skills from the best in the business. Additionally, the US population is growing. Because people will often concentrate themselves in and around cities, the increasing population creates an increase in demand for communal recreation areas. This increase in demand has resulted in the creation of numerous parks, golf courses, wildlife preservations, and recreation areas in various places throughout the country, all of which generate additional demand for horticultural goods and services.

The national green industry has become one of the most important components of agriculture in the United States. Unlike most agricultural commodities, the green industry has shown signs of strong growth. For example, between 1982 and 1997, farms of all kinds in the United States decreased in number by approximately 15%. In contrast to these trends, the green industry instead showed an increase in the overall number of farms. From 1992 to 1997, the farms classified to produce green industry goods increased over 30% to a total of 67,816 farms.<sup>7</sup>

The green industry provides benefits to society that other agricultural commodities do not. The aesthetic benefits are the easiest to see. Everyone would rather look at a beautifully manicured lawn than one that is poorly maintained. In fact, a recent Gallup Organization poll found that landscaping contributes significantly home value, accounting for between 7 and 15% of the total sale value. Additionally, houses with well-manicured lawns sell up to three times faster in the marketplace. These trends have encouraged businesses to

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<sup>7</sup> 1997 Census of Agriculture, The United States Department of Agriculture. AVAILABLE: <http://www.nass.usda.gov/census/>.

invest in landscaping and landscape architecture with the hopes of increasing the aesthetic appeal of the workplace.

The population in the United States is ever-increasing, and this creates proportional economic growth, which means new places of residence and business must be constructed. Nowadays, many locations employ community planners, whose main purpose is to keep the area beautiful. Often, when an architectural plan for a new construction is proposed to a city council, it must also contain a plan for the landscape design and architecture as well. Monetary benefits accrue to businesses and households that incorporate landscape architecture as a tool for remedying cooling costs. Strategically placed trees can reduce the need for extensive air conditioning by obstructing direct sunlight. In fact, it is estimated that a healthy lawn has the cooling capabilities of a one-ton air conditioner.

For many years, the importance of the green industry was grossly underestimated. Although the United States government sponsors the regular publication of many national databases, none of them include thorough investigations of the green industry. For example, landscaping and service firms have never been accounted for in most governmental investigations (such as the Census of Agriculture) because they are not categorized as producers of an agricultural product, yet they are an important aspect of the green industry as a whole.

In 1989, the Oregon Association of Nurseries (OAN) decided to conduct the first statewide in-depth investigation of the green industry. Their goal was to uncover the size and importance of the green industry to the economy of the state of Oregon through a detailed survey of industry participants.<sup>8</sup> The findings of this project were monumental for the green industry nationwide. Within several

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<sup>8</sup> Hannon, Clayton W. *Little Did They Know Then . . . Foresight of Survey Pays Off*: The Digger, November 1998, p. 62.

months of publication, the Oregon green industry went from a relatively unknown component of the state economy to a recognized important contributor and major player. Presently, the ornamental horticulture industry is the state's number one agricultural commodity, and this is recognized largely because of ONA's foresight to complete the original investigation. This study has led many subsequent Oregon studies and has inspired other states to conduct similar investigations into their own green industries.

Inspired by this analysis, subsequent years have produced many additional state analyses of their respective green industries. However, they often cannot be accurately compared. Each state structures its investigation according to its own methodology and often defines its green industry differently from other analyses. The table below illustrates examples of these state analyses and their findings. It is adjusted to 2000 dollars because the data used to determine the number of households per state was most recently published by the Economic Census Bureau in that year.<sup>9</sup>

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<sup>9</sup> All statistics pertaining to number of households, household incomes, and other general demographic information on a per-state basis was found through fact sheets available through the Economic Census Bureau. AVAILABLE:[http://factfinder.census.gov/servlet/QTGeoSearchByListServlet?\\_lang=en&\\_ts=106002725391](http://factfinder.census.gov/servlet/QTGeoSearchByListServlet?_lang=en&_ts=106002725391).

Table 2.1: Green Industry Assessments on a Per-Household Basis by State in 2000 Dollars

State	Total Sales	Per Household Sales	Employment Generated	Per Household Employment
California <sup>10</sup>	11,422,000,000	992.18	145,591	0.01
Idaho <sup>11</sup>	684,729,770	1456.46	133,349	0.03
Ohio <sup>12</sup>	2,709,127,296	609.26	93,871	0.02
Maryland <sup>13</sup>	1,152,730,216	581.66	14,798	0.01
Nevada <sup>14</sup>	730,460,013	971.39	15,295	0.02
Pennsylvania <sup>15</sup>	1,446,957,878	302.76	71,158	0.02
Florida <sup>16</sup>	2,976,270,000	469.36	179,781	0.03

### National Data Sources and Virginia’s Green Industry

Growth in the green industry differs greatly between states for many reasons, including climate differences, social changes, and variance in economic situations. To compare Virginia to the national green industry, several data sources can be utilized. National databases offer information about selected aspects of the green industry and offer regional and statewide comparison statistics. General data sources include the U.S. Census of Agriculture, the Census of Horticultural Specialties, The Floriculture and Nursery Crops Situation and Outlook Yearbook, and County Business Patterns. Although few sources have data relevant to the entire industry, each provides enough insight for the formation of a general picture.

The U.S. Census of Agriculture provides data on the ever-changing face of agricultural production in this nation. The Department of Agriculture (USDA) and the National Agricultural Statistics Service (NASS) conduct this census every five years. Information is collected from all farms in the United States that produce

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<sup>10</sup> Templeton, Scott R, Cheryl Brown, George E. Goldman, Seung Jick Yoo, and Vijay S. Pradhan, *An Economic Analysis of Environmental Horticulture with a Focus on California*: Department of Agricultural resource Economics and Policy, Berkeley, CA, October 2000.  
<sup>11</sup> Social Science Research Unit. *The Green Industry of Idaho*. Moscow, ID, 2001, p. 3.  
<sup>12</sup> Ohio Nursery and Landscape Association, *Green & Growing, Ohio’s Nursery and Landscape Industry*: Westerville, OH, 2002, p. 2.  
<sup>13</sup> Maryland Agricultural Statistics Service, *The Maryland Horticulture Industry, A Statistical Profile and Economic Survey*. Baltimore, MD, 2000, p. 7.  
<sup>14</sup> Drew, Debra Rae and The Nevada Landscape Association, *Our \$1.3 Billion Green Industry*. Reno, NV, 2001, p. 4.  
<sup>15</sup> Pennsylvania, p. 28.  
<sup>16</sup> Hodges, Alan W. and John J. Haydu, *Economic Impacts of the Florida Environmental Horticulture Industry, 2002*: University of Florida Institute of Food and Agricultural Sciences, Gainesville, FL, April 2002.

agricultural products with a total value of \$1000 or more per year. Relevant to this analysis is the category of “nursery and greenhouse crops.” Subsets of this category are floriculture crops, bedding, foliage and potted plants, cut flowers, vegetable and flower seeds, cut Christmas trees, sod, and mushrooms. According to these statistics, Virginia is not one of the leading states in production of nursery and greenhouse crops, but it does rank higher than most – 21<sup>st</sup> in the nation in terms of grower cash receipts. The top five producing states in the field of environmental horticulture are California, Florida, Oregon, Pennsylvania, and Texas, respectively. According to census data, there were over 5700 horticultural farms in California in 2002, around four times the amount of similar farms in Virginia. Horticultural and nursery products ranked fifth in Virginia’s agricultural economy in 1997, bringing in a little over 7% of statewide agricultural sales.

The industry has grown remarkably in recent years. Within the last five years, the number of farms producing horticultural or greenhouse goods in Virginia has increased from 618 (1997) to 1541 (2002). Land in cultivation has increased sizably as well, going from 848 acres in 1997 to 19,830 acres in 2002, over a 95% increase<sup>17</sup>. Virginia’s green industry stands to make a sizeable impact. Table 2.2 summarizes the findings of the most recent agricultural census, 2002.

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<sup>17</sup> USDA-NASS Census of Agriculture, 1997 and 2002. AVAILABLE: <http://www.nass.usda.gov/census/>

Table 2.2: Nursery, Greenhouse, Floriculture, Mushrooms, Sod, and Vegetable Seeds Grown for Sale in Virginia 2002

Crops	Under Glass or Other Protection		In the Open	
	Farms	Square Feet	Farms	Acres
Nursery, greenhouse, floriculture, aquatic plants, mushrooms, flower seeds, vegetable seeds, and sod harvested	698	16,820,158	843	19,830
Floriculture crops - bedding/garden plants, cut flowers and cut florist greens, foliage plants, and potted flowering plants	508	10,902,336	324	828
Bedding/garden plants	427	6,767,815	195	415
Cut flowers and cut florist greens	25	220,630	95	308
Foliage plants	45	493,484	19	38
Potted flowering plants	179	3,420,407	73	67
Aquatic plants	23	343,114	17	29
Bulbs, corms, rhizomes, and tubers-dry	4	49,820	17	[D]
Flower seeds	5	1,584	2	[D]
Greenhouse vegetables	52	1,754,889	[X]	[X]
Mushrooms	12	61,790	[X]	[X]
Nursery stock	157	2,986,186	481	11,062
Vegetable seeds	17	40,930	12	44
Other nursery and greenhouse crops	79	679,509	56	513

Source: USDA Census of Agriculture 2002

The Census of Horticultural Specialties is another census carried out by the USDA and NASS. This census has been completed every ten years since 1948, the most recent data from 1998. The purpose of this census is to gain a comprehensive picture of the United States horticultural industry. Operations included in the Horticultural Specialties census are those operations responsible for the production, growth, or sale of \$10,000 or more horticultural specialty products during 1998. Similar to the Census of Agriculture's definition for nursery and greenhouse crops, those products considered horticultural specialties are floriculture, nursery, and other specialty crops, sod, mushrooms, food crops produced under glass or other protection, transplants for commercial production, and seeds. The interesting comparison between the Census of Horticultural Specialties and the Census of Agriculture is the difference between operation sales. For an operation to be included in the Census of Agriculture, their gross sales have to total a minimum of \$1000, whereas the Census of Horticultural Specialties' requirement is \$10,000. Therefore, a comparison of the number of farms can yield an estimate for the percentage of operations that fall between \$1000 and \$10,000 in annual sales. In 1998, 234 farms in Virginia produced

more than \$10,000 in annual sales<sup>18</sup>. According to the Census of Agriculture for 1997, there were 618 horticultural farms in Virginia. Therefore, approximately 62% of Virginia horticultural operations have annual sales somewhere between \$1000 and \$10,000. Proportionally, approximately two-thirds of Pennsylvania's green industry also falls into this category.<sup>19</sup>

The Floriculture and Nursery Crops Situation and Outlook Yearbook is an annual publication of the Economic Research Service, published for the first time in the fall of 2000. The publication draws heavily from The Census of Horticultural Specialties, which is used to determine what known growers and cultivators of floriculture and nursery crops are surveyed. This survey is also conducted by the National Agricultural Statistics Service and covers both wholesale and retail trade by state and product type. This publication differs from the others in that only firms with net sales of over \$100,000 annually are asked to provide detailed sales statistics. Therefore, this dataset only accounts for the top 36 states in horticultural production. This data source is useful for predictive purposes, as well as for an accurate picture of state rank and sales according to the top tier of industrial participants. It accounts for the same plant categories as both the agricultural and horticultural censuses, but excludes the categories involving seeds and food crops. The charts below were created using data found in this publication and provide additional insight into the continuously growing green industry, both in Virginia and nationally. According to this publication, statewide sales of horticultural products in Virginia have increased 73% between the years of 1993 and 2002. Nationwide sales have increased 68% over that same time period, suggesting that Virginia's green industry is growing at a slightly more rapid rate.<sup>20</sup>

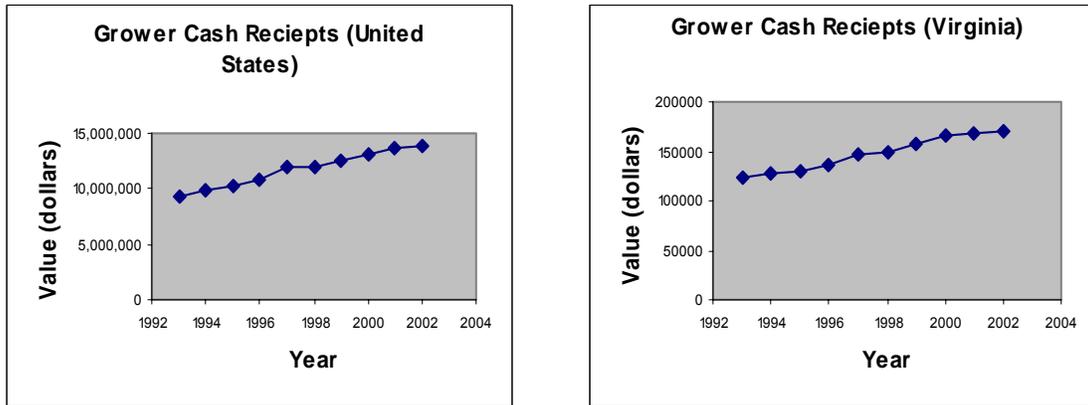
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<sup>18</sup> USDA-NASS Census of Horticultural Specialties, 1998. AVAILABLE: <http://www.nass.usda.gov/census/census97/horticulture/horticulture.htm>

<sup>19</sup> Pennsylvania p. 6.

<sup>20</sup> Market and Trade Economics Division, Economic Research Service. *Floriculture and Nursery Crops Situation and Outlook Yearbook*: U.S. Department of Agriculture, FLO-2003, June 2003, p. 11.

Figure 2.1: Annual Expenditures on Green Industry Goods, adjusted for Inflation



*County Business Patterns* are an additional national dataset compiled by the United States Census Bureau on an annual basis. The patterns offer insight by investigating the number of business establishments, total number of employees, both full and part-time (on March 12), and relevant payroll data, sorted by NAICS codes.<sup>21</sup> CBP data does not include statistics on the self-employed, those employed by private households, railroad workers, and most government employees. This data source provides insight into the retail aspect of this industry through employee and payroll statistics. It also estimates the total number of retailers statewide. CBP data helps to determine the approximate number landscaping industries statewide, as well as the number of people they employ, although it is likely that some smaller, independent landscaping industries are left out because those who are self-employed are not accounted for in this database. The table below is an example of the data obtained from CBP databases.

<sup>21</sup> Standard Industrial Classification (SIC) codes were converted to the North American Industry Classification System (NAICS) in 1997

Table 2.3: Employment and Payroll Data, Virginia

Industry	# Employees for week including March 12	First Quarter Payroll (\$1000)	Annual Payroll (\$1000)	# Establishments
Flower, nursery stock, florists' supplies wholesale	729	3244	14150	67
Home Centers	10939	61968	270416	137
Hardware Stores	2461	10436	43745	271
Nursery and Garden Centers	5033	21998	97265	445
Grocery (except convenience) Stores	61856	263818	1040222	1642
Florists	3642	12017	50187	628
Landscape Architectural Services	1279	6499	32711	163
Landscaping Services	16099	71736	359792	1923

Source: County Business Patterns, 2001

### Background into Water Use, Drought, and Restrictive Policies

The earth is considered a water planet – over 70% of the earth’s surface is water. It would appear as though there is a great abundance of water available, but this unfortunately is not the case. Over 97% of the earth’s water supply is ocean, which leaves a mere 3% freshwater. To make matters worse, of that 3%, less than 0.3% of the supply is considered renewable, meaning from a lake, river, or stream. The remainder of the world’s freshwater supply is located in glaciers (69%), groundwater (30%), and other places such as soil moisture, ground ice, permafrost, and swamp water.<sup>22</sup> Many countries, such as Kuwait, Saudi Arabia, and Israel are forced to rely on non-renewable sources, such as groundwater, to sustain their needs because of the lack of renewable freshwater in their geographic vicinity.

The United States has within its borders an abundance of freshwater resources, but unfortunately the resources are often stretched beyond capacity where population grows at a faster rate than water is restored. Areas with more severe water strain have devised plans for water use and allocation, often by instating various demand side management policies to reduce water use area wide. These policies include increasing the per-unit cost of water, sometimes uniformly but often in an increasing block fashion, meaning that the water costs rise as

<sup>22</sup> Shiklomanov, Igor, *World Fresh Water Resources, Water in Crisis: A Guide to the World’s Fresh Water Resources*. Peter H. Gleick, ed., 1993.

more water is used. These areas often create rebate incentives for the purchase of technology such as low-flow shower heads or toilets. When extreme circumstances present themselves, water use is sometimes rationed with penalties for exceeding your predisposed amount. Water restrictions are a type of water ration that prohibit water use by restricting when and how water resources can be employed.

Most regions of the Eastern United States are only faced with severe water strain during times of intense drought. Therefore, few of these states devise water allocation plans. In fact, they rarely focus on water demand side management until the municipal water supply levels get dangerously low. Then, city officials turn to restrictive policies in times of dire need. Often they issue executive orders or mandates temporarily banning the use of water for certain activities. These policies can be unfairly detrimental to certain economic sectors because of their reliance on water availability. The green industry, especially businesses providing landscaping services, is one of the economic sectors most heavily affected by these restrictions.

Over the summer of 2002, Virginia suffered through the climax of one of the worst droughts in over 50 years. Farmers' crops were affected, cornfields were yellow across the state, and many tobacco crops failed entirely. Those farmers who were lucky could maintain some irrigation with well water, but the severity of the drought caused many wells throughout the state to dry out. Because of the failed crops, feed for livestock was greatly reduced. Many farmers were forced to sell off their livestock earlier and with more prevalence than had been planned in order to stay afloat. Because few people willingly invest in goods with an uncertain future, nurseries and greenhouses saw a dramatic change in sales. By August, the rain still had not come. Throughout previous weeks, several cities and localized areas had enforced water restrictions in their own regions to

preserve existing water supplies. However, on August 30, 2002<sup>23</sup>, the entire state of Virginia (excluding DC suburbs and the southwestern tip of the state) was put into level III water emergency, instating a ban on all water use for washing cars, filling pools, and watering lawns. Although this water ban did not last long, the green industry was heavily affected. The restrictive mandates along with the drought itself caused several nurseries and greenhouses to suffer such a loss of business that they were forced to close their doors permanently. The landscape industry was hit hard as well, some firms losing as much as half or more of their business. This water use ban was lifted on November 12, 2002, lasting a little over two months.<sup>24</sup> Although the water ban was only temporary, in combination with the drought, it compounded water availability issues, having significant and lasting effects on the functional green economy.

Virginia's latest drought was longstanding, lasting the better part of three years before water restrictions were considered or enforced. It is important to clarify that it is a combination of both the drought and the restricted water use that negatively affected sales in the green industry as a whole. Water restrictions are not the only cause for the lost revenue, but they are responsible for compounding the problem during their enforcement. Separating out the impacts of the drought from the impacts of the water ban would be virtually impossible. Therefore, this research aims to determine the overall affects of the 2002 drought on the green industry of Virginia, with full knowledge that a variety of different components are responsible for the loss in revenues and business.

### **The Green Industry Defined**

The first objective of this research is to define what businesses are encompassed by the general "green industry" definition. The green industry includes a diverse range of businesses involved in production, wholesale, and retail trade. An in-

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<sup>23</sup> Hardy, Michael. *Warner Imposes Water Restrictions; His Order Supersedes Limits Already Imposed by Localities*. Richmond Times Dispatch, August 31, 2002, Pg. A-1

<sup>24</sup> Davis, Laura. *Virginia Eases Water Restrictions*. The Associated Press State and Local Wire, November 12, 2002.

depth look at the production and retail sectors is necessary, as well as a close examination of the interactions between them. Maintenance operations should be considered because they are suspected to be a significant component. Maintenance sectors are often left out of the data collection process when considering agricultural commodities. For example, the Census of Agriculture and the Census of Horticultural Specialties both survey cultivators of ornamental plants. However, many landscaping industries are involved in not only maintaining these plants, but also in their growth and sale. Because these industries are categorized as service industries under the industrial classification system, they are not included in these governmental investigations. Therefore, it is surmised that the green industry is greater in size and scope than currently measured.

The green industry will be categorized into four different industrial sectors – growers and wholesalers, re-wholesalers, retailers only, and landscaping and horticultural services. There are many hybrid businesses, such as landscape designers that grow and sell a few plants, contract to do the planting itself, and even maintain the site afterwards. This hybrid data can be difficult to filter out and therefore lead to double counting, so adequate precautions will be taken to separate the data accordingly. There is also a flow of plant materials in and out of the state that must be accounted for, as many industrial participants buy and sell finished plant products from other states.

#### The Role of the Growers and Wholesalers:

Growers are responsible for the initial growth and cultivation of the products. The growth sector is further divided into sub-categories, consisting of tree production, nursery and floriculture production, and Christmas tree cultivation. The tree production sector includes field-grown or in-container nurseries, used most often in tree and shrub cultivation. The nursery and floriculture production sector encompasses bedding plants, foliage plants, various potted plants, cut flowers, and other horticultural goods most often grown in greenhouses. Many firms have

facilities for field-grown plants as well as greenhouse crops. Therefore, these different sub-categories can exist separately or together, depending on the size and scope of the growth operation.

Frequently, these producers sell not only to retail, wholesale, and maintenance firms, but also directly to consumers. To be categorized as a grower, the firm must cultivate at least a fraction of the products it sells. The production sector is comprised of many different size firms, from the smaller, family-run businesses to larger scale corporate entities.

Growers are often also categorized as wholesalers as well. Firms are considered to be wholesale producers when some amount of goods is sold to another company at a discounted price. The amount sold wholesale tends to be greater than the amount sold retail, but this is not necessarily true. The wholesale sector of this industry often interacts with other growers, selling to them as well as to retail establishments and consumers. Wholesale goods differ from retail goods only through pricing, and include inputs needed for production such as fertilizers, various chemical applications like pesticides and herbicides, containers, and tools. Because the products sold by wholesalers are often manufactured and not cultivated, wholesale operations are often much larger and sometimes corporate firms.

#### The Role of the Re-Wholesaler:

Re-wholesalers are more commonly referred to as distribution centers. These market participants purchase plants and other horticultural products from the growers and other wholesalers and sell them to the retail sector at a slight markup. This sector of the green industry economy is becoming increasingly important, as many larger retailing firms purchase plants from distribution centers rather than the growers themselves. Often, distribution centers are classified as mail order establishments, providing horticultural goods through catalogue sales and discounted prices.

### The Role of the Retail Sector:

Horticultural goods are sold through a fairly well-defined market that consists mainly of home and garden centers, large-scale hardware stores, grocery stores, florists, and discount retail merchandizing stores. These businesses purchase the plants and horticultural goods they sell from wholesalers, re-wholesalers, and growers and are not in the business of cultivating the plants themselves.

However, they may extend some labor to continued maintenance of plants in their inventory. They are sometimes involved in value-added processes such as replanting or repackaging and contribute a great deal of added revenue to the green industry through markups and creation of additional employment.

### The Role of the Landscaping and Horticultural Services Sector:

Covered under this sector of the green industry are landscapers, landscape architects, and grounds and maintenance crews. This sector is responsible for installing and maintaining green products. Although they are not in the business of cultivating plants, they frequently act as product retailers. These industry participants not only maintain grounds and landscapes, but also sell and install the products they maintain. In addition to installing green products, landscape architects are responsible for the construction of outside decks, patios, pools, and various other enclosures. Businesses involved in tree removal and maintenance are also included in this sector. Although these activities seem unrelated to the green industry, these businesses are included in the analysis because they are responsible for installation and maintenance for green products in addition to the hardscape installations.

### **What Influences the Economy?**

The overall economic impact of any firm, industry, or group of industries is made up of three components: direct, indirect, and induced impacts.

Direct impacts are defined as the value of industrial output, the employment, and the total income generated by a particular sector. Data on these impacts is often generated through direct observation and can be obtained through measuring an industry's expenditures, profits, and payroll. Data are often reported in terms of sales, employment, or value-added. Quantifying the direct impacts is the first step in an input-output analysis because they drive the rest of the model.

Industries conduct thousands of transactions every day with other businesses, consumers, and governments. Although many of these transactions in fact seem unrelated, they are the backbone to a functional economy; they form the linkages that create the multiplier effects, or the effects the final demand of one industry has on others and the economy as a whole. Activity in one industrial sector often influences another, sometimes substantially. This happens through what can be referred to as input linkages. When businesses produce intermediate goods, they use inputs that are also manufactured or produced. These inputs themselves may be manufactured and their purchase leads to additional economic activity.<sup>25</sup> Indirect impacts are caused by the infinite rounds of expenditures created by production of a final good or service. For example, the greenhouse industry must purchase plastic containers, a manufactured good, for many types of plant species. If a specific greenhouse suddenly faces an increase in demand for their plant products, they must in turn purchase additional plastic containers to continue the growth cycle. This creates an increase in demand for plastic containers, and therefore an increase in demand for everything involved in their manufacturing process. Although the inputs for that process do not relate directly to the industry in question, they are affected by changes in demand for their product. These impacts are therefore considered indirect impacts.

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<sup>25</sup> Input purchases by firms are sometimes referred to as “backward linkages”

Induced impacts are generated through spending and investment from wages, salaries, and profits resulting from the direct and indirect impacts. Input-output models are a means of capturing these linkages within an economy.

### **Input-Output Analysis**

Input-output analysis can be used to estimate the total change in economic activity that results from a change in the local economy. In an input-output model, direct, indirect, and induced impacts are assumed to be created by a change in final demand, which consists of industrial, household, governmental, and foreign demand. Final demand is assumed to be determined by forces external, or exogenous, to the model, such as government policy or exports from the economy. For each sector in the economy being modeled, we assume that the output from that sector is produced with a specific set of inputs.

Input-output is based on the theory of perfect competition, specifically the idea that with a perfectly competitive industry, the costs of production equal the revenue generated from product sales. The revenue generated is determined by adding together all values generated from product sales. Profits to an industry are defined as the difference between the total costs to that industry and the total revenue generated by product sales. If an industry is perfectly competitive, the marginal costs of production will equal the unit price of the good produced. One of the fundamental assumptions allowing input-output analyses is that the amount of product produced is determined by the amount of that product demanded.

In a perfectly competitive industry, the producer's supply is perfectly elastic. This means that there is no change in price when the level of production changes. Graphically, this is a horizontal supply curve. In other words, there are no constraints on the supply of a product that would drive up the costs of inputs as production increases. Input-output analysis assumes supply is perfectly elastic, and production adjusts to meet demand without affecting prices of inputs or final

products. The models represent the current status of the economy in question only, meaning that no growth or investment activities are included in the analysis. This is what is called a static equilibrium model.

Another aspect of input-output analysis is accounting for transactions, or the flow of factors and products between sectors. These include governments and households, and are measured in dollars. An important fundamental assumption in this modeling technique is that all transactions are fixed and proportional to the value of the product being produced. A pertinent example would be the cost of plastic containers in the greenhouse industry. The dollar amount spent on plastic containers is assumed to be a fixed proportion of the dollar amount of greenhouse plants produced. In input-output modeling, there is no substitution between inputs and no economies of scale in production.

An input-output model breaks an economy into sectors, each producing a good or service with a specific set of inputs. The model can be represented in matrix form. Solving the set of material balance equations by setting the value of the inputs equal to the value of the outputs generates the multipliers. In this analysis, the green industry was broken down into 4 different economic sectors. These sectors are: 1) Growers; 2) Wholesalers and Re-Wholesalers; 3) Retail Sale; 4) Landscaping and Maintenance. With IMPLAN, the input-output modeling software used in this analysis, the sectors that account for these industries include: Greenhouse and Nursery Products, Landscape and Horticultural Services, Wholesale Trade, Building Materials and Gardening Centers, General Merchandise Stores, Food Stores, and finally Miscellaneous Retail.

### Structuring the Model<sup>26</sup>

There are three components to any input-output model – the transactions table, the direct requirements table, and the total requirements table.

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<sup>26</sup> The structure for this section was modeled after a similar derivation in the IMPLAN manual, Chapter 15.

Figure 2.2 represents a transactions table based on a one-year time frame. There are three industrial sectors in this illustrative model: A, B, and C. The rows represent sales of outputs, whereas the columns represent purchases of inputs.

Figure 2.2: Transactions Table (\$millions)

	<b>A</b>	<b>B</b>	<b>C</b>	<b>Final Demand</b>	<b>Total Output</b>
<b>A</b>	8	4	4	4	20
<b>B</b>	5	4	8	7	24
<b>C</b>	4	9	2	11	26
<b>Final Payments</b>	3	7	12	0	
<b>Total Input</b>	20	24	26		70

A transactions table shows the monetary flow of goods and services in an economy over a certain time period. Each industry is represented by a row and a column. The table itself shows the transactions that industries make through buying goods or services from other industries. Reading the table vertically, it accounts purchases made by one industry from another. In this example, industry A purchases \$8 million from other A industries, \$5 million from B industries, and \$4 million from C industries. Additionally, the transactions table accounts for factors or values outside the intermediate production process. These are accounted for in the Final Payments row and include value-added expenses such as labor, interest payments, taxes, and profits.<sup>27</sup> Industry A makes \$3 million of these payments according to the table. Total industry outlay consists of all the expenditures that are made to produce that industry's good. In this example, industry A has an outlay of \$20 million.

Reading the table horizontally shows where the sales for these particular industrial products are. In this example, industry A sells \$8 million of its own output to itself, \$4 million to industry B, and \$4 million to industry C. The final demand column refers to sales to final consumers. As stated in the fundamental

<sup>27</sup> In this example we have aggregated all these effects into one row; however they can be disaggregated into different categories such as wages paid, profits, value added, etc.

assumptions of input-output modeling, the total value of inputs for each industry equals the total output.

In order to make the geographic scope of a model clear, it must be regionalized. This involves what are called regional purchase coefficients (RPCs), which tell the model what percentage of goods are purchased from sources within the area of the analysis. For example, if there is \$1 of local need for a specific good and an RPC coefficient of 0.25, this means that 25% of that need is met through local manufacturers or producers. The remaining 75% of local need is imported from other regions. RPCs are generally derived using regional characteristics through an econometric model. Every commodity has a separate derivation equation and therefore an individually-derived RPC value. A coefficient, by definition, means a factor of a product. Regional purchase coefficients, therefore, must be multiplied by the final demand for a product to determine its regional purchases.

Figure 2.3 represents the direct requirements table for the transactions table in Figure 2.2. The direct requirements table is derived from the transactions table by dividing each industry column element by the column sum.

Figure 2.3: Direct Requirements Table

	<b>A</b>	<b>B</b>	<b>C</b>
<b>A</b>	0.4	0.167	0.154
<b>B</b>	0.25	0.167	0.308
<b>C</b>	0.2	0.375	0.077
<b>Final Payments</b>	0.15	0.292	0.462
<b>Total Input</b>	1	1	1

The resulting coefficients (represented by the shaded area) are referred to as the A Matrix. The columns corresponding to each industry represent that industry's production function, or where and in what proportions an industry spends its money to generate one dollar of output. For industry A, for every dollar of output, \$0.40 is spent within the industry, and \$0.15 of that dollar is invested in value-added activities.

## Deriving Multipliers

There are three types of multipliers derived through input-output modeling. Type I multipliers show how much an industry's output will change for a given change in final demand, but does not include final payments and their impact on an economy. Type II multipliers have the same function as type I multipliers, but in addition to the inter-industry transactions, type II multipliers also encompass household income and expenditures. The final type of multipliers calculated from this matrix framework are called type SAM multipliers, where SAM stands for Social Accounting Matrix. Type SAM multipliers include other institutions such as state and local government, as well as the inter-industry transactions used to derive type I multipliers and the household income and expenditures used to derive type II multipliers. They are called type SAM multipliers because they use all social accounting matrix information to generate the model.

All multipliers are derived from algebraic manipulation of the A matrix, but type II and SAM multipliers include more information and therefore invert a larger matrix. Type I multipliers are the most basic and therefore the easiest to derive. Refer to the A matrix derived in figure 2.2. The first step is to separate the matrix into a series of linear equations. In matrix notation, the equation is:

$$X = A * X + Y$$

This states that the output (X) is equal to the transactions (A\*X) plus the final demands (Y). In matrix format, this is written:

$$\begin{vmatrix} X1 \\ X2 \\ X3 \end{vmatrix} = \begin{vmatrix} 0.4 & 0.167 & 0.154 \\ 0.25 & 0.167 & 0.308 \\ 0.2 & 0.375 & 0.077 \end{vmatrix} * \begin{vmatrix} X1 \\ X2 \\ X3 \end{vmatrix} + \begin{vmatrix} Y1 \\ Y2 \\ Y3 \end{vmatrix}$$

When you subtract the transactions (A\*X) from both sides, the matrix becomes:

$$\begin{vmatrix} Y1 \\ Y2 \\ Y3 \end{vmatrix} = \begin{vmatrix} X1 \\ X2 \\ X3 \end{vmatrix} - \begin{vmatrix} 0.4 & 0.167 & 0.154 \\ 0.25 & 0.167 & 0.308 \\ 0.2 & 0.375 & 0.077 \end{vmatrix} * \begin{vmatrix} X1 \\ X2 \\ X3 \end{vmatrix}$$

The linear equations resulting from this subtraction are:

$$Y1 = (1 - 0.4)X1 - 0.167X2 - 0.154X3$$

$$Y2 = -0.25X1 - (1 - 0.167)X2 - 0.308X3$$

$$Y_3 = -0.2X_1 - 0.375X_2 - (1 - 0.077)X_3$$

Re-written in matrix form, this shows the formation of the identity matrix:

$$\begin{vmatrix} Y_1 \\ Y_2 \\ Y_3 \end{vmatrix} = \begin{vmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{vmatrix} - \begin{vmatrix} 0.4 & 0.167 & 0.15 \\ 0.25 & 0.167 & 0.31 \\ 0.2 & 0.375 & 0.08 \end{vmatrix} * \begin{vmatrix} X_1 \\ X_2 \\ X_3 \end{vmatrix}$$

In matrix notation, this is represented by the equation:

$$(I - A) * X = Y$$

Solving this equation for X, which represents the output, involves multiplying both sides of the equation by the inverse of the (I - A) matrix. This is often referred to as the Leontief Inverse. The resulting equation in matrix notation is as follows:

$$X = (I - A)^{-1} * Y \text{ OR}$$

$$\Delta X = (I - A)^{-1} * \Delta Y$$

This equation is referred to as the predictive multiplier model. It shows how output will change with a given change in final demand. The (I - A) inverse is the matrix of type I multipliers.

Figure 2.4: Type I Output Multipliers Table

	<b>A</b>	<b>B</b>	<b>C</b>
<b>A</b>	1.853	0.273	0.218
<b>B</b>	0.48	1.483	0.415
<b>C</b>	0.207	0.543	1.299
<b>Type I Multiplier</b>	2.54	2.299	1.932

Reading this table, for a one dollar change in Industry A's final demand, the response is a 1.853 dollar change in Industry A's output, a 0.48 dollar change in the output of Industry B, and a 0.207 dollar change in the output of Industry C. The final economy change in output is \$2.54 for that same \$1 change in final demand. This number, 2.54, is the multiplier for Industry A. To derive type II and type SAM multipliers would involve the inversion of a more complicated matrix because there would be more industry sectors encompassing household expenditures (type II and SAM) and government expenditures (type SAM).

### Limitations of Input-Output Modeling

Although input-output models are useful in accounting for transactions between industries, several economic factors are not included in this modeling technique. Input-output models are closed economic models based on a standard

accounting framework which must balance. Therefore, these models cannot account for factors that do not flow through markets, such as environmental costs and other externalities, opportunity costs, or the expansion of businesses and various social changes brought on by an increase in activity in an area.

The assumptions behind input-output modeling are restrictive. An assumption of this modeling technique is that manufacturers produce their outputs with a specific set of inputs. In reality, manufacturers constantly revamp their processes, substituting one input for another according to costs and availability. Input-output modeling, however, does not allow for substitution. Realistically, a supply curve is never perfectly elastic because there are always constraints on the continued supply of any good. Therefore, all economies are subjected to extraneous price fluctuations having nothing to do with the final demands on a product. Production has many non-market impacts in addition to those impacts with a market value. Externalities such as pollution, opportunity costs of laborers, and other similar economic phenomena cannot be included because they are not seen as a direct cost or input to the production process. Input-output models take a snapshot of an economic situation over a defined period of time. These and many more extraneous influences cannot be accounted for in the rigid matrix framework of input-output modeling.

### **Chapter Summary**

This chapter began with a summary of the national and statewide green industry. Methods for obtaining additional data were discussed. Useable governmental datasets providing additional insight into the industry were described in moderate detail. Following that, a brief background into water use and restrictive policies was discussed. The green industry was defined according to its economic sectors. A description of basic input-output modeling was provided, including an investigation of the assumptions behind the model itself.

## **Chapter III – Methods and Procedures**

### **Chapter Overview**

In this chapter, the model scenario is constructed, first explaining the role of the primary data and then detailing how the generic input-output model is regionalized. The methodology chosen for primary data collection will be described in detail. Additionally, the process of dealing with holes in the primary data, including additional estimates, tabulation procedures, sources of secondary data, and how these data are used will be discussed. Finally, the procedures for modeling using input-output modeling software, IMPLAN Professional, will be explained. The model will be analyzed using this software to achieve objectives two and three, assessing the direct, indirect, and induced impacts of the green industry on the economy of Virginia. It is important to note that all data is converted before use to the base year of 2002.

### **Scenario Construction**

Input-output models are frequently used to determine how much economic activity a business would generate in a specific area if a new plant was built or a new restaurant constructed. However, in this specific analysis, we wish to model the economic activity generated by an entire industry. In order to do this, we have to assume that the entire green industry of Virginia is lumped together to form a large one-time economic stimulus. We model what economic activity would be lost to the state if this industry was not a part of Virginia's economic structure. Economic activity would still exist, but because the demand for green industry goods would be met through imports rather than regional production, areas outside Virginia would reap the benefits. Model accuracy depends highly on accurate estimation of both the direct impacts and the regional purchase coefficients, both of which represent the final demand in the model itself.

Input-output analysis places a lot of focus on final demand as a driving force in the model. Final demand is defined as the demand for a product or service, also

referred to as final consumption. The final demand values on a sector are represented in an input-output model by the direct impacts, which are comprised of sales, value added, and employee salaries directly generated by industry activity. Determining the direct impacts of an industry involves determining the total revenues generated through the sale of products. Remembering that a key assumption of input-output analysis is that the expenditures and revenues of an industry are monetarily equal, the total revenues generated are assumed to be a compilation of the many different industry expenses, ranging from input purchases to employee compensation. Once the total expenditures of an industry have been determined, they are added together to provide an estimate for that industry's direct impacts. This estimate is the first step in input-output modeling. Direct impacts, in combination with the model, determine the indirect and induced impacts. Because they are the basis of the input-output model's ability to yield accurate results, it is important to estimate them as accurately as possible. Consequentially, this tabulation is one of the primary objectives of this research.

Direct impacts are determined through uncovering information on industry expenditures, sales, and payroll. This study used a mail survey to collect this direct data. However, the responses proved to be a poor sample representation, and alternative sources were used to augment the direct data for a more accurate total picture. In the case of the entire green industry, measuring the direct impacts is not simple. Double-counting, due to the vertically integrated nature of the industry, needed to be avoided. Also because of data limitations, information needed to construct the impact scenario was collected from a variety of sources and converted to one base year.

Once the direct impacts have been tabulated, the model must be regionalized. This is where regional purchase coefficients become important. First, you must determine what institutions are creating or affected by a change in final demand to understand how the final demand arises. For example, final demand for

pansies would comprise mainly of commercial properties that use these plants for beautification purposes, retail outlets that buy the plants wholesale for retail sale, and consumer purchases. Attached to the final demands are the regional purchase coefficients, which tell the model what percentage of final demand is met through local production. The remainder of those demands would be met by imports to the study area and are not included in the analysis of that region.

Say that one pansy plant has a final demand of \$1. If a pansy had a regional purchase coefficient of 1, this would mean that 100% of final demand for pansies was met through local production. A regional purchase coefficient of 0.7 suggests that 70% of final demand is met through local production, but 30% of final demand for pansies is met through imports to the study region (non-local production). In that scenario, only \$0.70 would represent the final demand for one pansy in the regionalized input-output model.

If pansies were not grown in Virginia, the final demands would still exist within the boundaries of the state. Understandably, the overall final demands would be lower due to various difficulties in obtaining these goods, such as increases in costs and decreases in availability. All demands would have to be met through imported products, which do not represent local production. Therefore, in a regionalized input-output model where all demands are met through imports, the regional purchase coefficient would be zero. With this scenario, the regionalized final demands for pansies would also be zero. Because the direct effects determine the indirect and induced effects, those too would be negligible. Therefore, it is important to accurately determine two important factors for an input-output model. As discussed before, an accurate measure of the final demands is necessary because they drive the remainder of the model. However, equally important is the determination of relevant regional purchase coefficients because they determine the percentage of those final demands that are relevant to a regionalized model and met through local production.

Traditionally, regional purchase coefficients are calculated automatically by input-output modeling software through a set of econometrically based equations.<sup>28</sup> However, in this particular analysis, direct impact data collection also involved collecting data on the percentage of goods and services sold within Virginia. Rather than allowing the model to calculate these coefficients, which can be notoriously inaccurate<sup>29</sup>, the RPCs used in this analysis will be determined exogenously through primary data acquisition.

### **Survey Design and Structure**

Data were collected using a mail survey of the primary industrial participants. The Virginia Agricultural Statistics Service (VASS) assumed all responsibility for survey data collection and tabulation. The surveys were designed to collect information on the 2002 calendar year from industries actively participating in green industry production or maintenance. This, coincidentally, is why 2002 was chosen for the base year in this analysis. The list of primary players included: (1) wholesale producers of ornamental plants and crops, including laboratory and greenhouse facilities, as well as container and field nurseries; (2) landscape installation contractors and providers; (3) landscape maintenance contractors and providers. Retail entities were not included unless the operation included wholesale production with retail sales. A list of industry participants was created using state sale permit information and the help of the Virginia Nursery and Landscape Association (VNLA). The survey asked detailed questions about input expenditures and sales for all aspects of operation. The design was such that each operation could be immediately categorized. Hybrid operations, those businesses that participate in more than one sector of the green industry, would be recognized through the results and adequately accounted for.

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<sup>28</sup> IMPLAN Users Manual, Chapter 8, p. 100.

<sup>29</sup> Lazarus, William F., Diego E. Platas and George W. Morse, *IMPLAN's Weakest Link: Production Functions or Regional Purchase Coefficients?* Journal of Regional Analysis and Policy 2002, Volume 32, p. 33.

The survey included detailed questions about sales and input expenditures. Sales were broken down by wholesale, retail, or landscape services. The survey also asked questions about the actual type of plant sold. This was divided into seven subcategories – 1) woody plants, trees, and shrubs; 2) herbaceous perennials; 3) fall annuals; 4) spring annuals; 5) specialty greenhouse crops; 6) aquatic plants; 7) Christmas trees – as well as three additional categories capturing plants that may not fit into the existing seven. Inquiries pertaining to the type of container for each plant sold were also asked. The categories were: 1) bareroot; 2) balled and burlap; 3) containers (all types); 4) flats; 5) cut flower; 6) other. Direct primary expenditures were broken down into five subcategories, separating out value added components from materials purchased. Categorized as value added components were the expenses caused from capital improvements and labor. The remaining 3 categories – plant material, equipment and supplies, and other expenditures – captured the direct input expenses. For the landscape installation and maintenance contractors, components of the survey included sections for total gross receipts, primary expenditures, and number of workers. The primary expenditure section of the survey was similar to that of the producer component. However, sales were broken down further, with categories such as hard goods (decks, ponds, or pavings), green goods, labor, and design. If a landscaper also had a wholesale or retail operation, the survey captured that as well.

Another important component of the survey was the section detailing labor expenditures. The survey included questions on hourly wage, total gross wages paid by the operation, and total peak number of workers. These were broken down into seasonal, full, and part-time, and also contained a section differentiating between employees and H2A and H2B workers.

### **Problems with Survey Methodology**

There are numerous drawbacks to using the survey method of data collection, three in particular that weigh heavily on the minds of those relying on survey data

for accurate results. The three generic pitfalls are a sample that is not representative of the whole, an unclear survey design, and poor response rates. In this analysis, the major issues pertain to a non-representative sample and poor response rates. Specifically, this analysis had an overall response rate of around 15%. Even if the sample had been an accurate representation of true industry proportions, the low response rate would make it difficult to project a reasonable estimate for complete industry size. However, certain sectors of the green industry were very poorly represented in the data, leading us to believe that the projections calculated by VASS were quite biased. A great deal of time was spent modifying the sample for an accurate picture of the industry in its entirety.

One of the most obvious pitfalls of surveys is not obtaining an accurate sample. In order for results to be accurate, the sample must be an accurate representation of the whole. In the case of the green industry survey, the ultimate goal was to accurately model the industry in its entirety. One of the most significant obstacles in an analysis that requires complete industrial data representation is a sample that does not permit representation of the entire sector. Often, with studies such as this, not all industry participants are included in the initial survey, mainly because the true universe is unknown. Regardless, even if every green industry participant was sent a survey, some individuals and firms choose not to return it. For statistical analyses, however, a complete sample is not needed. For the analysis to be accurate, you must be sure that your sample is representative of the whole. Unfortunately, the response rate was very low for this particular survey. VASS received a total of 1,146 survey responses for a response rate of 27%. Of these responses, 42 surveys indicated that they plan to have future green industry sales but were not presently involved in the business. Another 525 responses claimed to be no longer actively

involved in the industry.<sup>30</sup> Therefore, in reality, the actual response rate was much closer to 15%.

There are many reasons that firms choose not to participate in a survey. In some cases, the incentive to keep such information private outweighs the benefits of increased political awareness. For example, a quick statistical examination of survey responses shows that the landscape and horticultural services sector is poorly represented in the data. In fact, the data shows that firms categorized as a part of the maintenance sector completed fewer than 20 surveys. This is likely because many of these firms choose to pay their labor under the table, and therefore resist answering questions pertaining to the flow of funds in their operations. Additionally, larger corporate entities do not have the same incentives to respond that the smaller firms do – an increase in political awareness does much less for a larger firm than it does for a smaller, family-operated business. The resulting problem from these weaknesses is that the data obtained are not often an accurate representation of the population. In this particular analysis, the landscaping and horticultural services sector was poorly represented in survey responses in comparison with responses from other sectors. Additionally, the larger farms surveyed returned a relatively lower percentage of completed responses than did those farms on a smaller scale. These weaknesses had to be addressed by examining alternative data sources.

### **Additional Data Sources and Estimates**

There were many problems with primary data collection for this analysis that necessitated finding alternative sources. The reasons for using additional or alternative sources are numerous. Most obviously, additional sources can be used to verify existing data through comparison. Then, if you determine that your primary data is not comprehensive, these sources can be used to augment primary data for a more cohesive model. In this analysis, additional data sources

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<sup>30</sup> Virginia Agricultural Statistics Service. *Virginia Green Industry Survey 2002*, Virginia Department of Agriculture and Consumer Services, Richmond, VA, p. 4.

were used first to show that the VASS data collection procedures and subsequent analysis were not comprehensive enough for complete industry representation. Additional sources were then used to augment the existing primary data for a more complete model. The result of these procedures was two different model scenarios. The first model is an incomplete model of the green industry using only data collected through the survey methodology. The second model represents what we consider to be the best data representation of the green industry in Virginia given the resources available for use in this analysis.

The first step in analyzing the primary data is to verify if it is representative of the industry it will be used to model. This step was completed using additional data sources. For example, the Census of Agriculture provides an estimate for the number of greenhouses and nurseries in the state of Virginia. By comparing that value to the approximated number projected from the primary data analysis, you get a rough idea of how accurate your data is. Because of the poor overall response rate, it became necessary to determine if the total estimate provided by VASS was accurate despite the small sample size. Rather than investigating numerous sources for specific data, we chose to calculate two separate estimates of total green industry direct impacts. By comparing these estimates with the projection calculated by VASS, you can determine if the VASS data is comprehensive. Consumer expenditure data, acquired from the Bureau of Labor Statistics, was used for the first estimate. A meta-analysis compiled from various other similar state analyses provided the second estimate.

Upon completion of these estimate calculations, we determined the VASS survey impact estimate to be an incomplete representation of the whole. Table 3.1 highlights the different estimates and the sources they came from, ending in the final estimate used to create the IMPLAN model (which will be explained in detail later in the chapter). The first estimate came from consumer expenditure statistics through developing a relationship between national spending averages

on green industry products and household expendable incomes, then applying this relationship to household statistics in Virginia. The meta-analysis estimate was calculated by averaging household expenditures in different state analyses and again applying those values to household statistics in Virginia. A more thorough explanation of these estimates follows.

Table 3.1: Green Industry Direct Impact Estimates

<b>Average Green Industry Sales</b>	<b>Dollar Value</b>
Predicted by VASS – Model 1	\$1.14 Billion
Predicted from Consumer Expenditures	\$1.45 Billion
Predicted from Meta-Analysis	\$1.91 Billion
Combined Sources – Model 2	\$2.08 Billion

### Consumer Expenditure Estimate

Originally, we had planned to use consumer expenditure data to augment primary survey data by filling in possible gaps and holes in the data collection. We obtained this data through the Bureau of Labor Statistics Consumer Diary Survey, which provides a detailed account of what different households nationwide spent money on over a two-week period spaced randomly throughout the year. The rationale behind this data use was the thought that by approaching one problem from two separate angles (gross sales and consumer expenditures), the resulting data will be more comprehensive.

Unfortunately, upon detailed examination, we found the data to be fragmented and difficult to decipher on a per-commodity basis. The data did, however, provide some relative insight into the size and scope of the industry through the consumer demand for green industry goods and services as a whole. To calculate the overall estimate, we created an Engel relationship between green industry expenditures and the average total expenditures per household. Average household expenditures per income class were calculated using the regression equation. Combining this derived relationship with Virginia Census data, an estimate on total green industry expenditures by consumers was obtained (see Table 3.2). The total direct expenditure estimate for consumers in Virginia was approximately \$1.45 billion, adjusted to 2002 dollars, which is

several hundred million in excess of the VASS prediction. This, however, is an estimate from consumer expenditures. It does not include corporate and public purchases, and thus is still likely to be an underestimate of total statewide expenditures.

Table 3.2: Consumer Expenditure Regression and Estimate<sup>31</sup>

Equation:  $\ln(\text{Income Share}) = 7.68833 - 2.23082 \cdot \ln(\text{income}) + 0.07360 \cdot (\ln(\text{income}))^2$

Income	Average Expenditures (\$)	VA Households/Income Group	Total Expenditures
Less than \$10,000	13.08	214076	2,800,114
\$10,000 to \$14,999	13.83	141948	1,963,141
\$15,000 to \$24,999	15.41	308532	4,754,478
\$25,000 to \$34,999	16.80	326821	5,490,593
\$35,000 to \$49,999	18.74	444682	8,333,341
\$50,000 to \$74,999	21.58	549412	11,856,311
\$75,000 to \$99,999	21.21	307107	6,513,739
\$100,000 to \$149,999	29.39	254948	7,492,922
\$150,000 to \$199,999	35.03	80046	2,804,011
\$200,000 or more	42.96	72763	3,125,898

Source: Bureau of Labor Statistics Diary Survey, 2001

**Two-Week Expenditures: \$55 Million**  
**Total Overall Expenditures: \$1.43 Billion**

### Meta-Analysis Estimate

Many states have conducted analyses of their own green industries. Although they often fall short of complete comparability, they can provide a rough estimate of the magnitudes of total direct impacts of the industry in Virginia. This is completed by taking each study's direct impact assessment and converting it to 2000 dollars, again chosen because the fact sheets provided by the United States Economic Census Bureau were most recently published in that year. Then, that value was divided by the total number of households per state in that year.<sup>32</sup> This calculation yields a value for per household expenditures on green industry goods and services. In order to find the estimate for direct expenditures in Virginia, these expenditure values from other states were multiplied by the number of households in Virginia for that year. These multiplication values were averaged to determine an additional approximation of total direct impacts in Virginia. According to the Census of Horticultural Specialties, California, Florida,

<sup>31</sup> For regression statistics, see Appendix A, p. 63.

<sup>32</sup> All statistics pertaining to number of households, household incomes, and other general demographic information on a per-state basis was found through fact sheets available through the Economic Census Bureau

and Pennsylvania are three of the top five producing states in the horticulture industry. These three states were used in this meta-analysis, along with Maryland (similar in size, geographic location, and population to Virginia), and Ohio (randomly chosen). The results of the meta-analysis suggest that the total value for direct inputs in Virginia should be much closer to \$1.91 billion when converted to 2002 dollars than the \$1.14 billion that VASS predicts. See table 3.3 for those results.

Table 3.3: Meta-Analysis Estimate

State	Direct Impacts	# Households	Avg Expnd/Home	VA Total Expnd
Florida	\$6.59 Billion	6341121	1040	\$2.81 Billion
Pennsylvania	\$1.49 Billion	4779186	311	\$0.84 Billion
Maryland	\$1.15 Billion	1981795	582	\$1.57 Billion
Ohio	\$2.76 Billion	4446621	620	\$1.67 Billion
California	\$11.42 Billion	11512020	992	\$2.26 Billion
<b>Average Estimate:</b>				<b>\$1.83 Billion (2000 dollars)</b>

### Data Augmentation and Sources

From these separate estimates, it is apparent that the initial VASS estimate of green industry direct impacts is conservative. To remedy this, we used a combination of data sources to supplement the primary data collected through the VASS survey. Because the collected data was inconclusive, combining primary data with existing databases yields a more accurate estimate of industry size. These data sources include those discussed the background, as well as an additional governmental data source, County Business Patterns. For the larger retailing entities, a Brantwood publication entitled Nursery Retailer was used to provide rough sales estimates.

County Business Patterns<sup>33</sup> were used to account for the lack of data on the retail and maintenance components of the green industry. CBP data do not include statistics for the self-employed, those employed by private households, railroad workers, and most government employees. The data do, however, offer insights into the retail side of this industry through employee and payroll statistics, as well as providing an estimate for the total number of these retailers

<sup>33</sup> AVAILABLE: <http://www.census.gov/epcd/cbp/view/cbpview.html>

statewide. This estimate can then be compared to the estimate from Nursery Retailer, enabling a more accurate representation in the model itself. CBP data are also very helpful in determining the approximate number landscaping industries statewide, as well as the number of people they employ.<sup>34</sup> However, it is likely that some smaller, independent landscaping industries are left out because those who are self-employed are not accounted for in this database. Table 3.4 provides some useful employment and payroll statistics on businesses involved in the sale or maintenance of green industry goods, although not all of these statistics were used in the modeling process.

Table 3.4: Employment and Payroll Data, Virginia

Industry	Number of Employees for week including March 12 (2001)	2001 First Quarter Payroll (\$1000)	2001 Annual Payroll (\$1000)	2001 Number of Businesses
Flower, nursery stock, florists' supplies wholesale	729	3,244	14,150	67
Home Centers	10,939	61,968	270,416	137
Hardware Stores	2,461	10,436	43,745	271
Nursery and Garden Centers	5,033	21,998	97,265	445
Grocery (except convenience) Stores	61,856	263,818	1,040,222	1,642
Florists	3,642	12,017	50,187	628
Landscape Architectural Services	1,279	6,499	32,711	163
Landscaping Services	16,099	71,736	359,792	1,923

Source: County Business Patterns, Virginia 2001

Similar studies conducted in neighboring states have also discovered that larger retailing firms do not respond to mail surveys. Because these firms account for a large percentage of retail sales, the retail sector survey responses would be a poor representation of the true population. In this analysis, retailing firms were excluded from the survey process altogether unless they maintained a wholesale operation as well. It therefore became necessary to find and incorporate outside data on larger retailing firms to paint a more accurate picture of the industry as a whole. When Maryland encountered a similar problem, they estimated the data using the Census of Agriculture, the USDA-MASS database, and the MDA nursery license application.<sup>35</sup> Pennsylvania remedied this problem by hiring an

<sup>34</sup> IMPLAN software treats employment and sales as interchangeable, so either value can be used as an input to the model. Each industrial sector has a separate conversion factor. The software then converts between the two.

<sup>35</sup> Maryland, p. 6.

independent market research organization to conduct telephone surveys of pertinent corporate headquarters.<sup>36</sup>

For this study, national data was obtained from the horticultural research division of Brantwood Publications. *Nursery Retailer*, a bi-monthly publication, includes an annual report that summarizes the sales of the top 100 lawn and garden retailers nationwide, including average sales per store. A copy of this report was obtained for 2002. Through determining the number of these retailers in Virginia using a series of phone calls, a rough estimate of statewide retail sales was obtained. See Table 3.5.

Table 3.5: Retail Green Industry Sales

Store	Avg Sales/Store (\$1000)	# Stores VA (2002)	Avg VA Sales (\$million)
Home Depot	5230	40	209
Lowe's, Inc.	5000	42	210
Wal-Mart	1473	82	121
K-Mart	543	35	19
Target	580	31	18
Costco	939	13	12.2
Kroger	109	67	7.3
Sears Hardware	3150	2	6.3
Meadow Farms	1670	20	33.4
Agway, Inc	230	5	1.2
<b>TOTAL</b>			<b>\$637 Million</b>

Source: Nursery Retailer, June 2002

### Effects of Drought and Water Restrictions

The agriculture industry as a whole was greatly affected by the Virginia drought in the summer of 2002. Aside from crops dying and irrigation wells drying up, farmers were forced to sell livestock earlier than planned to compensate for the reduced income from other sources and lower feed levels. Agriculture is a seasonal industry, with most of the revenues generated during harvest in the late summer or early fall. During the planting seasons, farmers rely on water resources for a successful crop. If the water isn't available at key times in the growth season, the harvest (and therefore income) suffers in later months. According to many newspaper resources, many farmers in Virginia lost between

<sup>36</sup> Pennsylvania, p. 23.

20-35% of their annual revenues due to drought conditions, depending on what crops or livestock were raised and sold. The tobacco industry was the hardest hit. These losses are due mainly to water shortages and drought conditions.

The green industry is another very seasonal industry. Nurseries and greenhouses generally have the highest sales in the spring during planting season with another sales push in the fall for bulbs and other longer-lasting plants. Business is somewhat lucrative. Similar to the farmers, when initial spring sales are disrupted it can have lasting affects on fiscal responsibilities for the remainder of the year. These businesses are very heavily dependent on water and suffer significant losses in times of drought due to consumers' lack of purchase incentive. When restrictions are enforced, this only compounds the problems that arise from drought itself. The water restrictions enforced in Virginia during the summer and fall of 2002 lasted for approximately two months, during the fall planting season. This understandably affected the green industry negatively. For this analysis, we will assume that the green industry suffered similar losses due to both drought and water restrictions as the agriculture industry, totaling to around 25% of total revenues for the 2002 fiscal year.<sup>37</sup>

Landscape architect and maintenance firms are affected more heavily by water restrictions than the drought itself. This is because they are in the business of not only installing the plants themselves, but maintaining them through the installation of equipment such as lawn sprinkler systems. Therefore, when restrictions are enforced that forbid residents of a community from watering their lawns, the residents lose their investment and the landscape industry loses much of its purpose. Although there is less of an incentive to invest in lawn beautification during times of drought, we assume that the landscaping industry loses a great deal more revenue when restrictions are enforced that forbid lawn maintenance all-together. We assume, because landscape industries are

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<sup>37</sup> This estimate was arrived upon through many articles detailing the affects of drought on agriculture in many different states throughout the US. For these articles, please see the references section located at the end of the paper.

involved in the care and maintenance of green products, they lose approximately 30-50% of their revenues during times of drought and water restrictions. In Virginia in 2002, we will assume the landscaping and maintenance sector of the green industry lost approximately 40% of its revenues due to drought and restrictions.<sup>38</sup> Although some articles suggest that losses to this sector can total to a much greater percentage, the 2002 water restrictions were enforced towards the end of the summer and throughout the early fall, so much of the landscaping and landscape maintenance work had already tapered off.

### **IMPLAN Project Definition<sup>39</sup>**

A general outline highlighting the overall scenario for this analysis was presented earlier in this chapter. However, when a specific modeling and analysis program is used, it is also important to define the requirements of that software. This section will attempt to describe the decision-making process that goes into an IMPLAN input-output model, as well as defining key concepts such as local expenditures, margins, and deflators. The project definition contains many components, including your objectives, the impact location, the local expenditures (versus imports), the time frame that your model encompasses, the institutions affected, and the particular industries or commodities affected by your analysis.

The reach of your model is defined by determining the impact location, which means defining the geographic location of the economic activity you are modeling. The objectives of this research are specific to Virginia, so therefore the impact location is inherently stated through determining the objectives. This particular analysis defines the impact location as the entire state of Virginia. It is your impact location that helps determine the local expenditures.

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<sup>38</sup> Again, this estimate was arrived upon through similar means as the previous estimate, using sources explaining the affects of drought and water restrictions on the landscaping industry nationwide. For these article references, please see the references section.

<sup>39</sup> The project definition outline was taken directly from Chapter 9 in the IMPLAN users manual, Page 107

In this type of economic modeling, expenditures take three forms – there are local expenditures, import expenditures, and non-local expenditures. Import expenditures are dollars spent on goods brought into but not manufactured in the impact location. Local expenditures are dollars spent on goods manufactured within the impact location. Non-local expenditures are those dollars spent outside the defined area. In order to study the effects of an event on the local economy, only the local expenditures can be used in the modeling process. This has already been discussed through explaining regional purchase coefficients. Rather than RPCs, IMPLAN defines regional purchases with the percentage of local expenditures. Determining local expenditures can get tricky when the model is very specific. This model encompasses the entire state of Virginia, and to determine the local expenditures, we will assume that the expenditure percentages determined by the VASS green industry survey hold across the industry. See table 3.6 for these percentages.

Table 3.6: Regional Purchase Coefficients by Type of Expenditure

Type of Expenditure	Percent Spent in Virginia	Percent Spent Outside Virginia
Plant Materials	62	38
Total Supplies	82	18
Total Labor	96	4
Taxes Paid in 2002	95	5
Other Expenditures	94	6
Total Expenditures	88	12

Source: VASS Green Industry Survey 2002

In the scenario construction, we explained how it is important to determine what institutions are creating or affected by a change in final demands. An institution, according to IMPLAN, is defined as a type of final demand sector, which includes industries, households, and federal or state government. To simplify the process of determining the involved industries, IMPLAN has created a database that assigns a numeric code to each defined industry. In this analysis, the industries that have the most impact in changing final demands include Greenhouse and Nursery Products (23), Landscape and Horticultural Services (27), Wholesale Trade (447), Building Materials and Gardening Centers (448), General Merchandise Stores (449), Food Stores (450), and finally, Miscellaneous Retail (455). These are the industrial sectors this analysis focuses on. As for the

activity time frame, the green industry survey gathered information for the 2002 calendar year. Therefore, all data, calculations and results will be converted to 2002 dollars wherever necessary.

Each IMPLAN sector must be defined in the model as either an industry or a commodity. For an industry definition, the sector is assumed to be comprised of individual firms, businesses, or households that are susceptible to a final demand change. To be defined as a commodity-driven sector, the sector is assumed to be producing a good or service whose final demand is subject to change. To complete the project definition, you need to figure out whether the impact is commodity or industry driven. When defined as an industry, only the direct impacts of that IMPLAN sector are directly affected by a change in final demand. However, when you choose the commodity stance, all industries IMPLAN associates with producing the commodity are affected by the change. An industry-driven analysis is more focused than a commodity-driven analysis.

All IMPLAN analyses are completed using producer prices. Therefore, if you have data which includes retail markups, you will have to be more careful with how you define it. With the commodity definition, IMPLAN has built in an option to account for this markup. Rather than converting retail prices to consumer prices, IMPLAN uses the social accounting matrix to determine what industries affect this price increase and then distributes the direct impacts accordingly. Therefore, a commodity-driven impact is much more widespread in an economy because the impacts are dispersed over a variety of economic sectors. The difference between producer and purchaser prices is represented by the term *margin*. If your data is in purchaser prices or you are modeling something that is sold at a retail level, you will need to use the commodity definition to make use of this option. In this analysis, several different industries (outlined above) are direct participants in the green industry. Data relevant to retail stores were defined as commodities to utilize margins. This was necessary because retail

sales statistics are not in producer prices. All other components of the model were defined as industries for a more focused analysis on the green industry.

### **Constructing the Models**

Because of data weaknesses described, two separate models were constructed for analysis. The first of the models includes only data collected through the VASS survey and subsequent analysis and is assumed to be an under-representation of true industry size. The second model was augmented with several different data sources to depict a more thorough summary of the green industry in Virginia.

#### Model 1 – VASS Analysis Data

According to the Virginia Agricultural Statistics Service (VASS), the total direct impacts of the green industry in Virginia totaled approximately \$1.14 billion dollars. Plant sales represented approximately 31% of the total revenue with \$353.6 million in sales. However, VASS defined plant sales as wholesale and retail sales by licensed nurseries, and the analysis excluded sales from large chain retailers. The rest of the survey findings are summarized in the table below. These dollar values were entered into the IMPLAN framework through individually defined industry sectors. All sectors of this model were defined as industries in IMPLAN. Plant sales, because this category stretched through many different industrial sectors, were defined as a commodity so that the impacts would affect all involved sectors and not just greenhouse and nursery products.

Table 3.7: Preliminary Model, Model 1

<b>Sales by Business Function</b>	<b>IMPLAN Sector</b>	<b>Dollars</b>	<b>%</b>
Plant Sales	23 - Greenhouse and Nursery Products	353,560,000	31
Landscaping (maintenance only)	27 - Landscape and Horticultural Services	274,510,000	24
Landscape Installation (exclude hardscape)	27 - Landscape and Horticultural Services	259,530,000	23
Landscape Installation (hardscape only)	27 - Landscape and Horticultural Services	105,400,000	9
Design or Architectural Services	27 - Landscape and Horticultural Services	95,720,000	8
Other	27 - Landscape and Horticultural Services	54,710,000	5
<b>TOTAL GROSS RECEIPTS<sup>40</sup>:</b>		<b>1,143,430,000</b>	<b>100</b>

Source: VASS Virginia Green Industry Survey 2002

### Model 2 – Combined Sources

The second model is more complex than the first. The augmented model has specifically defined separate components, broken down into four sectors of the green industry defined in the background section – 1) growers and wholesalers; 2) re-wholesalers; 3) retailers; 4) landscape and horticultural services.

The first component of this second model, growers and wholesalers, was taken directly from the survey itself. The VASS publication included an estimate of total plant sales totaling approximately \$708 million, including installation costs. This estimate, however, created a problem in analysis with double-counting in the landscape and horticultural services sector. To remedy this problem, the growers and wholesalers component was analyzed separately to determine related impacts. The impacts on the landscaping and horticultural services sector were used to discount that sector before the final analysis. This was achieved by subtracting the impacted amount from the total gross expenditures of that sector. The full process for factoring out the installation costs follow below.

\$708 million = plant costs + installation costs; rearranging the equation yields  
 plant costs = \$708 million – installation costs

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<sup>40</sup> Total Gross Receipts is the terminology chosen by the statisticians at VASS to represent Total Direct Impacts

Therefore, we must determine the installation costs, which we do through a separate IMPLAN analysis of only the growers and wholesale sector. Table 3.8 depicts those results in 2002 dollars. Because the RPC coefficient for plant sales is 0.62 (see table 3.6), the direct impacts do not total to the \$708 million originally input. The OTHER category represents Virginia plant sales to other states and nations. The value used to represent installation costs is the indirect affects of the nursery and greenhouse industry on the landscaping and horticultural services industry, which is highlighted below. However, because installation costs apply to the landscaping and maintenance sector of the green industry, this value is used to discount that sector and not the total output for nursery and greenhouse products.

Table 3.8: Impact Results for Nursery and Greenhouse Products

<b>Sector</b>	<b>Direct</b>	<b>Indirect</b>	<b>Induced</b>	<b>Total</b>
Agriculture	0	8,162,532	984,933	9,147,465
<b>Nursery and Greenhouse Products</b>	<b>439,628,352</b>	<b>22,579,054</b>	<b>78,874</b>	<b>462,286,304</b>
<b>Landscape and Horticultural Services</b>	<b>0</b>	<b>63,652</b>	<b>163,399</b>	<b>227,051</b>
Mining	0	606,704	172,793	779,496
Construction	0	12,375,751	2,550,804	14,926,554
Manufacturing	0	6,952,801	10,824,820	17,777,620
TCPU	0	27,274,406	10,032,333	37,306,740
Trade	0	14,327,126	16,273,136	30,600,262
Green Industry Retail Sales	0	334,412	8,829,387	9,163,799
FIRE	0	19,218,788	28,932,572	48,151,360
Services	0	12,339,332	38,883,100	51,222,432
Government	0	1,107,240	3,031,894	4,139,133
Other	238,461,504	0	354,816	238,816,320
<b>Total</b>	<b>678,089,856</b>	<b>125,341,798</b>	<b>121,112,860</b>	<b>924,544,537</b>

To represent the landscaping and horticultural services sector, County Business Patterns data were used. Because the response rates for the VASS survey were so low, we felt that County Business Patterns data provided a better estimate of the industry through employment statistics. To prevent double-counting, only data from this source were used to represent this sector. The IMPLAN program has a built-in ability to convert between the number of employees and the total gross output of a sector according to labor intensity. By using the total number of employees for the landscaping and maintenance industry in 2001 (the most recent CBP publication), an estimate for the direct impacts was generated.

However, because installation costs were included in the VASS analysis of crop sales, it became necessary to discount the total output value in this sector by that amount (\$63,652).

The wholesale component of this model was also taken directly from employment statistics provided by the County Business Patterns. According to this database, in 2001 there were 67 different wholesale providers of nursery and florist stock employing approximately 729 people. Additionally, the wholesale farm and garden equipment sector employed over 1000 people of that same year. Because the VASS survey did not separate out the purely wholesale components of the green industry, these employment statistics provided necessary data into an industry sector that otherwise would have been excluded.

The retail component of this model was taken directly from the Nursery Retailer data and calculated estimates for store sales in Virginia. Each store was categorized into an IMPLAN sector and set as a commodity. Margins were set at the household level to allow IMPLAN to convert sales figures into producer prices. The final augmented model is represented by table 3.9. It must be noted, however, that the final direct impact estimate by the implementation of margins and RPCs, so the actual direct impacts will not total to the value shown below. In fact, they will be notably smaller.

Table 3.9: Final Model, Model 2

<b>Model 2</b>	<b>Data Source</b>	<b>Dollar Value</b>	<b>Sector</b>	<b>Basis</b>
<b>Growers and Wholesalers</b>	VASS Survey			
Woody Plants		392,000,000	23	Industry
Spring Annuals		150,375,000	23	Industry
Herbaceous Perennials		91,715,000	23	Industry
Fall Annuals		43,690,000	23	Industry
Other (Christmas trees, aquatic plants)		38,658,000	23	Industry
Specialty Greenhouse Crops		37,370,000	23	Industry
<b>Total</b>		<b>753,808,000</b>		
<b>Re-Wholesalers</b>	CBP, Virginia, 2001			
Flower, nursery stock, florists' supplies wholesale		82,569,330	447	Industry
Wholesale farm, garden machinery and equipment		188,131,200	447	Industry
<b>Total</b>		<b>270,700,530</b>		
<b>Landscape and Horticultural Services</b>	CBP, Virginia, 2001			
Landscaping Services		391,869,100	27	Industry
Landscape Architectural Services		31,132,400	27	Industry
Subtracted for installation costs (from survey)	IMPLAN Analysis	-63,652	27	Industry
<b>Total</b>		<b>422,937,648</b>		
<b>Retail Sector</b>	Nursery Retailer 2002			
Home Depot		209,000,000	448	Commodity
Lowe's, Inc.		210,000,000	448	Commodity
Wal-Mart		121,000,000	449	Commodity
K-Mart		19,000,000	449	Commodity
Target		18,000,000	449	Commodity
Costco		12,200,000	447	Commodity
Kroger		7,300,000	450	Commodity
Sears Hardware		6,300,000	455	Commodity
Meadow Farms		33,400,000	455	Commodity
Agway, Inc		1,200,000	455	Commodity
<b>Total</b>		<b>637,400,000</b>		
<b>Total Direct Impacts</b>		<b>2,084,846,078</b>		

## Double-Counting

Double-counting is when the same or overlapping data is used in an analysis more than once. When double-counting occurs, the calculation is higher than it would be otherwise because certain data values are represented in the model in different ways and can be counted twice or more in the output. These issues arise because there are always those businesses involved in more than one sector of an economy. Some examples pertinent to the green industry would be landscapers or retail entities that also grow and maintain a percentage of the

plants they sell. In this particular analysis, double-counting is one of the more likely causes for skewed results.

Our study combined data from various sources. Unfortunately, the methods for collecting the data differ from source to source, so it is possible that certain aspects of the industry are represented more than once in the model. The two most troublesome areas where double-counting issues could arise are discrepancies between survey data on plant sales and the wholesale and landscape data.

The most easily remedied instance of double-counting pertains to plant installation costs. When the survey responses for plant sales were tallied, the total included the installation costs. Although it is not immediately clear why the results were tallied this way, the likely reasoning behind the lack of separation is that these results are projected from a relatively small and biased sample. As stated before, the landscaping and maintenance sector was grossly underrepresented by the survey responses. We remedied this problem through the procedure described in the section explaining how Model 2 was constructed. Through figuring out the dollar value attributed to the installation costs, the landscaping and horticultural services sector can be discounted accordingly, thus eliminating any double-counting issues.

The problem is slightly more complex when accounting for the re-wholesale versus the wholesale sectors. The re-wholesale sector includes distribution centers, or market participants that purchase plants and other horticultural products from the growers and other wholesalers and sell them to the retail sector at a slight markup. This is a fairly large sector of the green industry not involved in plant production, but again the survey data does not represent it separately if at all. Because the survey data does not separate out the re-wholesale sector, we must assume that it is either lumped together with the growers and wholesalers data (involved in growth and sale of horticultural

goods), or it is not represented at all. Remembering that VASS chose not to survey larger retailing entities because they are not directly involved in plant cultivation, it is possible that the distribution centers and re-wholesalers were left out as well for the same reason. Regardless, it is difficult to determine where value of sales originates with the survey data. County Business Patterns data are reserved for the wholesale and retail sectors of an economy and therefore do not include producers of agricultural goods in their employment statistics. The database does provide data on the re-wholesale sector of the green industry, spanning both crop and machinery intermediate sales. Because this sector was not represented separately by the survey responses, nor was it possible to separate out data relevant to it, the underlying assumption was that the re-wholesale sector was not represented at all. By using County Business Patterns, the entire industrial sector was represented separately in the model. Because we assumed that the survey data pertinent to this sector is minimal or non-existent, most double-counting concerns are eliminated.

### **Chapter Summary**

This chapter has provided an outline of the project scenario, explaining exactly what it is that an input-output analysis assumes and what important factors are needed for model construction. The survey methodology and structure, as well as subsequent data analysis were briefly discussed. The chapter outlined how different additional analyses were used to determine that survey representation of the green industry was not comprehensive. Then it further explained how alternative data sources were used to fill in gaps in collected data, and explained the two models used in analysis and how they were structured, then constructed. The chapter closed with an explanation of possible instances of double-counting with the solutions used to minimize errors in analysis. The results of the IMPLAN analysis and discussion of the findings will follow in the next chapter.

## **Chapter IV – Results and Discussion**

### **Chapter Overview**

In this chapter, the results of the input-output analysis are presented, explained, and discussed. An explanation of the multipliers and multiplier effects of the green industry will start the chapter. The employment impacts results are explained and immediately followed by an explanation of the overall impact results. This chapter also explains the value of this impact analysis, as well as explaining the other industries most affected by the green industry and how that is important to the surrounding economy.

An impact analysis provides insight into an industry through determining what other sectors and industries are most affected by changes in output.

Businesses, households, government agencies, and various organizations interact with each other, conducting thousands of transactions. Although these transactions seem insignificant individually, they are an important pillar in a functioning economy. Understanding the flow of resources in an economy provides insight into the effects that one sector can have on another. Some links are fairly obvious, such as the gasoline industry and freight transportation. Others are more difficult to uncover, such as the link between real estate pricing and landscaping and horticultural services.

### **Multipliers and Multiplier Effects**

Final demand is a driving factor in an input-output model. Industries strive to meet the demands of consumers and other industries by supplying goods and services. By doing this, an industry creates its own demand for goods and services, which continues the supply chain. This trend iterates again and again throughout a functioning economy, and multipliers are the tools economists use to describe these iterations. The two IMPLAN industrial sectors that most directly encompass the green industry are greenhouse and nursery products (23), and landscape and horticultural services (27). We used IMPLAN to calculate type I

and II multipliers for both industries. The results are found in the table below and are the same for both models.

Table 4.1: Industry Multipliers

Industry	Type I	Induced	Type II
Greenhouse and Nursery Products (23)	1.29	0.28	1.57
Landscape and Horticultural Services (27)	1.15	0.50	1.65

Reading this table, a one dollar increase in the final demand for nursery and greenhouse products results in an overall output increase of \$1.57. For a one dollar increase in final demand for the landscape and horticultural services sector, there is an overall increase in output of \$1.65. However, these sectors differ in the location of the increased output – a much greater percentage of that increase is located in related industries for the landscaping and horticultural services sector than for the greenhouse and nursery products sector.

When considering Greenhouse and Nursery Products, the industries most affected by a change in final demand are (in order) wholesale trade (447), electric services (443), maintenance and repair of other facilities (56), real estate (462), and motor freight transport and warehousing (435).<sup>41</sup> These industries and related effects are easily understandable. Most greenhouses wholesale their products in addition to retailing them, so this would explain the heavy impacts on the wholesale sector. Greenhouses are heated and lit year round with very poor insulation, which would imply purchases of utility services. Additionally, they are generally made of glass or other thin materials, which would require more substantial repair expenses than other similar building materials. Real estate development and contracting generally involves landscaping in addition to building, which would require the green goods produced in nurseries and greenhouses. As for transportation, there are obvious costs associated with moving products from one area to another. However, because plants are perishable and nurseries are rather prevalent, these costs are relatively low in

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<sup>41</sup> These industries, as well as those associated with the landscaping and horticultural services sector, were determined through a read-only file in the IMPLAN program, accessed through the edit option.

comparison to similar goods because the necessary length of travel is shorter. However, freight transportation is still a significantly impacted sector.

Industries most affected by a change in final demand relative to the landscape and horticultural services sector are similar to those affected by nurseries and greenhouses. In order, they are greenhouse and nursery products (23), wholesale trade (447), legal services (492), and motor freight transport and warehousing (435). Greenhouse and nursery products and wholesale trade are affected because landscape industries are involved in the installation of products purchased from these industrial sectors. Greenhouse and nursery products, therefore, are seen as direct requirements to the landscaping and horticultural services sector. Additionally, landscaping industries often operate through hiring contracts, which requires legal services in construction and violation. The transportation impacts are similar to those of the greenhouse and nursery products industry, significant but comparatively inexpensive.

### **Input-Output Impact Results – Employment**

The impact results for employment are represented in employee numbers, not in the value of wages or salaries paid. All results are depicted in 2002 dollars. The two scenarios run are the models described in Methods and Procedures. The first model, Model 1, is an analysis of the survey data provided by VASS. Model 2 is the more complete augmented model.

Table 4.2: Overall Model 1 Employment Impacts, 2002

<u>Sector</u>	<u>Direct</u>	<u>Indirect</u>	<u>Induced</u>	<u>Total</u>	<u>State Total</u>	<u>% of State Total</u>
Agriculture	0	242.8	62.4	305.2	75,000	0.4
<b>Nursery and Greenhouse Products</b>	<b>4,818.00</b>	<b>939.1</b>	<b>5.2</b>	<b>5,762.30</b>	<b>7,665</b>	<b>100.0</b>
<b>Landscape and Horticultural Services</b>	<b>30,769.00</b>	<b>3.4</b>	<b>24.7</b>	<b>30,797.00</b>	<b>15,265</b>	<b>100.0</b>
Mining	0	3.8	4.3	8.2	14,944	0.1
Construction	0	199.9	134.3	334.3	340,171	0.1
Manufacturing	0	54.9	218.2	273.1	486,165	0.1
Transportation, Communication, and Utilities	0	215.4	232.7	448.1	199,529	0.2
Trade	0	187.6	1,280.90	1,468.50	577,610	0.3
<b>Green Industry Retail Sales</b>	<b>0</b>	<b>17.9</b>	<b>1,147.10</b>	<b>1,164.90</b>	<b>6,688</b>	<b>100.0</b>
Finance, Insurance, and Real Estate	0	237.1	449.2	686.3	295,912	0.2
Services	0	511.7	2,653.90	3,165.60	1,336,912	0.2
Government	0	22.3	98	120.3	55,192	0.2
Other	0	0	124.3	124.3	913,854	0.0
<b>Total</b>	<b>35,586.90</b>	<b>2,636.00</b>	<b>6,435.10</b>	<b>44,658.00</b>	<b>4,690,177</b>	<b>0.9</b>

Table 4.3: Overall Model 2 Employment Impacts, 2002

<u>Sector</u>	<u>Direct</u>	<u>Indirect</u>	<u>Induced</u>	<u>Total</u>	<u>State Total</u>	<u>% of State Total</u>
Agriculture	0	322.6	66.8	389.4	75,000	0.5
<b>Nursery and Greenhouse Products</b>	<b>6,959.10</b>	<b>700.2</b>	<b>5.5</b>	<b>7,664.80</b>	<b>7,665</b>	<b>100.0</b>
<b>Landscape and Horticultural Services</b>	<b>15,227.70</b>	<b>10.6</b>	<b>26.4</b>	<b>15,264.80</b>	<b>15,265</b>	<b>100.0</b>
Mining	0	5.1	4.6	9.7	14,944	0.1
Construction	0	263.5	143.9	407.4	340,171	0.1
Manufacturing	0	134.4	233.7	368.1	486,165	0.1
Transportation, Communication, and Utilities	0	280.1	249.3	529.4	199,529	0.3
Trade	2,266.50	244.6	1,372.30	3,883.40	577,610	0.7
<b>Green Industry Retail Sales</b>	<b>5,418.00</b>	<b>41.2</b>	<b>1,228.90</b>	<b>6,688.10</b>	<b>6,688</b>	<b>100.0</b>
Finance, Insurance, and Real Estate	0	318.4	481.2	799.6	295,912	0.3
Services	0	1,004.70	2,843.30	3,848.00	1,336,912	0.3
Government	29.8	51.4	104.9	186.1	55,192	0.3
Other	0	0	133.2	133.2	913,854	0.0
<b>Total</b>	<b>29,901.10</b>	<b>3,376.80</b>	<b>6,894.20</b>	<b>40,172.10</b>	<b>4,690,177</b>	<b>0.8</b>

The employment results differed between the two different models. Despite having used direct employment figures for two industrial sectors in Model 2 (taken from County Business Patterns data) that were not included at all in Model 1 (consisting of only the VASS survey analysis data), the analysis results regarding employment for Model 2 were slightly less than for Model 1. This is slightly disconcerting, but also easily explained. Regardless of the model,

however, the green industry is responsible for between 0.8 and 0.9% of Virginia state employment, over 40,000 jobs either way you look at it.

### Model 1 – VASS Survey Analysis

The structure of Model 1 was taken directly from the VASS survey analysis, which breaks down total sales by business function (see Table 3.6). This model is considered to be an incomplete model, due to reasons discussed in the previous chapter. Despite the under-representation of data on landscapers and landscape architects, the survey analysis projected that these services represent over 68% of the total sales in the green industry. This is largely due to the fact that the VASS analysis results are projected from a relatively small and, very likely, biased sample. This would sway the results in one direction or another due to incomplete representation. In this case, it is likely that the under-representation of the landscaping sector in the data caused the projection to overestimate its importance to the industry. Additionally, plant installation costs are lumped together with sales, and therefore the landscaping and horticultural services sector encompassed a larger segment of the industry than it would have otherwise. IMPLAN automatically calculates the employment associated with the total output of an industry, and vice-versa, through a per-industry conversion factor built into the modeling software. When considering an industrial sector such as landscaping, wages and salaries represent a rather large percentage of total revenues, so a large dollar value for output would convert to a large number of employees. This is why the direct employment statistics generated by IMPLAN for Model 1 are larger than for Model 2 – 68% of the output value in this model was categorized under the landscaping and horticultural services industry sector. When considering Model 2, only approximately 20% of the total output value is categorized under that sector.

### Model 2 – Combined Sources

The second model (Model 2) is considered to be the most comprehensive model in this analysis, constructed from several different data sources to encompass

the different sectors of the green industry. In the second model, the only survey data are used are what the VASS analysis defined as overall plant sales. However, unlike in the subsequent model, the VASS data used in this model were categorized under the nursery and greenhouse sector (growers), which is not as labor intensive in IMPLAN as the landscaping and horticultural services sector. Rather than allowing the program to convert between output and employment, direct employment statistics from County Business Patterns were used to represent the landscaping and re-wholesale sectors. Using these statistics rather than converted output yields a more accurate model, mainly because the statistics are governmentally collected and not projected through analysis. IMPLAN works only in producer prices, and the data representing green industry retail sales from Nursery Retailer (also not included in the first model) were set up in the model as a commodity to convert between retail sales and producer prices. The markups in price from producer to retail prices are caused by many different influences, which are why this model shows direct employment impacts in industry sectors such as trade, government, and transportation. Using these additional data sources makes Model 2 a more exact model with much clearer delineations between industrial sectors and their representative sales.

## Overall Output Results

Table 4.4: Overall Model 1 Output Impacts, 2002 Dollars

<u>Sector</u>	<u>Direct</u>	<u>Indirect</u>	<u>Induced</u>	<u>Total</u>	<u>State Total</u>	<u>% of State Total</u>
Agriculture	0	6,446,170	4,067,298	10,513,468	3,231,437,198	0.3
<b>Nursery and Greenhouse Products</b>	<b>304,366,368</b>	<b>59,327,920</b>	<b>325,714</b>	<b>364,020,000</b>	<b>364,020,000</b>	<b>100.0</b>
<b>Landscape and Horticultural Services</b>	<b>841,139,904</b>	<b>91,716</b>	<b>674,747</b>	<b>841,906,368</b>	<b>841,906,368</b>	<b>100.0</b>
Mining	0	634,026	713,551	1,347,577	3,136,276,629	0.0
Construction	0	14,296,368	10,533,589	24,829,956	28,849,061,673	0.1
Manufacturing	0	10,796,638	44,701,280	55,497,920	88,615,748,222	0.1
Transportation, Communication, and Utilities	0	35,599,148	41,428,692	77,027,840	32,589,261,358	0.2
Trade	0	20,884,292	67,200,200	88,084,488	34,946,061,847	0.3
<b>Green Industry Retail Sales</b>	<b>0</b>	<b>567,089</b>	<b>36,461,104</b>	<b>37,028,196</b>	<b>37,028,196</b>	<b>100.0</b>
Finance, Insurance, and Real Estate	0	27,972,428	119,477,552	147,449,984	60,129,742,738	0.2
Services	0	36,872,460	160,568,432	197,440,896	80,275,729,220	0.2
Government	0	2,493,268	12,520,256	15,013,525	5,940,407,684	0.3
Other	168,048,256	0	1,465,220	169,513,476	47,848,043,197	0.4
<b>Total</b>	<b>1,313,554,528</b>	<b>215,981,523</b>	<b>500,137,635</b>	<b>2,029,673,694</b>	<b>386,804,724,330</b>	<b>0.52</b>

Table 4.5: Overall Model 2 Output Impacts, 2002 Dollars

<u>Sector</u>	<u>Direct</u>	<u>Indirect</u>	<u>Induced</u>	<u>Total</u>	<u>State Total</u>	<u>% of State Total</u>
Agriculture	0	8,614,694	4,357,453	12,972,147	3,231,437,198	0.4
<b>Nursery and Greenhouse Products</b>	<b>439,628,352</b>	<b>44,232,736</b>	<b>348,950</b>	<b>484,210,048</b>	<b>484,210,048</b>	<b>100.0</b>
<b>Landscape and Horticultural Services</b>	<b>416,283,072</b>	<b>290,996</b>	<b>722,890</b>	<b>417,296,928</b>	<b>417,296,928</b>	<b>100.0</b>
Mining	0	848,749	764,455	1,613,203	3,136,276,629	0.1
Construction	0	18,899,854	11,285,040	30,184,894	28,849,061,673	0.1
Manufacturing	0	22,720,042	47,890,204	70,610,248	88,615,478,222	0.1
Transportation, Communication, and Utilities	0	50,553,184	44,384,156	94,937,336	32,589,261,358	0.3
Trade	274,498,880	26,080,908	71,994,160	372,573,952	34,946,061,847	1.1
<b>Green Industry Retail Sales</b>	<b>192,874,192</b>	<b>1,309,161</b>	<b>39,062,176</b>	<b>233,245,536</b>	<b>233,245,536</b>	<b>100.0</b>
Finance, Insurance, and Real Estate	0	43,919,244	128,000,920	171,920,160	60,129,742,738	0.3
Services	0	67,588,488	172,023,168	239,611,648	80,275,729,220	0.3
Government	4,359,092	5,156,368	13,413,433	22,928,892	5,940,407,684	0.4
Other	253,833,056	0	1,569,746	255,402,802	47,848,073,197	0.5
<b>Total</b>	<b>1,581,476,644</b>	<b>290,214,424</b>	<b>535,816,751</b>	<b>2,407,507,795</b>	<b>386,696,282,278</b>	<b>0.62</b>

The total impact results differ greatly between the models at the direct, indirect, and induced levels. Model 2, being the more comprehensive of the two models,

yielded higher impacts on all three levels. These impacts are important to note for several reasons. First, they help to uncover hidden links within a functioning economy. They also provide insight into the full reach of the green industry by including the industries most heavily relied on. Most importantly, the impacts generated by IMPLAN explain the importance of the green industry to the economy of Virginia by providing a value of output that would not exist without it. This industry was found to have significant financial influence on industrial sectors in the Virginia economy such as transportation, banking, and real estate.

Because the overall model framework is the same, both models show the most significant indirect and induced impacts in the same industrial segments. The highest of these impacts can be found in the services sector of the model, which encompasses industries such as all maintenance and repair facilities, legal services, medical services, and various membership sports and recreation facilities like country clubs and golf courses. Model 1 predicts almost \$37 million of created output in these sectors, and Model 2 almost than doubles this prediction to around \$68 million. Transportation, communication, and utilities industrial sectors are also heavily affected financially by final demand in the green industry. According to IMPLAN analysis, Model 1 predicts an impact of over \$35 million in the transportation and utilities sector, and Model 2 provided an estimate of close to \$50 million. The third most financially impacted industrial segment in this analysis was finance, insurance, and real estate. This segment is made up of all industrial sectors conducting banking, insurance, credit, and real estate transactions. Model 1 predicts the impacts on this segment at close to \$28 million whereas Model 2 increases that prediction significantly to around \$44 million. Indirect impacts totaled at around \$216 million for Model 1 and \$290 million for Model 2.

When accounting for the induced effects, the economic impacts on the industrial segments encompassing services, finance, insurance, real estate, and trade escalate exponentially. Model 1 estimates the induced effects on the services

sector to be over \$160 million, and Model 2 increases that estimate to over \$172 million. Concerning the finance, insurance, and real estate segment, predicted impacts are \$119 million (Model 1) and \$128 million (Model 2), respectively. The induced impacts on trade increase by a factor of close to 4 in both models. The green industry's indirect and induced impacts in these sectors brought about a sizeable amount of economic activity, accounting for between 0.2% and 0.3% of the total state output in those sectors. The green industry also has significant influence in the agricultural community of Virginia. Considering that nursery and greenhouse products are considered an agricultural commodity, according to these models the green industry is responsible for between 10% (Model 1) and 14% (Model 2) of total state agricultural output. The input-output framework uncovered these hidden links in the economy. Without this analysis, the links would remain hidden and this information would not exist. This analysis helps to show that the green industry is more heavily reliant on certain sectors than would have been revealed in a surface analysis.

The green industry is a heavily influential sector in the functioning economy of Virginia. Its impacts stretch over all sectors of the economy and range between \$2.03 and \$2.41 billion dollars depending on which model's output is considered. The multipliers and multiplier effects show that for even a small increase in final demand, there are rather large increases in output across the board. Problems arise when these influences are not recognized or accounted for by those in places of political power. Various legislative controls can and have been exercised that hurt this industry tremendously.

### **The Effects of Drought and Water Restrictions**

Remembering that multipliers work both ways, if the final demand for green industry goods decreases by one dollar because people are no longer allowed to care for the plants they have purchased or the lawns they maintain, the final output will decrease proportionally to the calculated multipliers. We have already stated that we plan to assume a 40% revenue loss to the landscaping industry

and a 20% loss to other related green industries. With these assumptions in place, the drought and restrictive water policies imposed by Virginia over the summer of 2002 resulted in a net loss to the green industry of over \$684 million according to Model 1 (VASS analysis), a decrease in revenues of over 33%. For Model 2 (combined sources), the net loss is around \$554 million, accounting for around a 23% loss of revenue. See the chart below for the impact results.

Table 4.6: Effect of Water Restrictions on Model 1, 2002 Dollars

<b>Sector</b>	<b>Direct</b>	<b>Indirect</b>	<b>Induced</b>	<b>Total</b>	<b>State Total</b>	<b>% of State Total</b>
Agriculture	0	5,000,682	2,588,474	7,589,156	3,231,437,198	0.2
<b>Nursery and Greenhouse Products</b>	<b>243,493,088</b>	<b>38,874,396</b>	<b>207,288</b>	<b>282,574,784</b>	<b>282,574,784</b>	<b>100.0</b>
<b>Landscape and Horticultural Services</b>	<b>507,594,976</b>	<b>64,007</b>	<b>429,417</b>	<b>508,088,416</b>	<b>508,088,416</b>	<b>100.0</b>
Mining	0	465,164	454,112	919,275	3,136,276,629	0.0
Construction	0	10,311,258	6,703,694	17,014,952	28,849,061,673	0.1
Manufacturing	0	7,461,411	28,448,396	35,909,808	88,615,478,222	0.0
Transportation, Communication, and Utilities	0	25,193,900	26,365,686	51,559,584	32,589,261,358	0.2
Trade	0	14,552,334	42,766,960	57,319,296	34,946,061,847	0.2
<b>Green Industry Retail Sales</b>	<b>0</b>	<b>387,719</b>	<b>23,204,256</b>	<b>23,591,976</b>	<b>23,591,976</b>	<b>100.0</b>
Finance, Insurance, and Real Estate	0	19,495,350	76,036,856	95,532,208	60,129,742,738	0.2
Services	0	23,930,088	102,187,552	126,117,648	80,275,729,220	0.2
Government	0	1,655,251	7,968,032	9,623,283	5,940,407,684	0.2
Other	128,334,152	0	932,482	129,266,634	47,848,073,197	0.3
<b>Total</b>	<b>879,422,216</b>	<b>147,391,559</b>	<b>318,293,205</b>	<b>1,345,107,020</b>	<b>386,375,784,942</b>	<b>0.35</b>

Table 4.7: Effect of Water Restrictions on Model 2, 2002 Dollars

<u>Sector</u>	<u>Direct</u>	<u>Indirect</u>	<u>Induced</u>	<u>Total</u>	<u>State Total</u>	<u>% of State Total</u>
Agriculture	0	6,816,699	3,309,331	10,126,030	3,231,437,198	0.3
<b>Nursery and Greenhouse Products</b>	<b>351,702,688</b>	<b>31,062,400</b>	<b>265,015</b>	<b>383,030,112</b>	<b>383,030,112</b>	<b>100.0</b>
<b>Landscape and Horticultural Services</b>	<b>249,769,872</b>	<b>248,876</b>	<b>549,010</b>	<b>250,567,760</b>	<b>250,567,760</b>	<b>100.0</b>
Mining	0	667,799	580,576	1,248,375	3,136,276,629	0.0
Construction	0	14,937,666	8,570,589	23,508,254	28,849,061,673	0.1
Manufacturing	0	18,391,406	36,370,916	54,762,320	88,615,478,222	0.1
Transportation, Communication, and Utilities	0	39,897,880	33,708,196	73,606,080	32,589,261,358	0.2
Trade	219,599,104	19,991,850	54,677,020	294,267,968	34,946,061,847	0.8
<b>Green Industry Retail Sales</b>	<b>194,612,272</b>	<b>1,081,877</b>	<b>29,666,340</b>	<b>225,360,496</b>	<b>225,360,496</b>	<b>100.0</b>
Finance, Insurance, and Real Estate	0	35,396,776	97,212,168	132,608,944	60,129,742,738	0.2
Services	0	53,738,336	130,645,504	184,383,840	80,275,729,220	0.2
Government	4,330,550	4,193,265	10,187,028	18,710,842	5,940,407,684	0.3
Other	199,992,128	0	1,192,167	201,184,295	47,848,073,197	0.4
<b>Total</b>	<b>1,220,006,614</b>	<b>226,424,829</b>	<b>406,933,861</b>	<b>1,853,365,316</b>	<b>386,420,488,134</b>	<b>0.48</b>

Remember that the VASS analysis associated 68% of the green industry revenues to the landscaping and horticultural services sector. 68% of Model 1 was decreased by a factor of 40%, whereas only around 20% of Model 2 was decreased by that value. The remaining revenues were decreased by a factor of 20% for both models. This explains the disparity between results.

Droughts and water crises are unfortunate realities. Restrictions on residential water use are an effective way to reduce water demand in times of emergency. Controlling the outdoor use of water is helpful because most of this water does not make its way back to the reservoirs, unlike indoor use where almost 90% of used water is returned. Unfortunately, the drought and restrictions tend to hurt certain economic sectors more than others. Water restrictions are implemented only in times of great water strain, but often such mandates are feared by industry participants because of the loss of revenue they associate with them. In fact, Florida green industry participants stated through survey responses that

drought and water use restrictions are seen as the number one threat to the industry as a whole.<sup>42</sup>

However, water restrictions do have allowances for those industries heavily reliant on water use. For example, golf courses are often permitted to water their greens, but often not their fairways. Public car washes are permitted to stay open for limited hours, and businesses that invest in newer watering technologies are often permitted water use allowances during certain times of day. Perhaps with increased awareness, similar allowances can be made for green industry participants.

### **Suggestions for Improvement**

This analysis was pieced together from many different sources to yield what we felt was the most accurate representation of the green industry. This was made necessary by poor response rates to the industry survey. Had the results not been biased, it would have been possible to complete this analysis without necessitating the use of other data sources. It would benefit both the industry and the analysts to invest more time and energy into the surveying process. A re-designed survey that clearly separates the different revenues and costs would be helpful in eliminating double-counting errors in hybrid businesses.

The redesigned survey should include sections separating out the taxed (goods) from the untaxed (services). The survey should definitively separate revenues for wholesale, re-wholesale, and retail sectors. A section questioning industry participants on what they believe to be risks to their businesses would help shed light onto possible improvements and money-saving techniques. For a complete representation of the industry, retail and re-wholesale industries should also be included in the initial data collection process. If necessary, private firms can be hired to elicit information from uncooperative larger entities.<sup>43</sup> Telephone surveys

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<sup>42</sup> Florida p. 43.

<sup>43</sup> Pennsylvania p. 23.

or reminders are also helpful in increasing response rates. By investing more time and energy into the data collection process, you ensure a more complete representation of the industry as a whole. Therefore the subsequent analysis can be more thorough, enabling such things as a more specific regional analysis along with the overall statewide analysis.

### **Final Thoughts**

The green industry is an important sector in the economic community of Virginia, and it continues to grow at impressive rates. With this continuing growth and expansion, the industry promises to continue its contributions to the state's economy, creating additional jobs, incomes, and adding to the overall beautification of the state. Although this report focused on the economic impacts of the industry, the contributions impact the economy in many other positive ways. Creation of communal recreation areas, wildlife preservations, and maintenance of golf courses, lawns, and gardens all create aesthetic benefits to surrounding communities and improve the quality of life of the civilians. These improvements, along with the economic contributions, give the green industry sizeable economic importance.

## Appendix – Regression Statistics

The REG Procedure  
 Model : MODEL1  
 Dependent Variable: Inshare

### Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	1318.04877	659.02439	421.20	<.0001
Error	1867	2921.19256	1.56465		
Corrected Total	1869	4239.24133			

Root MSE	1.25086	R-Square	0.3109
Dependent Mean	-7.64714	Adj R-Sq	0.3102
Coeff Var	-16.35720		

### Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr >  t
Intercept	1	7.68833	1.26592	6.07	<.0001
Inamount	1	-2.23082	0.25688	-8.68	<.0001
Insqamount	1	0.07360	0.01300	5.66	<.0001

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