

GREENER GRASS? FACTORS RELATED TO REDUCING ENVIRONMENTAL
IMPACTS OF LAWN CARE COMPANIES

by

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ABSTRACT

GREENER GRASS? FACTORS RELATED TO REDUCING ENVIRONMENTAL IMPACTS OF LAWN CARE COMPANIES

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Co-Chairs: Rachel Kaplan and Raymond De Young

Lawn care companies, in response to the cultural norm of a green, weed-free lawn, are providing services that can negatively impact both ecological and human health. Since these companies have widespread impacts and are relied upon for their expert decisions, it is useful to understand factors that influence their practices. This study examines the roles that *psychological factors*, *company characteristics* and *use of information sources* play in influencing lawn care companies' decisions regarding fertilizer and pesticide application. The intention is to identify strategies for improving communication with lawn care companies as a means of influencing their practices.

Interviews (n=29) and a survey (n=65) administered in southern Michigan explored how *company characteristics* and *psychological factors* affect lawn care companies' *use of information sources*. Then, each of these three domains was examined for their effect on a variety of lawn care practices involving fertilizer and pesticide use.

Findings suggest that lawn care managers' motivations match their use of information sources; for example, companies with managers motivated by business considerations were significantly more likely to use industry-promoting information sources. With respect to practices, industry-promoting information sources were shown to be related to use of preferred fertilizers (such as slow-release nitrogen), but also to damaging pesticide practices (such as weed-n-feed). Furthermore, larger lawn care companies made more applications per year and were significantly less likely to engage in preferred pesticide practices (such as Integrated Pest Management).

Recommendations are detailed to assist organizations that communicate with lawn care companies in efforts to improve ecological and human health. These organizations should consider utilizing industry-promoting sources, targeting larger companies, and framing the messages to match the motivations salient for the greatest percentage of lawn care companies—business considerations. In addition, efforts could be made to simultaneously address the cultural norm of the weed-free lawn aesthetic, and to encourage lawn care companies to recognize that they can be agents of change to reduce impacts on the environment.

CHAPTER ONE

LAWN CARE AND ENVIRONMENTAL IMPACTS: INTRODUCTION AND OVERVIEW OF STUDY

Lawn care, the environment, and human health

As land is developed into suburban and urban uses, lawns and their associated problems have become a major threat to the quality and health of the environment (Robbins, 2003). Lawns occupy about 32 million acres of the US landscape (Milesi et al., 2005), an area larger than the size of the state of Ohio. As new housing is established in suburban areas lawns are commonly planted as a ground cover (Jenkins, 1994), and now represent approximately 23% of all developed land (Robbins & Birkenholtz, 2003).

Part of what is driving this expansion in lawns is the cultural importance that has become associated with lawns in the US over the past sixty years (Jenkins, 1994; Steinberg, 2006). The maintenance of a green, weed-free lawn is now considered by many to be a civic responsibility and a requirement for being a good neighbor (Steinberg, 2006). The lawn care industry promotes use of its products by capitalizing on the desire to maintain this perfect lawn image. Although maintaining this green, weed-free lawn is a powerful social norm in many suburban communities, the maintenance of lawns has been associated with numerous environmental and health problems (Shern, 1994).

Environmental and health impacts

The care for lawns has been documented as contributing to a variety of changes in the environment, including negative impacts on water quality, air quality, and other environmental problems related to human and ecosystem health (Bormann et al., 2001). Lawns often require large amounts of water inputs, and cutting the grass commonly uses fossil fuels and releases emissions (Priest et al., 2000; Robbins, 2007). A substantial amount of pesticides and fertilizers is applied to lawns each year, with residential land

use applications per acre equaling or exceeding that of agricultural areas (Robbins & Birkenholtz, 2003).

Use of fertilizers has been linked with numerous environmental water quality problems, most notably nuisance algae, eutrophication, and contaminated groundwater (Barth, 1995). In the state of Michigan, where adequate levels of phosphorus are found in most soils, the application of additional phosphorus has the potential to run off the lawn, impacting surface water and streams or lakes (Carpenter et al., 1998; Frank, 2005; Shuman, 2002). Use of nitrogen in fertilizers can also run off and contaminate larger water bodies (Guillard & Kopp, 2004; Shuman, 2002), and has the potential to leach through soils and contaminate groundwater (Erickson et al., 2001; Frank et al., 2006; Relf, 1997).

Pesticides used in lawn care have been associated with multiple human health and environmental problems. Research has shown correlational relationships (of varying strength) between pesticides and health issues, including increased risk for leukemia (Lowengart et al., 1987) reproductive and fertility problems (Shaw et al., 1999), birth defects (Garry et al., 1996; Hunter et al., 1999; Kristensen et al., 1997), Non-Hodgkin's Lymphoma (Cantor et al. 1992; Zahm & Blair, 1992), Parkinson's Disease (Hubble et al., 1993), and cancer (Alavanja, 2003; Gold et al., 1979; Fleming et al. 1999; Teitelbaum et al., 2007). In addition to these increased risks for humans, pesticides have been found to be toxic to some birds (Bart, 1979; Stansley et al., 2001), amphibians (Hayes, 2006; Howe et al., 2004), and have been proposed as a possible cause in the recent decline of pollinators (Ingram et al., 1996a; Ingram et al., 1996b; USFWS, 2006). Pesticides have been found in water, including drinking water, and have impacted numerous fish and other aquatic organisms (Connors & Black, 2004; Johnson & Finley, 1980; Mechenich & Shaw, 1994; Stokstad, 2008). They often impact non-target species including beneficial organisms in the soil as well as important habitat for a variety of species (Cox 1995; Pimentel et al., 1992). In addition, several studies on pets have revealed adverse health effects, including liver problems, digestive disorders, and canine malignant lymphoma (Glickman et al., 2004; Hayes et al., 1991; Smalley et al., 1968). Although pesticides

currently used in lawn care have been approved by the US Environmental Protection Agency (US EPA), research continues to uncover toxicities, and regulations continue to be revised. A recent restriction in 2000, on the distribution of diazinon and chlorpyrifos—two common lawn organophosphates that present an exposure hazard—was established in an attempt to stop the sale of home and lawn forms of these products, but new products have appeared to replace them (Robbins, 2007).

Because of the toxicity of many pesticides, numerous communities in Canada have banned the use of them for non-essential cosmetic lawn purposes (Kassirer et al., 2004). In the US, while pesticides used in the agriculture sector have been decreasing, the use of lawn and garden pesticides has been increasing over the past few decades, and is the only pesticide sector to show growth in sales (Donaldson et al., 2002).

Lawn care industry

Lawn care companies are situated close to the problems associated with lawn care, as they make decisions about practices and services that can have widespread impacts. Although many lawns are cared for by do-it yourselfers, the lawn care industry is expanding, managing an increasing number of lawns (Jenkins, 1994). In 2003, lawn mowing services were reported as growing at 39% per year, while the turf fertilization market was growing at 9% and weed control was growing at 5% per year (Brakeman, 2003). Companies are relied on by customers to make good lawn care decisions, and many manage turf for commercial facilities such as corporate offices, apartment complexes, or day care centers. In addition, research has shown that the lawn's appearance is often of more concern than the environmental impacts related to its care (Robbins, 2007), and one study found that the appearance of the lawn was valued more by those who hired a lawn care company than by those who cared for their own lawns (McGrath, 2004). These issues, combined with the fact that lawn care companies apply, on average, more chemical applications per year than are applied by residents (Scotts, 2006), highlight the importance of addressing factors influencing lawn care companies.

Factors influencing lawn care companies

In addition to the cultural norm dictating the American lawn aesthetic, several other factors are likely to influence lawn care company practice decisions. Research suggests two factors that are important for certain companies to reduce their impacts on the environment include information sources and psychological variables of the owner/manager (Mir, in press). Lawn care companies that are more likely to use certain information sources, such as those from watershed councils that stress environmental impacts or those from product vendors that emphasize product features, may take different approaches to their lawn care practices. Psychological factors such as beliefs, motivations and a sense of responsibility are likely to influence both a company's choice of information sources and their lawn care practices. Lawn care company managers who are motivated to take action to reduce impacts on the environment because they believe that this is good business may be more likely to choose certain practices that reduce impacts such as testing soil before determining a fertilizer nutrient grade. In addition, company characteristics such as the size of the company or the number of years that a company has been in business are likely to influence a lawn care company's use of certain information sources and the types of practices in which it engages. Larger companies may have a larger network of sources from which to gather information about the environment, and may choose certain practices such as using slow-release fertilizer learned about through this network. A better understanding of these factors will guide more effective communication with lawn care companies for organizations that seek to reduce environmental and health impacts. The following examines each of these factors in more detail.

Use of information sources

Different organizations such as industry groups, government agencies, and watershed councils communicate about issues related to lawn care practices, but they may not all be met with equal acceptance by lawn care companies. Instead, companies might favor and use certain sources over others, and some may seek more information and look across a broader set of sources. The extent to which different lawn care companies have access to and seek out different kinds of information is likely to vary, because certain information sources such as watershed councils may communicate less information than trade

associations or university extension agencies and lawn care companies may have different kinds of relationships with (and evaluations of) information sources. This variance in use of information sources can translate into different practices, as different sources are likely to emphasize different issues and frame information differently.

Because of these differences, it is important to understand which information sources lawn care companies are more likely to use, what influences the use of these sources, and how these translate into different practices performed and services offered. Are lawn care companies that use more information sources more likely to incorporate buffers between their chemical applications and waterways? Are those that use environmental non-profit sources more likely to be motivated by an environmental ethic? The answers to these questions can inform strategies for more effective communication with lawn care companies in order to reduce impacts on the environment. Several factors related to the information sources—including the frequency of communication, the mode of distribution, and the content—can influence a lawn care company manager’s use of certain information sources. At the same time, underlying the manager’s decisions to attend to information sources and engage in practices are psychological factors including beliefs, motivations, and sense of responsibility.

Psychological factors

Psychological factors that relate to taking action to reduce impacts on the environment can include beliefs about one’s role or one’s impact, motivations such as government regulations or business considerations (such as customer concern, reputation, better equipment), as well as having a sense of responsibility to engage in activities that go beyond regulations. The literature on pro-environmental behavior attempts to make clear divisions between beliefs, attitudes, motivations, and sense of responsibility, but these distinctions are not clean, as a belief can motivate someone to action, and a sense of responsibility can act as both a belief and a motivation. This study examines beliefs, motivations, and sense of responsibility as part of the same psychological framework that people use to make decisions. Although most pro-environmental literature identifies these psychological variables as resulting from information inputs, this study explores the role that these psychological variables play as antecedents to the choice of information

sources, drawing from the idea that people tend to trust information sources that confirm their way of seeing the world (Renn & Levine, 1991; White et al., 2003). In addition, these psychological variables are likely to affect decisions about lawn care practices. Lawn care professionals who are motivated to reduce impacts on the environment by business considerations such as company image may be more likely to avoid damaging practices such as broadcast spraying of pesticides. Those motivated by business considerations may differ from those who are more motivated by a desire and sense of responsibility to go beyond regulations. Understanding the roles that these psychological variables play is essential for designing more effective communication plans for those organizations seeking to reduce impacts of the lawn care profession.

Company characteristics

Use of information sources and decisions to engage in actions that reduce impacts on the environment can also be influenced by characteristics of the company, such as its size, the number of years it has been in business, whether it has predominately residential or commercial customers, and its policies regarding training of employees. Lawn care companies differ in size and structure, ranging from one to several hundred employees, and most fall within the category of small-to-medium enterprises (SMEs). Very small companies are expected to take fewer actions to reduce impacts on the environment, partly because of more limited access to information, partly because of perceived costs, and partly because of their perception that they are only making a small impact (Revell & Blackburn 2007; Taylor et al., 2003). Research has shown that companies that have been in business for longer periods of time are more likely to take actions to reduce impacts (Mir, in press). In addition to the number of years in business, companies are likely to differ in the amount of training that they offer to employees. A company's commitment to sharing information by training employees may be related to the ways that it gathers information (and uses information sources) and to the practices it chooses (Petts et al., 1998; Post & Altmann, 2004). Offering more training may be related to using more information sources and engaging in more practices that reduce impacts on the environment. Lastly, it is hypothesized that lawn care companies that have more residential (rather than commercial) customers, will be more likely to engage in practices that reduce their environmental impact. This is based on differences in the fundamental

quality and perceived use of these types of properties. Lawn care companies caring for a greater percentage of residential properties may need to take more precautions to limit exposure to children or pets and may therefore be more likely to avoid damaging practices such as broadcast spraying of pesticides. In general, these company characteristics can influence the kinds of practices chosen by a lawn care company and need to be examined alongside the other variables identified, information sources and psychological factors.

Research questions

In order to better understand how to improve communication with lawn care companies and reduce detrimental environmental impacts associated with lawn care, this research is seeking to answer the following three questions:

- 1) Which psychological factors and company characteristics influence the types of information sources that lawn care companies are more likely to use?
- 2) In what ways do company characteristics, psychological factors, and use of information sources influence a lawn care company's practices with respect to application of fertilizers?
- 3) In what ways do company characteristics, psychological factors, and use of information sources influence a lawn care company's pesticide application practices?

Structure of dissertation

This dissertation is divided into seven chapters that explore the relationships between company characteristics, psychological factors, use of information sources, and lawn care practices among lawn care companies in southern Michigan. Chapter Two provides a literature review of the context for lawn care, the main constructs in the study, and how they are related to each other. Chapter Three outlines the research methods and introduces company characteristics as a key independent variable. In Chapter Four, these company characteristics as well as psychological factors are examined as potential influences on lawn care companies' use of information sources. The influences of all three domains—company characteristics, psychological variables, and use of information sources—are examined with respect to lawn care practices in the following two chapters.

More specifically, Chapter Five focuses on fertilizer practices such as testing soil before choosing a fertilizer grade and choosing slow-release, low/ no phosphorus products, while Chapter Six explores pesticide practices including damaging practices such as use of weed-n-feed products and preferred practices such as Integrated Pest Management. The final chapter, Chapter Seven, explores the implications of the findings and offers recommendations.

CHAPTER TWO

FACTORS INFLUENCING LAWN CARE PRACTICES: A REVIEW OF THE LITERATURE

Many lawn care companies engage in environmentally unsustainable practices influenced by a complex mix of institutional, informational, and psychological factors. This chapter provides a review of the literature on factors that influence lawn care practices, including social norms, use of information, psychological variables, and company characteristics. The chapter begins with a review of literature on the history behind the norms that encourage lawn care companies in the US to maintain a particular aesthetic ideal, and an overview of resulting detrimental impacts on the environment and human health. Next the chapter examines the role that information plays in relation to the practices of lawn care companies. The literature on three underlying psychological factors—beliefs, motivations, and sense of responsibility—is then detailed in an effort to highlight lawn care company managers’ decisions to choose practices that reduce impacts on the environment. The chapter includes an overview of the literature on company characteristics that can influence environmental responsibility among small-to-medium sized enterprises such as lawn care companies, and concludes by identifying gaps in the literature and a context for this study.

Lawn aesthetic and lawn care impacts

Since the post-WWII housing boom, maintaining an emerald green, weed-free, closely cut lawn has been valued for “aesthetic, psychological, normative, and economic reasons” (Shern, 1994), and several theories exist on how and why the American lawn aesthetic grew in popularity in the way that it did. Although grasses have been around as a ground cover for much of human history, the ubiquity of turfgrass is said to be a modern phenomenon that is the result of a complex web of forces (Robbins, 2007).

Jenkins (1994) provides a detailed account of the history of the American lawn, and describes the evolution of the aesthetic in several waves. One of the early influences was the original American suburban communities in the 19th century, which were designed to be park-like, borrowing from earlier English and European landscapes of the wealthy and royal. Later, according to Jenkins (1994), the influence of the growth in popularity of golf helped shape the American lawn aesthetic, and middle-class suburbs were developed in a new car culture in which symbolic expressions of leisure and wealth began to be displayed in front of more ordinary people's homes. Steinberg (2006) presents a complementary environmental history to describe a similar pattern with suburbanization, and in particular, Levittowns, fueling the increased desire for lawns. The desire for a "perfect" lawn, he suggests was inspired by new trends in color as well as the democratization of golf and its emphasis on research on chemicals and new varieties. The chemical and industrial revolutions combined with other technological advances (such as lawn mowers, and then gas-powered lawn mowers), and effective advertising added to the popularization of the lawn as the standard suburban landscape (Jenkins 1994, Steinberg 2006). The post-WWII housing boom that drew on all of these influences helped create a lawn-dominated suburban landscape which now seems to have always existed.

Environmental impacts of lawn care

Robbins (2007) demonstrates that many people who value lawn care are also people who care greatly about the environment, and of these seemingly conflicting values, the desire to be neighborly by presenting a nice lawn often takes precedence over reducing one's impact on the environment. As a result, many people sacrifice ecological and human health in an effort to take care of their lawns and be respected by their neighbors. Some lawn care industry companies even suggest to their customers that they are doing something good for the environment by taking care of their lawn (Lawn Institute, 2006, in Clayton, 2007).

Maintaining lawns to achieve the "perfect" aesthetic is associated with devastating effects on human and environmental health (Bormann et al., 2001; Robbins, 2007; Steinberg, 2006). The list of impacts is extensive, with some problems more widely recognized than

others. For instance, in an effort to reduce harmful air emissions associated with polluting lawnmower engines, the US EPA has recently made an effort to regulate the phasing in of new technology to reduce this impact (Werner, 2006). Less recognized is the fact that with the exception of Red Fescue, all of the dominant turfgrass species in North America are non-native, and many have arrived in the US in the past century (Robbins & Sharp, 2003). The upkeep of these non-indigenous landscapes is often associated with great water needs and a variety of chemical inputs.

Excessive use of lawn fertilizers can run off of properties and contribute to non-point source pollution, cited by some as one of the most complex water pollution problems facing the Great Lakes region (Bocking 2002). Excessive phosphorus in the water can result in nuisance algae or eutrophication, and there are cases in which overfertilizing with the nutrient nitrogen can leach through soils and contaminate groundwater, especially when rainfall or watering levels are high (Barth, 1995; Carpenter et al., 1998; Erickson et al., 2001; Schueler, 1995; Shuman, 2002). In the state of Michigan, adequate levels of phosphorus are found in most soils, and the application of additional phosphorus has the potential to contribute to algae blooms and associated dead zones (City of Ann Arbor, 2006; Frank, 2005).

Pesticides used in lawn care have been shown to lead to numerous problems as well. Although lawn care professionals are licensed and many take precautions to reduce chances for human exposure, pesticides have been discovered to have been tracked inside homes where conditions for their breakdown are less ideal, so they can persist for longer periods of time (Nishioka et al., 1996; Nishioka et al., 1999). Research has demonstrated correlational links between pesticides and many human diseases including increased risk for reproductive and fertility problems (Shaw et al., 1999), birth defects (Garry et al., 1996; Hunter et al., 1999; Kristensen et al., 1997), Non-Hodgkin's Lymphoma (Cantor et al., 1992; Zahm & Blair, 1992; Zahm et al., 1992), Parkinson's Disease (Hubble et al., 1993), and cancer (Alavanja, 2003; Gold et al., 1979; Fleming et al., 1999; Teitelbaum et al., 2007). Although the associations have not been determined to be causal and they vary widely, the increased likelihood for disease suggests that these findings need to be

strongly considered. Pesticides pose the greatest threat to children who are most vulnerable because of their stage of development (USEPA, 2002; Garry, 2004).

In addition to being associated with adverse effects on humans, pesticides also pose a threat to the integrity of ecosystems and health of wildlife and animals. Many pesticides have been found to be toxic to birds (Bart, 1979; Stansley et al., 2001), amphibians (Hayes et al., 2006; Howe et al., 2004), and have been associated with the decline of pollinators (Ingram et al., 1996a; Ingram et al., 1996b; USFWS 2006). Pesticides have been detected in water and have impacted fish and other aquatic organisms (Conners & Black, 2004; Johnson & Finley, 1980; Stokstad, 2008). They often impact non-target species including beneficial organisms in the soil and important habitat for a variety of species (Cox, 1995; Pimentel et al., 1992). In addition, several studies have revealed adverse health effects on pets (Glickman et al., 2004; Hayes et al., 1991; Smalley et al., 1968). These impacts are related to individual pesticides because the majority of research is limited in its approach to studying pesticide exposure. This masks the true impact of pesticides which might show substantially more negative associations as research is conducted on combinations of pesticides (Hayes et al., 2006)—a more likely scenario in suburban and urban watersheds. In addition, inert ingredients are often not tested and in some cases have been found to be more toxic than the active ingredients which are more commonly tested (Cox, 1995).

In the US, the use of lawn and garden pesticides has been increasing over the past few decades, and is the only pesticide sector to show growth in sales (Donaldson et al., 2002). The main purpose for all of these lawn chemicals is to create and maintain the cosmetic appearance of the lawn, land for which maintenance is often reported as the most common activity (Shern, 1994).

Opposition to lawn care practices

There is evidence of a small but visible movement that seeks to substantially reduce or eliminate the use of chemicals in lawn care. In addition, governments in certain municipalities are establishing policies aimed to reduce the impacts of lawn care practices. Numerous communities in Canada have banned the use of pesticides for

cosmetic purposes (Kassirer et al., 2004), and the state of Minnesota and several northern US communities have banned or severely restricted the use of phosphorus in fertilizer, as this nutrient is abundant in many soils of this region (Robbins, 2007).

Several non-profits are involved as well. One national environmental group in the US, Beyond Pesticides, has actively challenged anti-regulation messages created by the lawn care industry associations, possibly contributing to political tension between the industry groups and people with an interest in environmental issues. Another group, the Toxic Actions Center, has produced a report entitled, “Refuse to Use Chemlawn for a Truly Green Lawn,” aimed at potential users of the largest lawn care company in the US, TruGreen Chemlawn (Wilson & Rasku, 2005). Formulators of lawn care products have been criticized by many groups, including the National Cancer Association, for their creation and marketing of products that are considered toxic or linked to health problems (Robbins, 2007). Several groups have tried to address legislation, and have been fighting to change lawn care practices around school grounds (Miller, 2007).

Alternatives to lawns

The cultural norm of the lawn goes nearly unquestioned by much of the public, although there is also a growing movement that has sought to replace lawns with more ecologically friendly alternatives (Bormann et al., 2001). In his book *Second Nature*, Pollan (1992) reflects on the problematic environmental impacts of lawn care, and asks the important question, “*Why Mow?*” The forces operating against this simple question are also major contributors to the perpetuation of certain aspects of the lawn norm. Most communities in the US require residents to mow by having regulations on maximum lawn heights that can result in fines as well as government intervention to make sure that lawns are kept short (Bormann et al., 2001; Robbins, 2007). These kinds of laws were designed with public health interests in mind, but they contribute to the difficulty in establishing alternatives to a lawn, and in the end are working against public health interests.

Nevertheless, certain people, organizations and communities have tried to reframe the lawn aesthetic to include alternatives that have less impact on the environment. Several communities, such as in parts of the northern Midwest have encouraged the planting of

rain gardens (Robbins, 2007), collections of tolerant plants planted in swales that grow deep roots and offer the benefit of absorbing larger amounts of stormwater than a typical lawn and reducing the surface stormwater flow. Once established, rain gardens require much less care, and typically do not include the addition of inputs such as pesticides. Some communities in the Northeast have encouraged residents to allow whatever grows in the soil to be the lawn, known as the “freedom lawn,” a more biologically diverse landscape requiring less effort and inputs (Bormann et al., 2001). Other communities have tried to reframe what is considered a weed by focusing on the beauty and cultural importance of lawn species such as dandelions, or the ecological services provided by groundcovers such as clover (Robbins, 2007). Several organizations such as the National Wildlife Federation and Wild Ones encourage the planting of species that are likely to create better habitat for wildlife or that are more ecologically appropriate (Robbins & Sharp, 2003). In water sensitive areas such as the Southwest, the practice of xeriscaping, in which drought tolerant plants are chosen, is often greatly encouraged. On a less transformative level, there are signs that some people are reducing the amount of yard committed to a green grass lawn, recognizing that they do not need or use the entire lawn (Bormann et al., 2001), which reduces the amount of care and inputs used to service the lawn.

Efforts to influence preferred practices

Offering a different alternative, various organizations share information on and encourage what are considered to be environmentally preferred practices, which reduce impacts on the environment but maintain the lawn aesthetic that has become perceived as an important part of community responsibility. These preferred practices include mowing grass high, leaving clippings behind to act as a fertilizer, clearing fertilizer from hard surfaces such as sidewalks or driveways after an application, using certain types of fertilizers such as those with low or no phosphorus or slow-release nitrogen, testing soil before choosing a fertilizer grade, avoiding broadcast applications of pesticides, avoiding weed-n-feed type products that can lead to overuse or poorly timed applications, and encouraging the use of Integrated Pest Management, an approach that utilizes biological, cultural, mechanical, and physical means of reducing pests before resorting to use of chemicals (Frank, 2005; MDEQ, 1992; SOCWA, 2005, 2008; USEPA, 2004).

These alternative lawn care practices are encouraged by a range of organizations, such as university-based extension offices, local watershed councils and state agencies, in efforts to influence lawn care practices in general. In most cases, these organizations are encouraging voluntary reductions of environmental impacts. Some state agencies, such as the Michigan Department of Agriculture, are responsible for regulating use of chemical inputs such as pesticides, whereas other state agencies, such as the Michigan Department of Environmental Quality, oversee potential regulation on use of fertilizers. Smaller local groups, such as the Southeast Oakland County Water Association—a division of a regional government in Michigan, have developed healthy lawn and garden programs in attempts to influence practices of both do-it yourselfers and lawn care companies. Industry groups, such as the Michigan Green Industry Association, have also developed programs to encourage environmental stewardship in lawn care.

Role of lawn care companies

While do-it-yourself residents have been criticized as being the main source of overuse of fertilizers and pesticides (Focus Group, 1999), lawn care companies have a potentially larger impact on the environment. One report by Scotts (2006) suggests that do-it yourselfers apply, on average, two applications of lawn treatments per year, whereas lawn care companies average five applications per year; lawn care companies' impact per acre, therefore, is likely to be more substantial. In addition, lawn care companies are responsible for servicing multiple properties, and as a result, changes in their practices can have more widespread impact. Many lawn care companies also maintain commercial properties including apartment and condominium complexes, places of worship, and corporate parks, a growing and substantial part of the landscape that are less likely to be maintained by do-it yourselfers.

The percentage of lawns being serviced by lawn care companies is not precisely known, as reports suggest different figures in different parts of the country; but the trend is certainly one in which more lawns are being serviced by lawn care companies each year, and this number is expected to continue to grow (Brakeman, 2003; UMN Extension, 1998). The growth in the use of lawn care companies may be due in part to the difficulty

involved in maintaining the perfect lawn aesthetic and the hectic schedules that many people have. Lawn care companies have indeed shown a greater ability to produce the aesthetic of lawn that is so commonly desired (Robbins, 2007). In addition, the aging of the US population is expected to contribute to this growth in use of professional lawn services as well (West, 2003).

Factors influencing lawn care practitioners

Given the widespread potential for impacts resulting from the practices of lawn care companies and the growth in the lawn care service sector, the focus of this dissertation is on lawn care companies. The cultural, economic and historical influences illustrate the strong motivations present for lawn care companies to satisfy a desired aesthetic.

However, the push for lawn care companies to minimize their impacts on the environment may not be as strong or widespread an influence, as pointed out by Robbins (2007). Yet, many lawn care companies make decisions that reduce their impacts on the environment, such as by avoiding broadcast applications of pesticides or testing soil before choosing a fertilizer. Understanding the factors that contribute to these decisions can shed light on strategies for reducing overall impacts on the environment caused by lawn care companies.

In describing differences between lawn care companies, it is important to recognize that these organizations can differ tremendously in their size and structure, ranging from one person and a truck to very large corporations consisting of hundreds of people and fleets of trucks. The vast majority of lawn care companies are considered small-to-medium enterprises (SMEs) in the organization management literature¹, with most being micro enterprises (<10 employees) and family-owned businesses. There are also a few very large corporations that operate across several states.

Some research on corporate greening has focused on the beliefs of individual managers to explain differences between organizations (Flannery & May, 2000; Sharma, 2000;

¹ Small business definitions vary across countries and across sectors: micro <10, small <50 and medium <250 for some studies in UK (Revell & Blackburn, 2007, from SBS, 2000), while in the US, small business can be either <100 or <500 or less than certain standard gross income levels (USSBA, 2007).

Zietsma & Vertinsky, 1999), as these managers are making policy level decisions for the organizations. While Prakash (2000) has pointed out that individuals within firms can vary tremendously in their beliefs and values, and therefore may not represent the entire company, managers making policy-level decisions that structure the companies' practices can be assessed to better understand the relationship between beliefs and practice decisions at the organization level. Recognizing this, and because lawn care companies can differ so much in size and structure, theories from both organizational management and individual-level psychology literature can provide insights into how decisions are made in lawn care companies across a range of sizes. The most pertinent literature is that focused on SMEs and microenterprises, but research focused on different levels is included to address various organizational structures.

An overview of the research on SMEs suggests that two important characteristics that influence decision-making and environmental behavior are information and psychological characteristics of the owner/manager (Mir, in press). An in-depth look at how organizations and individuals seek and use information to assist with decision making builds on the concept of access to information, and is detailed in this section along with an overview of the role that certain psychological variables may play.

Use of information

The information that lawn care companies use is a critical factor to consider in understanding their decision-making processes. Organizations often use information strategically to make sense of changes in their situation and to help make decisions (Choo, 2006). Lawn care companies need to know about new regulations affecting their business, new opportunities that will add to their competitive edge or help cut costs, and new strategies for dealing with pests such as grubs or dandelions. Information can also serve as a motivation for taking action or provide guidelines for how to act. Several communication models and theories emphasize information as a fundamental influence on decision-making (see Wilson, 1997; Choo, 2006), and information can lead to knowledge and understanding, which serve as the foundation for any action (Choo, 2006). Information can influence the modification of one's behavior; and people are said to act more reasonably and cooperatively if their information needs are met (Kaplan &

Kaplan, 1982). At the same time, the provision of information often does not lead to intended consequences (Costanzo et al., 1986). For these reasons, a focus on the use of information is appropriate. Understanding the factors that influence the use of information sources can suggest more effective ways to communicate with lawn care professionals.

Organizations such as lawn care companies encounter an abundance of information, regardless of their intention to seek it. Whether coming from a regulator highlighting a rule or a vendor marketing its products, information targeted at lawn care companies is in great supply, and the lawn care company must decide what is most relevant for its needs at various points in time. The decisions to attend to information occur across time and place, and the information can be from both formal and informal sources (Choo, 2006). Competition for the attention of the lawn care professional exists not only from messages about lawn care, but also from the enormous amount of information that individuals encounter in their everyday lives. An understanding of how people cope with the abundance of information and choose to attend to certain information sources to meet their information needs can be illuminated by understanding the role that heuristics play in allowing people to more quickly make decisions.

Heuristics and selecting among information sources

Although many behavior models suggest that decision making is a rational process, this perspective has been the target of substantial criticism over the past several decades (see Shafir & LeBoeuf, 2002). People are likely to be limited in time and resources necessary to process large amounts of information (Choo, 2006), and have evolved to make quick decisions as a critical act of survival (Todd & Gigerenzer, 2003). People develop biases and heuristics as shortcuts to make decision making easier (Gilovich et al., 2003; Kahneman & Tversky, 2000; Kahneman et al., 1982; Todd & Gigerenzer, 2000). These heuristics come in many forms such as using information that is most easily accessible or that which is based on direct experience, even if anomalous. People use mental models to help make sense of the abundant information they encounter, as the models serve as reference points from which to evaluate information. People can actively seek out new information as a way of building mental models and balance this exploration with making

sure that they understand the new information (Kaplan & Kaplan, 1982). For instance, lawn care professionals may seek information to help them address a persistent grub problem or may read news alerts to understand weather patterns that will affect their business.

The building of mental models can influence both the choice of information and the desire to go beyond what is known and explore more information. People use their mental models, no matter how well developed, to make decisions. This can influence not only what they see, but also what they do not see. A manager who does not have a category developed to represent a certain focus area will not be likely to use information targeting that focus. On one hand, people might disregard or ignore information that does not fit within their realm of experience or does not support their way of seeing the world. On the other hand, when they recognize that they do not know something that would be useful or beneficial, they can be motivated to go beyond the information and seek out different sources or types of information.

Trust in information

In deciding what information to use, people can have a bias toward seeking information that confirms their own perspectives, and are more likely to trust information that matches their already established beliefs (Renn & Levine, 1991; White et al., 2003). A substantial amount of literature over the past fifty years has focused on understanding how source credibility plays a role in use of information from the perspectives of the source itself, the message being communicated, how the information is communicated, and factors related to the receiver (Pornpitakpan, 2004). One conclusion is that in all cases, high levels of source credibility make information more likely to be received and believed. Many factors influence a person's trust in information including perceived similarity with the organization or person communicating, perception that the communicator has one's interests in mind, and perceived objectivity. The importance of trust in the source of information has been well studied in persuasion, dating back to research by Hovland et al. (1953) on source credibility, which looked specifically at perceived competence, objectivity, and caring as dimensions of trust.

Lawn care companies have multiple reasons to trust or distrust based on experience, awareness, or inference (Hardin, 2004; Lewicki et al., 1998). Credibility can be determined either through first-hand experience in which various assessments are made, or by reputations, or third-party reports or advice. An important point about credibility is that it is a perception, not a trait inherent in the source. Kaufman et al. (2003) suggest that people use “credibility/trust frames,” including group endorsement frames, credentials frames, objectivity frames, and personal relationship frames to evaluate technical information presented by organizations. These frames act as heuristics to help with deciding what information to use. Hertzum (2002) showed that for a certain professional group, software engineers, ease of trustworthiness may be a greater influence than accessibility in explaining their higher use of certain information sources. Relying on familiar information sources can reduce the cognitive effort needed to evaluate the trustworthiness of new information, with trustworthiness being a major determinant of the use of the information.

Relevance

In addition to being trustworthy, information is more likely to be used if it is relevant to the concerns of the users (Kaplan & Kaplan, 2003). Relevance is considered a foundational concept in understanding use of information sources, and has “cognitive, affective, and situational dimensions.” (Choo, 2006, p. 67; Saracevic, 1975). Information can be relevant to a topic of interest, a set of goals or motivations, or one’s situation. For instance, a lawn care manager who is motivated to replace equipment will likely scan ads related to his or her equipment needs. This person might attend an exposition and spend time in the showroom rather than attending presentations. If looking to improve safety standards, a manager might actively seek articles dealing with safety issues and ignore articles about soil testing. In this way, people go beyond confirming what they know and explore information relevant to their needs.

Information and lawn care practices

The use of information is indispensable in decision making, and decisions can shape a great range of lawn care practices and behaviors. Decisions such as whether to test soil or to engage in broadcast application of pesticides are likely to be part of the policy

developed by the management. Identifying how use of different information sources influences decisions about practices is a fundamental question to address. Is the source of the information, such as a watershed council, more likely to affect preference for environmentally-preferred practices? Does the use of more information sources translate into choosing different practices?

Underlying psychological factors

In addition to information, several underlying psychological factors can play a role in lawn care company managers' decisions to establish practices that reduce impacts on the environment. One can imagine that managers are motivated by business considerations such as satisfying customers, creating a positive image, or cutting costs as well as avoiding the negative incentive of fines associated with government regulations (Masurel, 2007). Other factors may also motivate a lawn care manager to establish practices that reduce impacts on the environment, including ethical reasons or efforts to take care of one's employees (Masurel, 2007). In addition, belief structures, such as those about the magnitude of environmental impact or what entity is most responsible for reducing environmental impacts are also likely to play a role in motivating action. Understanding the extent to which (and conditions under which) these various motivations influence action is critical for improving communication with lawn care companies to reduce their impacts on the environment.

A large body of research links various psychological factors with engagement in environmentally sustainable behaviors. Several models have been developed to better understand and predict behaviors based on psychological factors. Models include variables such as *beliefs* (Ajzen & Fishbein, 1980; Fishbein & Ajzen 1975), and *personal responsibility* (Schwartz, 1970, 1977; Thøgersen, 2006, Van Liere & Dunlap, 1978), and most imply a combination of these serve as a motivation for action (Pelletier, 2002). Although these models do explain environmental behaviors, no one model has stood out as superior for predicting the adoption of environmentally preferred practices in a small business context such as lawn care. The models emphasize and assume different motivations for taking action that range from self-interest and protecting or improving one's resources (see Ajzen, 1991; Ajzen & Fishbein, 1980) to acting morally and

altruistically (see Schwartz, 1977; Thøgersen 1999). However, multiple motives have been found to be related to environmental behaviors (De Young, 2000), and it is therefore not appropriate to use any one of these models because they do not explain across the range of possible motives.

Many factors need to be considered to effectively measure psychological variables such as beliefs, attitudes, and motivations, as nuances can play significant roles in defining the relationships between these factors and behavior. Eccles & Wigfield (2002) examine beliefs, values and goals as a subset of motivation and provide an overview of researchers examining the links between cognition and motivation. According to Gray (1985), it is often difficult to separate the various aspects of what are measured as attitudes and beliefs, and there is inconsistency in the literature in what distinguishes these constructs. A sense of responsibility serves as an ideal example of a belief (about whether one is responsible or who is responsible) and a motivation (I am acting because it is my responsibility or duty). Together these psychological factors can serve as a cognitive structure that play a role in the manager's forming decisions and actions on behalf of a lawn care company.

Beliefs and belief systems

This study examines beliefs as both perceptions of reality and basic understanding of issues with normative value, and considers that beliefs serve a foundational role in motivations—both are psychological factors that provide a basis for decisions and behavior. A lawn care company can choose to test soil because the manager believes that it is the role of the company to take action to reduce impacts on the environment and believes that excessive fertilizer nutrients cause environmental damage. In this case, both beliefs about a company's role and beliefs about an ecological relationship can factor into the manager's motivation to take action. In the same way that people possess multiple motivations that influence their behavior, people also hold a combination of beliefs that can be part of a system that influences their decisions.

Sabatier & Jenkins-Smith (1999) suggest that belief systems can include multiple perceptions about an issue, such as perceptions of causal relationships, qualities of

problems (such as how large a problem is), and effectiveness of various policy instruments to solve the problem, and these are relied on as a system². This description of belief systems is relevant for understanding decisions made by lawn care professionals in their attempts to reduce impacts on the environment. If these professionals believe that environmental problems are caused by excessive fertilizer, are big in scope, and are best solved by government regulation, then they may wait for government intervention to take action. Alternatively, if lawn care professionals perceive that using lawn care chemicals causes health risks and perceive that lawn care companies are in the best position to solve the problem, they may be more likely to make decisions to limit use of pesticides. Such belief systems can serve as heuristics for making decisions and a foundation for being motivated to take action. Although there is evidence that suggests a relationship between beliefs and behaviors, it remains an unsettled topic (Eagly & Chaiken, 1993; Scott & Willits, 1994)³, and more research is needed to understand conditions under which this relationship exists in various contexts such as the lawn care situation.

Motivations

Identifying motivations can be helpful for better understanding antecedents to behavior and for designing interventions such as those that encourage less damaging lawn care practices. While there have been few, if any studies examining motivations of lawn care professionals, studies in different fields have yielded relevant findings with respect to what motivates action to reduce environmental impacts. A study by Ryan and Wolf (2002) on farmers' motivations to reduce non-point source pollution (similar to that created by the lawn care industry) determined five relevant motivation categories, which include (in decreasing expressed level of importance): 1) *stewardship ethic*-having a connection to the land, 2) *asset protection*-protecting assets such as livestock or other investments, 3) *personal commitment*-being committed to extra work or time necessary, 4) *feasibility*-ease of implementation and having the right resources, and 5) *external influences*-such as government regulation or community pressures. Another relevant

² In Sabatier and Jenkins-Smith (1999), this is in relation to the act of developing a policy.

³ In particular, the question of the specificity of the belief or attitude may affect the likelihood of the behavior (Fishbein & Ajzen, 1975). Thus a general environmental belief may not provide a sufficient basis to motivate specific environmental actions. A general belief may, however, inspire a more specific belief, which then might lead to specific behaviors (Corral-Verduga et al., 2003).

study by Masurel (2007) examining small and medium-sized (printing) firms' motivations for reducing environmental impacts organized motives into five categories: 1) *employment* considerations- relating to satisfaction and effectiveness of employees, 2) *regulation*- satisfying legislation, 3) *social responsibility*- driven by moral considerations and a desire to be innovative, 4) *market* considerations- such as satisfying customers and creating a positive image, and 5) *internal management* considerations- such as those that lead to cost savings or a cleaner shop. Despite the different contexts, these motivation groupings offer insight for understanding what motivates lawn care companies to reduce their non-point source pollution impacts on the environment.

Sense of responsibility

Lawn care companies exist in a regulated business world in which they are trying to maintain profits while pleasing customers and following regulations that limit what they can do. They are competing with other lawn care companies and with residential customers' decisions to take care of their own lawns. At the same time, they are the professionals who are relied upon by their customers to take care of their lawns.

Depending on the lawn care manager's perspective, he or she may consider that reducing impacts on the environment is primarily the company's responsibility. Alternatively, this manager may feel that in light of government regulations, the locus of responsibility is in the standards set through the regulatory process. It is also possible that some managers feel it is the responsibility of the customer to make demands in the marketplace.

Numerous researchers have emphasized the importance of a sense of responsibility for action to solve problems (Schwartz, 1977; Stern et al., 1999), including environmental problems (Garling et al., 2003; Hopper and Nielsen, 1991; Wondolleck & Yaffee, 2000). Schwartz's Moral-Norm Activation theory suggests that people develop personal norms to act based on a combination of awareness that their behavior is having an impact and a sense of responsibility for solving the problem. The theory has been shown to be effective in predicting several types of prosocial environmentally related behaviors (Hopper & Nielsen, 1991; Thøgersen, 1999; Van Liere & Dunlap, 1978). A model proposed by Stern et al. (1999), the Value-Belief-Norm theory, builds on Schwartz's

model to suggest that beliefs influenced by values combine with a sense of responsibility to lead to personal norms which then influence behavior.

The differences in sense of responsibility among lawn care professionals are likely to influence the kinds of practices in which they engage. If a lawn care manager feels that the responsibility for reducing the impacts of lawn care rests with the government, then the company is more likely to do only what is required by law, a phenomenon reported in other SMEs (Revell & Rutherford, 2003). If, however, a lawn care manager feels that the company is primarily responsible for reducing impacts, it is more likely to take action, according to these theories.

An extensive literature also exists on corporate social and environmental responsibility (eg. Haas, 1973; Hoffman, 2001, 2005; Makower, 1994; Prakash, 2000). Applying models from this literature focused on larger corporations to explain environmental responsibility in smaller companies, however, is considered inappropriate because the pressures, challenges and resources that smaller companies experience present a different situation (Borga et al., 2006; Dandridge, 1979; Thompson & Smith, 1991). Nonetheless, some researchers have been exploring business environmental responsibility among these smaller companies, (eg. Hillary, 2000; Tilley, 1999), although most of this research is occurring outside of the US (Mir, in press).

Influences of company characteristics

Various company characteristics can play an important role in both preventing and enhancing opportunities to reduce environmental impacts. Factors such as the size of the company, the number of years a company has been in business, and the amount of training it offers to employees have been demonstrated to be related to a company's likelihood of reducing impacts on the environment. In addition, having a larger customer base in new residential areas versus commercial properties may also play a role. This section examines these factors, considering the segment of the business world in which most lawn care companies exist, SMEs.

Size of company

As stated earlier, the vast majority of lawn care companies are considered small-to-medium enterprises including mostly micro enterprises, although a few are very large corporations that exist in several states. Scholars have argued that small companies are different from larger companies in many ways including their management style and organizational structure (Dandridge, 1979), and as a result face different challenges (such as access to information, resources necessary to survive or grow, etc.) in achieving desired environmental actions (Tilley, 1999). While there has been a minor but growing body of research on small firms in Europe, there has been a distinct lack of study of small US companies. The work that has been done suggests that differences are found in awareness and action between different sized companies, with larger companies demonstrating greater environmental awareness than smaller companies (Mir, in press). The opportunities that companies have to network with other companies, various organizations and product vendors through professional organizations can influence the access to information that a lawn care company has, and these can be influenced by the size of the company. Many smaller companies have been shown to resist the adoption of environmental practices because of their perception that the small changes required are expensive and that the impacts caused by the company are relatively insignificant (Revell & Blackburn, 2007).

Number of years in business

Research conducted on microenterprises in a different yet similarly structured industry, automotive repair, found that older companies are significantly more likely to engage in pro-environmental activities (Mir, in press). More experience may translate into more opportunities to learn about and engage in practices that have less of an impact on the environment. In the case of lawn care companies, which require relatively minor resources to start-up, it is assumed that the older more established companies will also be more likely to engage in practices that reduce their impacts on the environment.

Amount of training offered

Making more training available for workers has been identified as one way to improve strategic environmental management (see Byrne & Kavanagh, 1996). The amount of

training offered across worker levels can be a reflection of a company's commitment to organizational learning and sharing information, and this has been shown to positively impact possibilities for improving environmental performance (Post & Altmann, 1994), even in SMEs (Petts et al., 1998). At the same time, the difficulty that small companies face in supporting extensive training opportunities is recognized (Petts et al., 1998). In the lawn care industry, many opportunities for training exist in industry associations and through the government, but smaller companies may have more difficult times accessing these resources, or may avoid them as a way of staying under the radar and eluding regulatory attention (Mir, in press; Tilley, 1999). Nonetheless, training is believed to play a role in both information gathering and sharing, and in practices in which lawn care companies engage such that more training offered is likely to be associated with practices that reduce impacts on the environment.

Percent residential (type of service and customer contact)

Although it is not common for SMEs to experience environmental demands directly from customers (Mir, in press), and many customers are not proactive in encouraging environmentally preferred practices (Robbins, 2007), the proximity of the customer to the property being serviced by lawn care companies may play a role in the types of practices in which a lawn care company engages. No academic research was found on this factor, but one can speculate that lawn care for commercial properties involves a different emphasis than residential lawn care. There may be even greater attention placed on the aesthetic aspects of the lawn on commercial properties. In addition, the use of residential properties is perceived to be different than that of commercial properties. Although it is common for residential lawns to act simply as an extension of the house (Bormann et al., 2001), residential lawns are more likely to be used for recreation purposes. Commercial lawns (outside of picnic areas), alternatively, are perceived simply as green frames for corporate offices and other commercial properties, not places to play, walk, or relax. This difference may influence lawn care companies with a greater residential customer base to seek different information and take more actions to reduce human health and environmental impacts.

Research needs, objectives, and setting

Research needs: Psychological factors and use of information

This literature review points out that the way that lawn care companies achieve the social norm of a green, weed free, closely-cut lawn varies widely and may be influenced by their sources of information, psychological variables, and company characteristics. Many models in the environmental education and communication literature link information as an antecedent to variables such as one's beliefs, motivations, and sense of responsibility which are then said, in turn, to influence behavior. The use of information sources, however, may also be influenced by these psychological factors—one's beliefs, motivations, and sense of responsibility. Although a few studies examine the connections between psychological factors and use of information sources, the literature focused on this is scarce. This understudied area may yield significant insight about communicating with lawn care professionals. How each of these three underlying psychological constructs might relate to use of information is detailed in this subsection.

Beliefs play an important role in our interpretation of information (as described in reference to heuristics and mental maps), and because of this may be related to which information a lawn care manager uses. As discussed, people are more likely to trust information that tends to confirm their beliefs about the world. This can include beliefs about one's role in solving environmental problems, about what is causing environmental impacts, or about ways to solve a problem. For instance, if a manager believes that the company should go beyond regulations in order to reduce impacts on the environment, it is likely that he or she will use information sources beyond those that describe regulations. People seek to actively build their mental models, and base their decisions about which information to glean using their mental models. A belief that using chemicals such as pesticides creates a health risk might be related to a lawn care manager's decision to explore information about alternative practices across a range of information sources in order to reduce the perceived risk.

Motivations also can be related to information needs and can play a role in the information sources a lawn care company uses. One's decision to use certain information

sources can be influenced by having intrinsic motivations to act in environmentally preferred ways (Seguin et al., 1999), as these motivations can inspire an organization to use health risk information from particular sources. If a lawn care company is motivated to reduce its impacts on the environment as a part of improving its reputation, then it may use those types of information sources that are more likely to address reputation considerations such as industry related journals. Being motivated by an environmental ethic to reduce impacts on the environment might also encourage the use of more sources. This connection is in need of more research.

Similarly, the degree to which a lawn care manager feels responsible for taking action to reduce impacts related to lawn care also may play a role in the information sources that he or she chooses to use. If, for instance, the manager believes that the responsibility lies primarily with the government, this may increase the use of government related sources, or may contribute to less information-seeking behavior and the use of fewer sources. If the manager feels primarily responsible, he or she may use a wider set of information sources in an effort to stay more broadly informed.

These psychological variables of beliefs, motivations, and sense of responsibility underly the concepts of heuristics, trust and relevance and are fundamental for understanding decisions about information sources. Perceived gaps in knowledge arise mostly in response to beliefs held by a person or organization. Beliefs are an indication of what is familiar and relevant and act as a foundation for trust. Motivations and sense of responsibility can reflect that which is relevant to the person or organization. Probing the relationship between these variables and lawn care managers' use of information will be very valuable for understanding the bigger picture of information, psychological variables and decisions about practices.

Study objectives

This dissertation explores the relationship between psychological factors and use of information sources as a foundation for understanding how both of these variables influence the practices in which a lawn care company chooses to engage. It is expected that psychological factors play a role in lawn care managers' use of information sources

in the nuanced ways described above. It is also hypothesized that in addition to the psychological factors, information sources that lawn care companies use will be related to their established practices. The dissertation examines the company characteristics of size of company, number of years in business, amount of training offered, and percent residential to confirm or disconfirm their roles in explaining variance among lawn care companies in both information use and lawn care practices. Fertilizer practices are assessed separately from pesticide practices, as these represent different information and practice realms, and may be performed by completely different lawn care companies. The findings from this study will be useful for understanding how to more effectively communicate with lawn care companies in efforts to reduce impacts on the environment.

Michigan context

The focus of this dissertation is on the lawn care company situation in southern Michigan, a state where 1.9 million acres of turfgrass were maintained in 2002, over one fifth of the total agricultural acreage (MTF, 2002). In that same year, lawn care companies in Michigan employed 11,600 workers and accounted for \$260,500,000 (about 14%) of the \$1.86 billion spent on the turfgrass industry in Michigan (MTF, 2002). Turfgrass is considered big business in Michigan. Michigan also has soils with abundant phosphorus and adequate, yet threatened water supplies. The factors described in this chapter, including use of information sources, psychological factors, and company characteristics are explored in their relationship with each other and with southern Michigan lawn care companies' practices, considering impacts on the environment.

CHAPTER THREE RESEARCH METHODS

A two-phase approach was used to study lawn care company managers' use of information, psychological factors and company characteristics in relation to company practices. The first phase involved a series of interviews with both lawn care professionals and with leaders of interest group and government organizations seeking to influence environmental impacts related to lawn care. The second phase involved a survey of lawn care companies in southern Michigan. This research was conducted between May 2005 and June 2006, before the enactment of a new phosphorus ban in the City of Ann Arbor, Washtenaw County that went into effect in January 2007⁴.

Phase I: Interviews with lawn care professionals and organizations

Semi-structured interviews were conducted with both lawn care professionals and individuals in various organizations that work on issues related to water quality impacts such as those from lawn care. The interviews with lawn care professionals explored awareness of environmental issues, sources of information related to pollution prevention, practices, willingness to learn or adopt new practices, and a range of belief questions focused on perception of impacts, barriers, facilitators, and sense of personal responsibility. Interviews with representatives from organizations addressing these issues paralleled the other interviews with respect to awareness of issues, information sources used, and beliefs, and also included questions about recommended practices, perceived extent of influence of these organizations, and types of information provided to lawn care companies (See Appendix A).

⁴ The first ban on phosphorus in lawn fertilizer in Michigan was passed in Muskegon County, also to be implemented in January 2007. The ban was challenged and determined to not be enforceable according to state law. Preliminary reports suggest stores are voluntarily complying by selling no-phosphorus fertilizer (Gunn, 2007). No surveys or interviews were conducted in Muskegon County. Other counties have since passed similar legislation, with more than one case being declared unenforceable.

A list of lawn care companies in Michigan was generated (May 23, 2005) using Reference USA including the categories Lawn Care & Maintenance (07826), Property Maintenance (734908), and Landscape & Lawn Spraying (078209). Lawn care companies were chosen from the list by turning to randomly chosen pages and calling companies within certain area codes (734, 248, 517, 810, 269, 313) that represent the geographic regions of Washtenaw, Oakland, Ingham, Livingston, Kalamazoo, and Wayne counties. Counties were chosen to spatially represent a diversity of dominant land patterns (rural, suburban, urban) in southern Michigan. Companies were asked to participate in the study (see Appendix A for script) by taking part in interviews designed to last thirty minutes. Company identification was kept confidential, and either verbal or written consent was required to participate.

The organizations that work on issues related to water quality or lawn care were identified through web searches. County drain commissions were first identified as potential major players in this area, but were discovered to be less involved than other organizations in communicating and educating on this topic. Individuals from the Michigan Department of Environmental Quality (MDEQ), the Michigan Department of Agriculture (MDA), the federal Environmental Protection Agency (US EPA), and a local non-profit dedicated to healthy lawns and gardens (Southeast Oakland County Water Association—SOCWA) were contacted and interviewed. Interviews were designed to last thirty minutes: responses were kept confidential and verbal consent was required to participate.

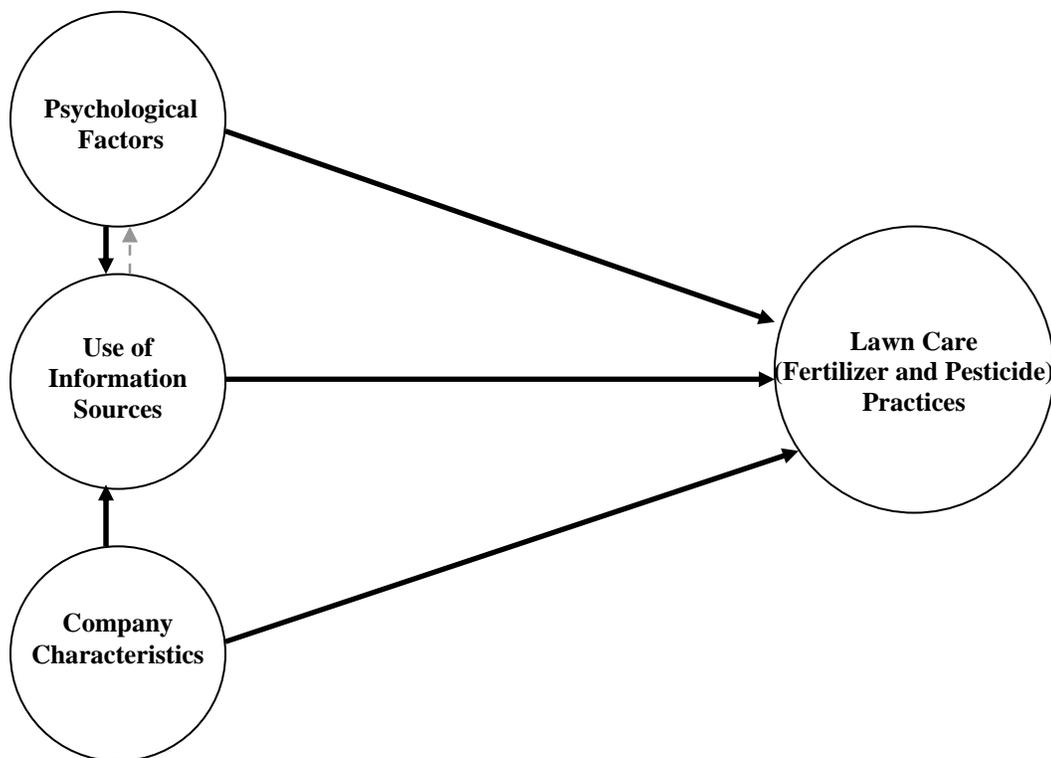
A total of 29 interviews were conducted, 19 with lawn care professionals, and 10 with organizational professionals. This represents 67 percent of the lawn care companies contacted about participating in interviews and 100 percent of those in organizations related to lawn care. Interviewees were provided with the option of being visited in person for the interview, or being interviewed over the phone. After several interviewees declined having the interview recorded, the decision was made not to record and transcribe the interviews.

Phase II: Survey of lawn care companies

The interviews were also used to inform the design of a survey, the next phase of the research. The five-page survey (see Appendix B) focused on four main constructs: psychological factors, use of information sources, company characteristics, and lawn care practices (see Figure 3.1).

Company characteristics are one of the main independent variables and were included as the first section of the survey. Questions in this section dealt with the size, years in business, services, characteristics of their customer base (residential vs. commercial), professional organization membership, and amount of training offered.

Figure 3.1 Path diagram of study constructs



Lawn care practices are the main dependent variable in this study, and this construct was included as the second section of the survey. It was divided into three subsections: grass cutting, fertilizer applications, and pesticide applications. Cutting practices included average height of grass cutting across seasons, frequency of grass cutting, and actions

taken with grass clippings. The sub-section on use of fertilizers presented questions about types of fertilizers used across seasons, ratio of fertilizer grade nutrients, frequency of testing soil before choosing a fertilizer, percentage of customers for which one tests soil, and reasons for not testing more often. Pesticide practices were assessed using a 5-point Likert scale for various practices such as weed-n-feed, broadcast or spot applications. The scale included: 1=Never, 2=Rarely, 3=Sometimes, 4=Somewhat regularly, and 5=Always, with an additional option of “Don’t Know.” The average number of applications per year was also assessed in the pesticide sub-section.

Use of information sources was examined as an additional dependent variable as well as a potential input to the choice of lawn care practices. In the third section, participants were asked about their likely use of each of 11 information sources, with response categories of 1=Not at all likely, 2=Not likely, 3=Somewhat likely, 4=likely, and 5=Very likely. A write-in line presented the option for listing additional information sources. Participants were also asked how often they used various media types to access information about lawn care, such as websites, brochures, or even themselves. This question also used a Likert scale with 1=Never, 2=Rarely, 3= Sometimes, 4=Somewhat regularly, and 5=Always. In addition, participants were asked to circle their three most regularly used sources.

The model displayed in Figure 3.1 shows an additional set of constructs focusing on **psychological factors**—motivations, beliefs, and sense of responsibility. These topics are the basis of the final section of the survey consisting of questions about lawn care and environmental impacts. Questions include those about belief of extent of lawn care impacts on the environment, belief about actions taken to reduce impacts, listing of actions taken, and banks of questions about motivations for and perceived barriers to reducing impacts on the environment. For the latter questions, the response categories are 1=Not at all, 3=Somewhat, and 5=A great deal, with an option for “Don’t Know,” and an option for participants to write in an additional motivation or barrier. A set of questions was asked about beliefs about the lawn care industry and what might be done to reduce impacts. These asked about who is responsible for taking action, opinions about

regulations related to lawn care, perceptions of risk related to using chemicals, beliefs about priority for environmental certification and beliefs about customers. Finally, the survey asked participants to rank who is most, second-most, and least responsible for taking action to reduce impacts among lawn care companies, government, and customers.

Survey distribution

The survey distribution was divided into two waves. The first surveys were distributed at the Michigan Green Industry Association professional symposium on March 7-8, 2006. Surveys were handed out near booths associated with the Southeast Oakland County Water Association (SOCWA) and Michigan State University (MSU) horticulture program. People passing the booth were approached, asked if they would be willing to fill out a survey, and were provided with a stamped addressed envelope or given directions to place the surveys in a box at the booth. One researcher was involved in all recruitment. Of the 85 surveys handed out, 18 were returned, for a response rate of 21.2 percent. An additional effort was made at the Detroit Home and Garden Show in which six lawn care companies were approached. Two surveys were completed at the show, for a response rate of 33.3 percent.

The second wave involved mailing the survey to interested companies. The contact list generated for the interviews was used to call lawn care companies to assess their interest and availability in filling out the survey. This time, area codes were used to represent Washtenaw, Livingston, Oakland, and Wayne counties (734, 810, 248, and 313) and were limited to these counties in an effort to maximize response rates in regions that represent a diversity of land patterns (rural, suburban, urban) in southern Michigan. Participants were kept anonymous, and consent was provided by filling out the survey. Approximately 715 phone calls were placed, and messages were left on 157 answering machines or voicemail systems, with 12 companies returning a call (a 7.6 percent return call rate). A survey was mailed only if someone agreed on the phone to fill out the survey. The most common reasons noted for not completing the survey included “not interested” and “too busy.” A total of 65 respondents participated in the survey representing 21 percent of those contacted and 46 percent of those who had surveys sent to them because they agreed to participate. This somewhat small sample covers a range

of organizational sizes, structures, and services, but does not claim to be representative of the entire population of lawn care companies in southern Michigan. The sample, however, allows for meaningful comparisons that can provide insight into relationships between independent and dependent variables.

Company characteristics and hypotheses

Based on responses to the first section of the survey, the 65 respondents are described here in terms of the size of the organizations, number of employees, number of years in business, degree to which their customers are in residential areas, and the amount of training offered. Each of these variables is detailed in the following subsections. In addition, this section discusses hypotheses based on this independent variable. Many of these hypotheses are derived from the insights gained from the interviews and are included as a way of controlling for these factors with respect to other variables in the study.

Number of employees

While the survey asked for separate tallies of the number of seasonal and year-round employees, these are combined here to show the total number of employees. Of the 58 companies that answered this question, 37.9 percent of the companies had 5 or fewer employees, 34.5 percent had 6-15 employees, and the remaining 27.6 percent were companies with greater than 15 employees.

In the Phase I interviews, the size of company appeared to play a role in a lawn care company's ability to engage in less harmful practices. It was found that very small companies were less likely to be part of a professional organization, and may have fewer opportunities to obtain information about lawn care impacts or less harmful practices. Mid-size to large companies were found to be more aware of what is environmentally preferred, maybe because of their networks of information created through professional organizations. The largest lawn care companies have their own research staff that work to define what is considered environmentally preferred.

Based on the interview responses and the literature, it is hypothesized that the size of a company will play a role in the types of information sources used and the practices in which it engages. Larger lawn care companies are expected to have greater access to professional organizations, and because of the greater access be more likely to use more information sources. Based on this exposure to information, larger companies are expected to be more likely to engage in practices that reduce impacts on the environment.

Number of years

In the survey sample, 32 percent of the companies have been in business for 1-10 years, with another 30 percent having been in business for 11-20 years; and the remaining 38 percent are more than 20 years old.

Although clear patterns related to number of years in business were not identified in the interviews, the amount of time a company has been in business is presumed to have an influence on its exposure to information about lawn care practices and the practices themselves. Companies that have been in business for longer periods of time may have had more opportunities to gather information and build a network of information sources. They may have developed different sensitivities to customer desires based on their years of experience. They may also have had more exposures to information about the impacts of lawn care. Conversely, they may be less aware of new information such as that related to problems related to phosphorus running off from Michigan soils if they have developed patterns in the practices they offered without having that information.

Based on this argument and supporting literature outlined in Chapter Two, it is hypothesized that companies that have been around for a longer period of time will have had more opportunities for exposure to professional organizations, and are more likely to have access to and use more information sources. Following this, it is expected that more years in business will be related to practices that have less of an impact on the environment.

Percent residential

The variable *percent residential* represents the percentage of customers that a lawn care company has that are residential, rather than commercial, ranging from 0 to 100 percent. About 63 percent of lawn care companies in this sample have more than half residential customers, leaving about 37 percent of companies with less than half of their accounts in residential customers.

The percentage of residential vs. commercial customers that a lawn care company has may influence how it approaches lawn care in general. Based on the assumption that commercial properties have lawns that are used for aesthetic more than interactive purposes and less precaution may be perceived as being necessary, companies with a lower percentage of residential customers (and therefore a higher percentage of commercial customers) may be engaging in fewer preferred practices.

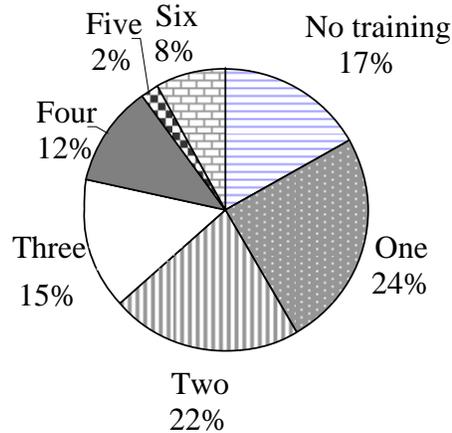
Based on these assumptions, it is hypothesized that those companies with a higher percentage of residential customers will be more likely to engage in practices that have less of an impact on the environment. The percentage of residential customers is hypothesized to not play a role in explaining variance in the company's sense of responsibility or use of information sources taken by themselves.

Amount of training offered

Amount of training offered was measured by asking, "Your employee training involves (check all that apply)," with the following options provided: 1) Outside training at workshops (for either selected staff or all staff), 2) Formal in-house training, 3) Informal in-house training, 4) Showing safety videos, 5) Showing technique videos, and 6) One-on-one mentoring. Participants were also invited to write in additional items. The write-ins included "articles from trade publications and website," "MSU turf," and "on the job training." The *amount of training* variable was determined by simply adding the number of opportunities (rather than arbitrarily assigning different weights to each option) based on the premise that more training opportunities reflect a greater commitment to organizational learning. Of the companies in this study, 17 percent did not offer training, 25 percent offered one option, 22 percent offered two options, 15 percent offered three

options, 12 percent offered four options, 2 percent offered 5 options, and 8 percent offer six options (see Figure 3.2).

Figure 3.2 Number of training options offered



It is hypothesized that more training will be related to beliefs about responsibility, such that those companies that offer more training will have managers who are more likely to consider themselves as more responsible for taking action to reduce impacts on the environment. In addition, *amount of training* is hypothesized to be related to number of information sources used, as more responsibility may translate into a desire to be more widely informed, and therefore also to the kinds of practices in which a company engages. The commitment to organizational learning (associated with more training) may be reflected in more informed practices and therefore, those with lower impacts.

Data analysis

Interviews

The Phase I interview data was analyzed using two main approaches. First, because the interviews were semi-structured, a majority of the questions lent themselves to quantitative analysis, and were entered into a spreadsheet. SPSS Version 11 was used to analyze relationships between independent and dependent variables. Comparisons were made of different groups (lawn care professionals and representatives from organizations

communicating about lawn care practices). Patterns of responses were highlighted to better understand individual differences within and across lawn care companies.

Survey

SPSS Version 13.0 was used in all statistical analyses of the Phase II survey. The survey contains many sections that involved developing scales through factor analysis. In all cases, a principal component analysis with varimax rotation was performed treating missing values with pairwise deletion. Items with factor loadings greater than 0.50 were included, and those with loadings of .50 or greater on more than a single factor were excluded from any of the factors. Factors also had to have values greater than .70 on Cronbach's alpha coefficient.

Relationships between independent and dependent variables were assessed using forward multiple regression analyses. This method was chosen because the variables are all scale (either continuous or interval) and because of correlations among some independent variable groups. Forward regression involves SPSS choosing to first enter the most highly related variable, and then continue adding variables that explain additional variance while minimizing colinearity. Adjusted R^2 values are used to represent the explained variance. Paired sample t-tests are used to compare means in analyses. Statistical significance is reported in three levels with $p < .05$ represented by *, $p < .01$ represented by **, and $p < .001$ represented by ***.

CHAPTER FOUR

USE OF INFORMATION SOURCES: INFLUENCES OF COMPANY CHARACTERISTICS AND PSYCHOLOGICAL FACTORS

Encouraging lawn care professionals to engage in practices that reduce impacts on the environment can include multiple approaches, most of which involve the sharing of information. An emphasis is placed on sharing information because of the difficulty of regulating diffused environmental impacts related to lawn care. There has not, however, been adequate research on which information sources lawn care professionals are most likely to use and what might relate to the choices of those information sources. This chapter examines which information sources are more likely to be used by lawn care companies and how *company characteristics* and the *psychological factors*—beliefs, motivations and sense of responsibility—may be related to this use.

Choosing information sources in a world of too much information

Lawn care company managers, like in many other professions, can be overwhelmed by the surplus of information sources that seek their attention. In addition to information from product vendors, managers can receive information about lawn care from industry groups, agriculture extension services, state government agencies, environmental organizations, and local watershed organizations. One lawn care company manager interviewed stated that he regularly received fifteen different landscaping publications. Often, these information sources can be in addition to those that the professionals actively seek on their own.

Understanding which information sources are more likely to be used by different lawn care companies and factors that might explain why managers use those sources may be of

interest to those who endeavor to minimize environmental impacts related to lawn care. Presenting a picture of the use of these information sources can help information providers understand the most effective media to communicate messages about reducing impacts related to lawn care.

Measuring use of information sources

To assess which information sources lawn care professionals are likely to use, the question was asked, “How likely are you to look at information from each of the following sources.” The choices offered and mean ratings are shown in Table 4.1. Although likelihood of using information sources was measured, this document infers and describes these results as describing “use of information sources.” While none of the sources received strong endorsement, commercial vendors (those that sell lawn care products, from fertilizers to lawnmowers) are the most likely source of information for this sample, with Michigan State University the next most likely source. Local sources and environmental education groups were much less likely to be used, on average, with their means falling below “somewhat likely.”

Information source	Mean
Commercial Vendors	3.81
Michigan State University	3.70
MI Department of Agriculture	3.60
Michigan Nursery and Landscape Assoc.	3.39
Michigan Turfgrass Foundation	3.38
MI Department of Environmental Quality	3.27
US Environmental Protection Agency	3.08
Watershed Council	2.65
SOCWA Healthy Lawns & Gardens	2.60
Environmental Education Group	2.55
County Drain Commission	2.47
1= Not at all likely, 2=Not likely, 3=Somewhat likely, 4= likely, and 5= Very likely	

Types of information sources

Based on a factor analysis, the information sources were organized into three main groups, displayed in Table 4.2. Three of the information sources loaded on multiple factors and were, therefore, excluded from the factors. The high correlations between each of these and one of the factors also excluded them from further analyses. In particular, the Southeast Oakland County Water Authority (SOCWA) Healthy Lawns and

Gardens program correlated .81 with the *environmental/ local* groups factor, the Environmental Protection Agency correlated .73 with the same factor, and Michigan State University (MSU) as an information source correlated .67 with the *industry-promoting* factor. These information sources may be perceived as bridging across information source types. For instance, the Environmental Protection Agency may be perceived as similar to both a (*state*) *government* source and an *environmental/ (local)* source, whereas MSU may be perceived as sharing attributes with both *state government* and *industry-promoting* sources.

As is evident from Table 4.2, the factor means for both *industry-promoting sources* and for *state government sources* are above mid-scale and are more likely to be used, while the mean for *environmental/local sources* is significantly lower than either of these (t=5.35 and 6.10, p<.01, respectively), suggesting these sources are more likely to be avoided or overlooked.

Information source	Cronbach's alpha	Mean ¹	Standard Deviation
Industry-promoting sources	.80	3.60 ^a	1.13
Commercial Vendors Michigan Turfgrass Foundation Michigan Nursery & Landscape Association			
State government sources	.84	3.44 ^b	1.12
Michigan Department of Agriculture Michigan Department of Environmental Quality			
Environmental/ local sources	.89	2.60 ^c	1.10
Drain Commission Watershed Council Environmental Education group			
¹ SCALE: 1= Not at all likely, 2=Not likely, 3=Somewhat likely, 4= likely, and 5= Very likely ^a (mean) significantly different than ^c (t=5.35). ^b (mean) significantly different than ^c (t=6.10), p<.01.			

These information sources vary considerably in their purpose, content, mode of distribution, and frequency of producing information. For example, commercial vendors are selling products and providing information sheets and packets on their products and benefits. Some might also attend trade shows to display and provide more detailed information, demonstrations, and even samples. They commonly have websites, as well as salespeople to make direct connections with lawn care companies. The content of their information is focused mostly on benefits of the product that they are selling and strategies related to how to use it. This differs from trade groups such as the Michigan

Nursery and Landscape Association (MNLA) that represent the lawn care industry. MNLA provides monthly newsletters (previously bi-monthly), has a website, and builds and enhances networks of lawn care companies through organizing events such as the Great Lakes Trade Exposition. Many vendors advertise in trade journal publications. In some cases, entities such as the Michigan Turfgrass Foundation collaborate with university extension offices such as Michigan State University, and have sponsored industry-led certification processes for stewardship, such as the Michigan Turfgrass Environmental Stewardship Program focusing on environmental impacts related to golf courses.

In a different category, state government sources such as Michigan Department of Environmental Quality (MDEQ) and Michigan Department of Agriculture (MDA) produce information that details how to comply with current regulations, in addition to resources on best practices that reduce potential for non-point source pollution and hazardous contamination. Complementing websites, information pamphlets, and representatives to discuss issues, state government works through other sources by having their information at trade expos, in local drain commission offices, and a variety of other venues. The MDA has additional contact with lawn care professionals through certifying pesticide applicators and conducting voluntary inspections of lawn care company shops.

The *environmental/ local* sources differ in their outreach efforts not only by type, but by location. Some watershed councils are very active in producing materials aimed at lawn care practices, while others are more focused on other activities such as stream restoration. Most watershed councils use a website and produce sundry materials such as brochures and booklets on what to avoid that will impact local water quality. Some make suggestions to minimize the number of applications per week, suggesting that certain vendors prescriptions are excessive (HRWC, 2005). Drain commissions, the local legal entity responsible for managing county watershed areas, often produce fact sheets or other materials on non-point-source pollution. Some have initiated programs aimed at a variety of small business types (including lawn care), and many do not actively attempt to reach lawn care professionals, but instead make information available for those who are

interested. Lastly, environmental groups vary widely, with some targeting consumers, and others reaching out to lawn care companies themselves. In general, the survey was designed to measure likelihood of using these sources, not rates of actual use.

Number of information sources likely to be used

A *number of information sources* variable was created to reflect the total number of the listed sources that received ratings of 4 (likely) or 5 (very likely). This variable ranges from 0 to 11 as shown in Table 4.3. For the 57 lawn care companies that answered this question, there is great diversity in the number of information sources that they are likely to use, with more than half (63 percent) of the sample likely to use five sources or less. In this study, indication of using more information sources represents a more widely informed perspective on lawn care issues.

Number of info sources	Number of lawn care companies	Percentage	Cumulative percentage (of 57 companies included)
0 - 2	19	33.3 %	33.3 %
3 - 5	17	29.9 %	63.2 %
6 - 8	14	24.5 %	87.7 %
9 -11	7	12.3 %	100.0 %

The number of information sources that a lawn care company is likely to use is highly correlated ($r=.57$) with the *number of professional organizations* variable. That is, the more likely a company is to belong to several professional organizations, the more likely this company is to use more information sources. Given this correlation, *number of professional organizations* is not used as a variable in this study, and *number of information sources* is used to assess attention to a more broadly informed perspective⁵.

Predicting use of information sources

The purpose of this section is to examine the role of two groups of independent variables, *company characteristics* and *psychological factors*, in their relation to the likelihood of use of information sources. Each of these two groups is initially examined separately using forward regression analysis with each dependent variable. This method was chosen

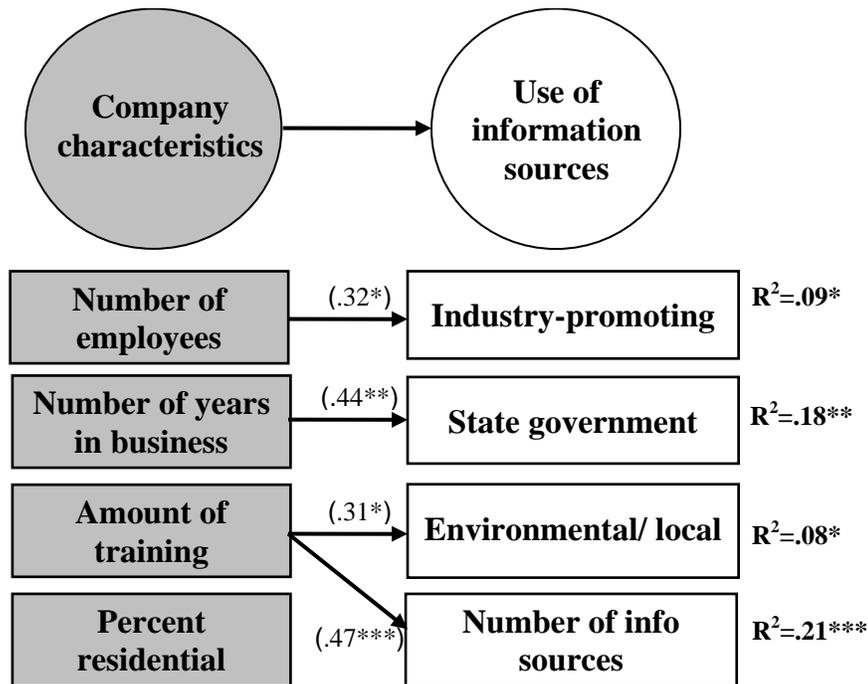
⁵ Although availability or ease of access to the information source may play a role, it is assumed that lawn care companies that seek a broader perspective will gather and use information from more sources.

to minimize colinearity. Significant predictor variables from each group are then entered into the next step of the analysis, hierarchical regression analyses. This section provides an overview of the first step, individual contributions in each independent variable group.

Company characteristics and use of information sources

Company characteristics (see Chapter Three) were found to be significant predictors of *use of information sources*. The size of the company (*number of employees*) is predictive of the *use of industry-promoting* sources such that managers in larger companies are more likely to use these sources (Figure 4.1). This supports the hypothesis that managers in smaller companies are less likely to rely on trade groups as sources of information.

Figure 4.1 Relationships of company characteristics with information sources^a



(B values in parentheses; * significant at p<.05, ** significant at p<.01, *** significant at p<.001.)

^a each relationship is based on a forward regression in which all company characteristics were entered together as a group. Arrows indicate significant relationships.

Figure 4.1 also shows that *state government* sources are more sought after by company managers with a greater *number of years in business*. This relationship is somewhat perplexing, as it was expected that managers in newer companies would be eager to seek information from government organizations that may be regulating them. This sample, however, contains many companies that are not regulated (fertilizer applicators and lawn

cutting operations), and those that rely on other sources of information. It may be that over time, lawn care managers eventually access state government agencies or that managers in older companies have built more trust in these organizations through repeated exposure, and as a result are more likely to use these sources.

The variable, *amount of training offered*, was found to be predictive both of using *environmental/ local* sources and of using more information sources. The *amount of training offered* may be reflective of a company culture that emphasizes employee safety and welfare, and may be suggestive of a larger sense of social responsibility that translates into using additional sources of information.

Psychological factors: Motivations and beliefs

In addition to assessing company characteristics, the survey assessed psychological factors including motivations, beliefs and sense of responsibility. The construction of each of these potential factors is discussed in this section. This is followed by an analysis of their role with respect to information sources.

Measuring motivations and beliefs

In order to evaluate motivations for reducing environmental impacts among lawn care companies, responses were assessed from the question, “To what extent do the following motivate you to reduce environmental impacts.” Motivations listed in this section include: 1) government regulations, 2) customer concern, 3) environmental ethics/ values, 4) good business/ reputation, 5) better equipment, 6) better information, and 7) company standards.

Highly ranked motivators

Respondents were also asked to rank the two items among the listed seven that they consider their strongest motivators. Both *good business/ reputation* and *customer concern* were ranked as primary motivators by 29 percent of those answering. *Good business/ reputation* also received 38 percent of second place ranking while *customer concern* was ranked second by 23 percent. Both of these could be considered business considerations. *Government regulations*, by contrast, was ranked as number one by 21 percent and as number two by 10 percent of those that responded. In other words, a

small, but substantial minority of lawn care companies in this sample believe they are primarily motivated by *government regulations*, a belief that may be partly influenced by the strength of the current regulations⁶. Alternatively, a majority of the sample is strongly motivated by business considerations.

Business considerations and government regulations

A principal component factor analysis using the Likert-scale responses to the seven motivation items listed above yielded a single factor that included all but the "governmental regulations" item (Table 4.4). These six items share the characteristic of describing *business considerations* (Cronbach's alpha=.90), self-determined motivations to reduce impacts on the environment. These represent motivations that lawn care managers choose to respond to in order to run a successful business. Most lawn care professionals in this study report being greatly motivated by these self-determined *business considerations*, as shown by the mean, 4.31 with 1=not at all and 5=very much.

Table 4.4 Business considerations factor	Cronbach's Alpha	Mean	Standard Deviation
Business consideration items	.90	4.31	.73
Good business/reputation Company standards Better information Better equipment Environmental ethics/values Customer concern			

Government regulations as motivation stands separately from the *business considerations* factor, based on the factor analysis. On average, lawn care managers reported feeling significantly more motivated by *business considerations* than by externally derived *government regulations* as shown by the mean of 3.87 (t=-2.44*). They may feel more motivated by these factors because they believe these actions are going to be good for business, and they perceive them as an autonomously elected gain for the company rather than a restriction on what they can do.

⁶ The degree of government regulation may influence the extent to which someone considers that it is motivating. The response to this question, however, showed lawn care managers across service types both agreeing and disagreeing with it. For example, several lawn care managers whose companies only cut grass (and are therefore subject to much less direct regulation than those who apply pesticides), responded as feeling highly motivated by government regulation.

At the same time, the distribution of responses for being motivated by *government regulations* shows that a majority of the lawn care professionals in this study are more than somewhat motivated by *government regulations* (by reporting a 4 or 5, with 5=very much). It may be difficult for anyone to suggest that they are not motivated by *government regulations*, because not following government regulations would mean breaking the law.

A question in a different section of the survey assessed beliefs about the lawn care industry by asking for a response to the statement, “Regulation is what drives lawn care companies to adopt different practices⁷.” Less than 10 percent of respondents disagreed with this statement, highlighting the prevalence of the belief that regulation is important for influencing change in the lawn care industry. Nonetheless, the mean (3.64) does not reflect strong endorsement. While this item differs in its emphasis with *government regulation* as motivation, responses to both are highly correlated ($r = .58^{***}$), suggesting that many who consider government regulation as an important change agent for the industry also see themselves as greatly motivated by it. In light of their similar content and high correlation, the two items were combined to form a single *government regulation* measure ($\alpha = .73$).

Responsibility beyond regulations

The survey included fifteen items⁸ asking for agreement or disagreement with several statements about lawn care. Principal component factor analysis yielded a single factor named *beyond regulations* ($\alpha = .84$), consisting of four statements (Table 4.5).

Table 4.5 Statements for Beyond Regulations factor	Alpha	Mean	Std. Dev.
Beyond Regulations	.84	3.35	1.02
Lawn care companies should engage in practices that go beyond regulations in order to reduce impacts on the environment.			
It is the responsibility of the lawn care company to choose practices that reduce environmental impacts.			
A statewide program that would certify environmentally responsible lawn care companies is something I desire.			
I would pay a fee to be recognized by a program that certifies environmentally responsible lawn care companies.			

⁷ This item did not load with other items to produce a coherent factor.

⁸ Two items – "I am supportive of statewide bans on phosphorus" and "Local bans on phosphorus are an effective way to reduce environmental impacts – received substantial (i.e., greater than 20% of sample) "don't know" responses and were excluded from further analysis. The remainder of the items can be found on page 5 of the survey in Appendix B.

This factor encompasses what might seem to be two different motivation groups, with the first two statements focused on personal responsibility for going beyond regulations and the second two focused on company image for being environmentally responsible. This is consistent, however, with the factor described earlier, *business considerations* motivation that contains both *good business/ reputation* and *environmental ethics*. In fact, the two factors are somewhat correlated ($r=.31^*$), although they differ substantially in the respondents' endorsements. While the *business considerations* motivation has a relatively high mean (4.31), the mean for *beyond regulations* is only slightly above the neutral point, at 3.35 (s.d.=1.02). The companies in this study are almost evenly divided between those indicating that they believe the company is responsible for going *beyond regulation* (55 percent) and those who disagreed with this idea (45 percent). This desire to engage in practices that go *beyond regulations* to reduce impacts on the environment is hypothesized to be associated with using more information sources, which may result from a desire to obtain more perspectives on approaches to lawn care.

Overview of motivations and beliefs

Table 4.6 provides an overview of the three beliefs and motivations variables that were created from the survey responses. It is hypothesized that the use of information sources will differ between: 1) those that have a stronger and weaker belief that *government regulation* is an important motivator, 2) those that are more and less motivated by self-determined *business considerations*, and 3) those that more strongly believe it is their responsibility to go *beyond regulations* to reduce impacts on the environment. It is important to keep in mind that someone can have stronger beliefs in all three areas.

Table 4.6 Motivations and beliefs			
	Cronbach's alpha	Mean	Standard deviation
Business considerations	.90	4.31	0.76
Government regulations	.73	3.76	1.01
Beyond regulations	.84	3.35	1.02
All means are significantly different from one another at $p<.01$.			

Psychological factors: Sense of responsibility

An additional psychological factor addressed by this study is *sense of responsibility*. The degree to which lawn care companies see themselves as responsible for taking action to reduce environmental impacts in comparison to government or customers may also be related to the information sources used. A *sense of responsibility* about actions to solve environmental problems is likely to encourage the seeking of information. Who a lawn care manager considers to be primarily responsible for taking actions to reduce impacts may play a role in his or her desire to seek more information through more sources. It is hypothesized that lawn care managers who see companies as a more responsible entity will seek information from more sources.

Rank of company responsibility

Assessment of respondents' beliefs about relative responsibility was based on their prioritizing the agent of responsibility for taking action to reduce environmental impacts. The survey asked participants to "Please rank...who is most responsible for reducing environmental impacts related to lawn care (1= most responsible)," among A) Customer, B) Lawn care company, and C) Government. Table 4.7 shows the distribution of responses for the 60 lawn care companies who provided a response. An equal percentage of lawn care managers in this sample see companies as primarily responsible as those who consider that government is most responsible (42%). It is also important to notice that a large percentage sees the customer as least responsible (58%). Lastly, while only 10 percent of the responding managers place themselves as least responsible, more than half of the lawn care managers in this study do not believe that the responsibility for reducing impacts is primarily their duty.⁹

Perceived responsible agent	Most responsible	Mid-level	Least responsible
Lawn care company	42%	48%	10%
Government	42%	28%	30%
Customer	17%	25%	58%

-Negative inter-correlations exist for government and customer ($r=-.66^{**}$), lawn care company and government ($r=-.53^{**}$), and lawn care company and customer ($r=-.28^*$).
- 42% of respondents consider companies most responsible; 42% consider government most responsible.

⁹ Throughout this dissertation, sense of responsibility is understood on a continuum, recognizing that a manager can consider the company as the most responsible party, or as simply as having a sense of responsibility (without being ultimately responsible). The mid-level response is assessed as more responsible than another and less responsible than another.

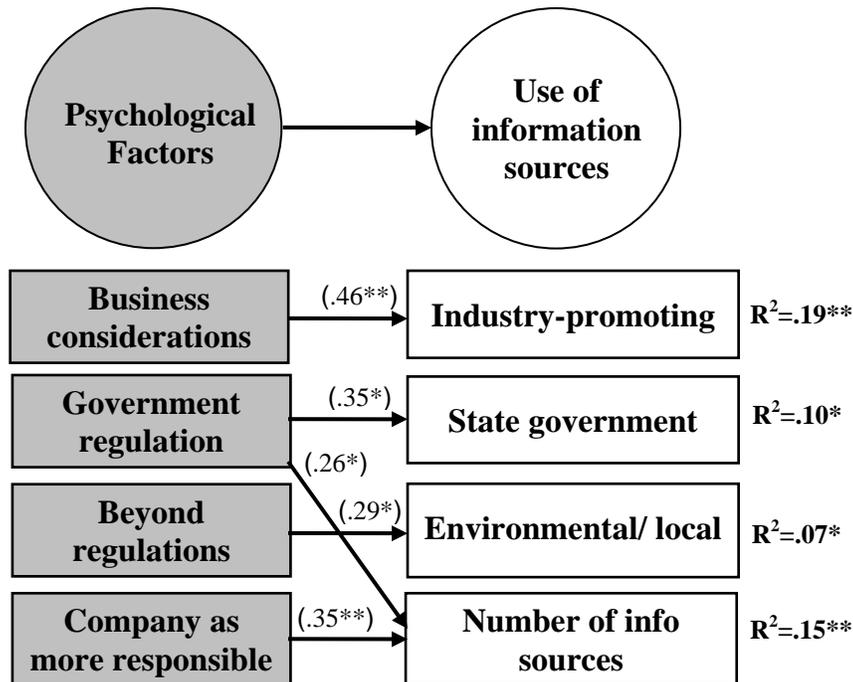
Role of psychological factors in predicting use of information sources

Regression analyses were used to test the role of *psychological factors*—*beliefs, motivations* and *sense of responsibility*—in predicting the likelihood of using information sources. As with the company characteristics, separate analyses were conducted for the three information sources—*industry promoting, state government, and environmental/local*—as well as for the number of sources a company is likely to use. For each analysis, a forward regression was used with the same four independent variables: *business considerations, government regulation, beyond regulations* and *company as more responsible*. The results shown in Figure 4.2 reveal a pattern of distinct motivators/beliefs for each of the information sources—in other words, each of the information source variables is associated with a different psychological factor, and the number of sources used is predicted by two *psychological factors*. The adjusted R^2 values suggest that these factors explain 7 to 19 percent of the variance. A closer look at each of these relationships is warranted.

Business considerations associated with use of industry promoting sources

Consistent with what was expected, being motivated by *business considerations* is strongly related to using *industry-promoting* sources with this set of motivations explaining 19 percent of the variance. Managers who are motivated to reduce impacts by better equipment, better information, customer concern, good business/ image, and environmental ethics might look to vendors and industry groups who will provide them with information about how certain products might be beneficial for creating green lawns and simultaneously protecting the environment. Vendor communications might include information about applying liquid control products as coarse sprays rather than fine sprays to reduce pesticide drift, making sure sprayers and spreaders are properly calibrated or making sure that grass blades are dry when applying granular pesticides. In a sense, these information sources deliver information consistent with what these lawn care managers desire and are likely to be perceived as having their interests in mind.

Figure 4.2 Relationships of psychological factors with information sources^a



(B values in parentheses; * significant at $p < .05$, ** significant at $p < .01$, *** significant at $p < .001$.)

^a each relationship is based on a forward regression in which all psychological factors were entered together as a group. Arrows indicate significant relationships.

Government regulation and use of state government sources

In contrast, belief about the importance of *government regulation* is significantly associated with likelihood of using *state government* sources, with *government regulation* explaining 10 percent of the variance in use of these sources. Those lawn care managers who believe that *government regulation* is an important motivator might use information from the Michigan Department of Agriculture more because it regulates pesticides and provides updates on what is and is not allowed. They may choose information from the Department of Environmental Quality because this *state government* source monitors and informs about environmental aspects such as phosphorus levels in watersheds. These *state government* sources provide less information on products and techniques for minimizing impacts of those products, and more on what are the essential things to know and perform to be in compliance with the law.

Beyond regulations and use of environmental/local sources

Figure 4.2 also shows that the belief in responsibility for engaging in practices that go *beyond regulations* has a small, but significant relationship with the use of *environmental/ local* sources. Those managers who see themselves as being responsible for going *beyond regulations* and seek recognition for their environmental impact reduction efforts are more likely to use *environmental/ local* information sources such as watershed councils, drain commissions, and environmental education groups.

Those who have a greater desire to engage in practices that go *beyond regulations* report choosing *environmental/ local* information sources, perhaps because they encourage such activity. These sources of information such as watershed councils and environmental education groups are interested in sharing information and encouraging activities that they deem as important for environmental quality that are not covered by government regulations, such as fertilizing with grass clippings, testing soil before choosing a fertilizer, and even establishing alternatives to lawns such as rain gardens. In some cases, they question manufacturers' guidelines. One publication from this group suggests, "Most manufacturers' guidelines are excessive for this area. One application of low phosphorus fertilizer in the fall is adequate for most lawns" (HRWC, 2005). Using these sources is related to a desire to engage in actions that are proactive and beyond compliance with regulation. The managers who use these sources are also more likely to desire a program that would certify lawn care companies for their efforts.

Greater sense of company responsibility predicts use of more information sources

Figure 4.2 shows that ranking lawn care companies as more responsible than government or customers predicts using a greater *number of information sources*. Those managers who rank themselves as more responsible are more likely to use a greater number of information sources. This is consistent with what was hypothesized, as having a sense of greater responsibility would encourage a lawn care manager to seek as much information as possible to ensure that one is taking the right steps.

Those managers who use more sources do so evenly across the three information source types in the same relative pattern of use. Overall, the use of *industry promoting* and *state government* sources was reported as having a significantly higher likelihood of use than *environmental/ local* sources. Those that use more information sources are significantly more likely to use *environmental/ local* sources than those that use fewer sources; those that use more sources are significantly more likely to use *industry promoting* and *state government* sources as well.

Government regulations also associated with using more information sources

Figure 4.2 also shows that believing that *government regulation* is important as a motivator is positively associated with using more information sources, although to a smaller extent than for having a sense of company responsibility. One plausible explanation is that companies that believe *government regulation* is an important motivator may be more focused on regulations, and are more vigilant in making sure they are informed across a variety of sources. Another reasonable explanation is that using more information sources has a high correlation ($r=.69^{**}$) with use of *state government* sources; this use of *state government* sources is related to belief in the importance of *government regulations* (established above), and thus, this belief is associated with use of more sources.

Explaining relationships

Overall, the fact that different beliefs about who is responsible and what motivates one to reduce impacts is associated with use of different information sources suggests that lawn care professionals may be choosing to use certain sources because of their belief structures. The use of certain information sources may reinforce particular ways of seeing the world that feed back to influence the decisions to use certain information sources. In a sense, this cycle can make it less likely for lawn care professionals to entertain information sources that fall outside of what is acceptable for their interpretive frames. The information provided to lawn care professionals is more likely to be used if it matches their needs for information such that if they are more motivated by regulations, then the information would serve better if it emphasized what the law states. If they are

motivated to engage in practices that are beyond what regulations suggest, then the information sources are more likely to achieve their goal if they address those concerns.

Hierarchical regression analysis

Building a model of significant predictors for each of the information sources was the next step in the analysis. This involved hierarchical regression analyses in which the significant variables from the *company characteristics* and the *psychological factors* groups were entered sequentially in a block-wise fashion to examine the additional variance explained by each independent variable of the model. Significant components of the *company characteristics* were entered first, followed by variables from the *psychological factors* that were found to be significant in the initial step. Tables 4.8 - 4.11 show the results from these analyses for each of the use of *information source* dependent variables. The tables are set up to mark the addition of each independent variable group and show the contribution of that variable to predicting each dependent variable.

Use of industry-promoting sources

Both *business considerations* and *number of employees* are significant in predicting use of *industry-promoting* sources (Table 4.8). Together, these variables explain 25 percent of the variance for use of these sources, but the six-item *business considerations* variable played by far the bigger role. Larger companies and those motivated by *business considerations* are more likely to use these sources. Variance explained by this *psychological factor* (in addition to that explained by *company characteristics*) further demonstrates the match between motivations and information use.

Independent Variable type	Significant Independent Variable	Company characteristics	Adding Psychological factors
		Step 1 (B)	Step 2 (B)
Company characteristics	Number of employees	.32*	.27*
Psychological factors	Business considerations		.42**
	Adjusted R²	.09*	.25**
	R² Change		.18***

* significant at p<.05, ** significant at p<.01, *** significant at p<.001.

Use of state government sources

As shown in Table 4.9, both the variables *government regulation* and *number of years in business* are significantly related to use of *state government* sources. In other words, managers in older companies and those that are more motivated by *government regulation* are most likely to use *state government* sources. With respect to use of *state government* sources, the variable reflecting *company characteristics* (i.e., *number of years in business*) plays a bigger role than the *psychological factor*. Together they account for almost one-quarter of the variance, with the *government regulation* survey item accounting for about a third of the explained variance.

Independent Variable type	Significant Independent Variable	Company characteristics	Adding Psychological factors
		Step 1 (B)	Step 2 (B)
Company characteristics	Number of years in business	.44**	.39**
Psychological factors	Government regulation		.28*
	Adjusted R²	.18**	.24***
	R² Change		.08*

* significant at p<.05, ** significant at p<.01, *** significant at p<.001.

Use of environmental/ local sources

As determined in the first set of analyses, both the *amount of training* offered and the psychological factor *beyond regulation* are significant predictors of the use of *environmental/ local* sources. As shown in Table 4.10, however, when these two variables are both entered into the hierarchical regression analysis, they contribute about the same to explaining the variance, but neither is a significant player. The reason for this lack of additional variance explained may be a result of the force that the company culture plays on both of these variables. Both the commitment to *training* and going *beyond regulations* may be indicative of an ethic within certain organizations that seeks to go beyond the minimum levels. The study, however, did not include questions that give insight into what that company culture might be.

Independent Variable type	Significant Independent Variable	Company characteristics	Adding Psychological factors
		Step 1 (B)	Step 2 (B)
Company characteristics	Amount of training offered	.31*	.26
Psychological factors	Beyond Regulations		.23
	Adjusted R²	.08*	.12
	R² Change		.05

* significant at p<.05, ** significant at p<.01, *** significant at p<.001.

Use of more information sources

With respect to the *number of information sources*, the indication of *amount of training offered* played a significant role even when the *psychological factors* were added to the equation (Table 4.11). Together with the latter, more than one-third (34%) of the variance was accounted for, with one of the two *psychological factors* adding significantly to the total. Managers who see the company as most responsible as well as those that provide more training are more likely to draw on a greater variety of information sources. This provides further evidence supporting the hypothesis about the relationship between having a sense of responsibility and using more information sources. The motivation provided by *government regulation*, however, does not explain additional variance, a finding that is in line with what was predicted.

Independent Variable type	Significant Independent Variable	Company characteristics	Adding Psychological factors
		Step 1 (B)	Step 2 (B)
Company characteristics	Amount of training offered	.47***	.39**
Psychological factors	Government regulation		.21
	Company as more responsible		.28*
	Adjusted R²	.21***	.34***
	R² Change		.11*

* significant at p<.05, ** significant at p<.01, *** significant at p<.001.

Conclusions

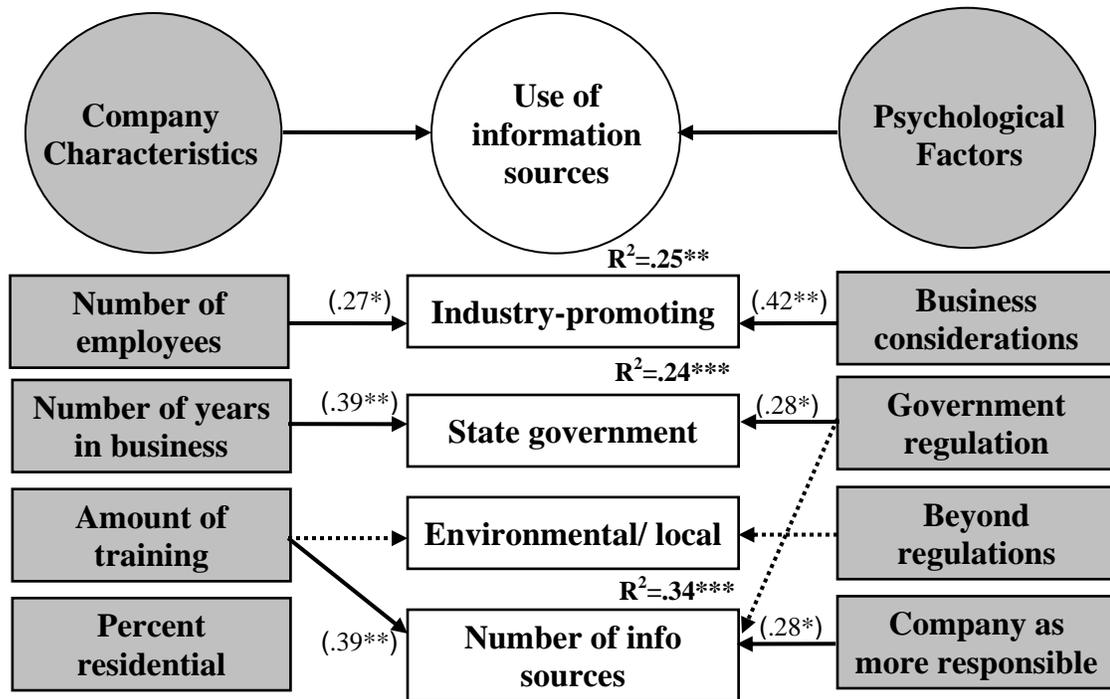
Understanding the use of information sources in lawn care is important for those seeking to communicate about reducing impacts related to lawn care. A lawn care manager's

choice of which information sources to use is made more difficult by the volume of information being shared by a number of different organizations. Lawn care managers, on average, are more likely to use *industry-promoting* sources and less likely to use *environmental/ local* sources. Therefore, organizations providing information about reduction of environmental impacts in lawn care might consider targeting *industry-promoting* sources to reach a wider audience.

Although many factors play a role in a manager's use of *information sources*, a match with one's motivational needs seems important. The *psychological factors*—beliefs, motivations and responsibility—were found to be related to the use of *information sources*. For instance, the *psychological factor* referred to as *business considerations* is strongly associated with the use of *industry-promoting* sources. *Government regulation* is associated with the use of *state government* sources, and being motivated to engage in practices that go *beyond regulations* is associated with use of *environmental/ local* sources. This pattern can be explained by matches between the information provided in these sources and the information needs of the lawn care managers related to their beliefs, motivation and sense of responsibility. Although, the direction of the relationships is not certain, knowing that the relationships exist can be helpful for organizations communicating with lawn care professionals.

In most cases, these relationships with *psychological factors* explain variance in addition to that explained by *company characteristics*, findings which are also useful for organizations seeking to influence lawn care professionals (see Figure 4.3). It is important to consider that managers in larger companies are more likely to use *industry-promoting* sources, that those in older companies are more likely to use *state government* sources, and that more training is related to use of a greater number of *information sources*. These findings can inform various communication strategies to target sub-sectors of the lawn care industry.

Figure 4.3 Relationships of company characteristics and psychological factors with information sources



(B values in parentheses; * significant at $p < .05$, ** significant at $p < .01$, *** significant at $p < .001$.)
 ---dotted lines represent initially significant relationships no longer significant in hierarchical regression.

In one case, the addition of *psychological factors* did not explain additional variance beyond that explained by *company characteristics*. The company characteristic, *amount of training offered* and the psychological factor, *beyond regulation* did not significantly explain use of *environmental/local* sources. These variables may be measuring different aspects of a larger construct, one that is focused on company culture.

Insight can also be gleaned from the relationship between having a greater sense of responsibility and the use of more *information sources*. Again, the direction of the relationship can be debated, but those managers who use a greater range of *information sources* were found to be more likely to also consider themselves as having greater responsibility. Convincing lawn care professionals to use more sources, however, is neither reasonable nor practical. In the end, decisions may need to be made about how to more effectively reach a wider audience. The high likelihood for use of *industry-*

promoting sources suggests that these sources will reach more lawn care managers, and the associated high endorsement for being motivated by *business considerations* suggests that using these sources will address issues in a way that speaks to a greater percentage of lawn care managers' concerns. While efforts to reach lawn care companies will continue through other sources, more effort could be made to address multiple motivations through *industry-promoting* sources.

This has already been occurring on a number of levels in and with certain organizations in Michigan. Collaborations between *environmental/ local* sources, *state government* sources, and *industry-promoting* sources are combining some of the messages identified with each type. In many ways, industry may be interested in staying ahead of regulation by promoting certain practices that minimize environmental impacts (Khanna et al., 2007; Lyon & Maxwell, 2004; Maxwell et al., 2000), such as Integrated Pest Management (IPM) or testing soil before choosing a fertilizer. Small local groups are working with statewide industry groups to devise checklists and actions for lawn care companies to perform to move *beyond regulations*. These efforts are widening the circle of trust, and may be key to exposing those companies motivated by *business considerations* or *state government* to develop a motivation to go *beyond regulations* to reduce impacts on the environment.

CHAPTER FIVE FERTILIZER PRACTICES

Fertilizer run-off is problematic in various areas in Michigan such that certain communities have recently passed legislation banning the sale and use of lawn fertilizers containing phosphorus¹⁰. In other communities, practices such as the use of low/no phosphorus fertilizer, the use of fertilizers with slow-release nitrogen, and testing soil before choosing a fertilizer grade are recommended for lawn care by water agencies, watershed councils, and environmental non-profits.

The Phase I interviews and Phase II survey explored a number of variables related to use of fertilizers. Lawn care company managers who indicated application of fertilizer as part of their business were asked about three practices that serve as the dependent variables in this chapter: 1) use of *low/no phosphorus* fertilizers, 2) use of *slow-release* fertilizers and 3) *soil test frequency*. This chapter provides an overview describing these dependent variables, examining how each is influenced by *psychological factors*, use of *information sources*, and *company characteristics*.

Sample

Of the 65 lawn care company professionals who filled out the survey, 34 report that application of fertilizers is part of their business.

Apply fertilizers, apply pesticides and cut grass	20 companies
Apply fertilizers and apply pesticides	5 companies
Apply fertilizers and cut grass	6 companies
Apply fertilizer only	3 companies

A One-way ANOVA reveals that there are no significant differences between these groups with respect to the dependent variables.

¹⁰ See article in Ann Arbor News (Davis, 2006)

Description of dependent variables

Two measures, *low/no phosphorus* fertilizer and *slow-release* fertilizer, represent preferred fertilizer practices, and are based on responses to the question “Which types of fertilizers does your company apply (check all that apply).” This question has separate response lines for each of the three application seasons, spring, summer, and fall. An additional measure, *soil test frequency*, was assessed by responses to the question, “How often do you test soil before choosing a fertilizer?”

Low/no phosphorus fertilizers

Given the high phosphorus levels in Michigan soils, soil ecologists suggest that the application of additional phosphorus is often unnecessary and can lead to run-off of this nutrient (City of Ann Arbor 2006; Frank, 2005). This run-off has been reported as relating to numerous surface water quality problems. Therefore, using fertilizer with a low level or no phosphorus is a preferred practice recommended by numerous organizations ranging from Michigan State University Extension to watershed councils and non-profit healthy lawn care groups. Although distinctions are made between low and no phosphorus fertilizers by several organizations, they were grouped together in this survey.

About 34 percent of the lawn care professionals who reported that they apply fertilizer use *low/no phosphorus* products and do so consistently across three seasons. Responses to this question were supported by answers to another question on the survey that asked, “What is the average fertilizer ratio used most commonly by your company.” Options were provided to write in a percentage number for the nutrients—nitrogen, phosphorus, and potassium—and “Don’t know¹¹” for all three application seasons. The reporting of using *low/no phosphorus* fertilizers was significantly correlated ($r=.48^{**}$) with the reporting of low or no phosphorus in fertilizer grades (average of 3 percent or less across the seasons).

¹¹ Over one third (37%) of the 30 respondents who answered the fertilizer grade question report that they “don’t know” the fertilizer grade. This may be problematic. It is, however, possible to not know this figure and still be using the right percentage. In addition, “not knowing” may be the logical response if a lawn care company does not use only one percentage—in this case, they may actually be engaging in a preferred practice.

The interview findings suggest that certain lawn care managers may be unaware of the problems associated with the use of excess phosphorus in fertilizer. For example, when one manager of a small company (with 90 percent commercial customers that typically applies four to six applications of weed-n-feed products) was asked about ways to prevent pollution caused by lawn care, after being prompted with several questions about low or no phosphorus products, he replied “I hadn’t heard about phosphorus [being a problem], in particular.” This manager went on to ask if phosphorus was a problem, and after a brief discussion stated that this was “good [information] to know.”

Slow-release fertilizers

Slow-release fertilizers are those which are designed to release a portion of their nitrogen slowly so that the turfgrass has more time to absorb the nutrient. Excess nitrogen can be an environmental problem, especially when there are high levels of watering or rainfall. High levels of watering can cause excess nitrogen to leach into groundwater and cause problems with drinking water (Kussow et al., 1997; MDEQ, 1992). While *slow-release* fertilizers are generally recommended by organizations seeking to reduce impacts (MDEQ, 1992; SOCWA, 2005), there are situations in which lawn care companies choose to use faster release products to provide nutrients that are available more quickly in order to make the grass greener in short time.

Of the 32 professionals who answered the questions on fertilizer use, 7 indicated they never apply *slow-release* fertilizers, 6 apply them in one season, 5 apply them in two seasons, and 14 apply *slow-release* fertilizers in all three seasons. These results suggest that the practice of using *slow-release* fertilizer is quite common, given that only about 22 percent of the sample never uses them. The use of *slow-release* fertilizers is not correlated with the other dependent variables.

Preferred fertilizers: Low/no phosphorus and slow release

Because of their conceptual similarity, the two variables, *slow-release* and *low/no phosphorus*, were combined into one variable by using their mean. From a pollution prevention perspective, the use of either of these practices relates to reducing the

possibility of having excess nutrients impact water quality. The combined variable is called *preferred fertilizers*.

Grass clippings

As an alternative to applying fertilizers, leaving grass clippings on the lawn is recommended by a majority of turf specialists and organizations promoting more environmentally friendly lawn care. The clippings function as a source of nitrogen, returning nutrients back to the soil as a form of what some organizations call “grasscycling,” which was promoted starting in the early 1990s (Steinberg, 2006). For those companies who cut grass, this message has been put into practice by a majority of those who answered the question “What do you do with your grass clippings? (Check all that apply).” Options were provided for “Bag,” “Compost,” “Grasscycling,” “Leave to fertilize,” and “Remove.” Of the 55 lawn care companies who answered this question, about 93 percent reported that they leave clippings after cutting grass (by indicating that they engage in “grasscycling,” “leave to fertilize,” or both). Because there was very little variance in this practice, it is not examined in greater detail.

Soil test frequency

One effective way to avoid using excess nutrients when fertilizing a lawn is to conduct a soil test before choosing and using a fertilizer grade. Responses to the question “How often do you test soil before choosing a fertilizer?” were coded as 1=Never, 2=Rarely, 3=Sometimes, 4=Often, and 5=Always, with an option for “Don’t Know.” Table 5.2 shows that of the 34 lawn care companies who answered this question, 66 percent indicated that they test soil rarely or never and only 3 percent test soil more than sometimes.

Frequency of testing	Response Frequency	Response Percentage	Cumulative Percentage
Never	7	21.9%	21.9%
Rarely	14	43.8%	65.6%
Sometimes	10	31.3%	96.9%
Often	0	-	-
Always	1 ¹²	3.1%	100.0%
Don’t know	2		

¹² This outlier was left out of regression analysis on the associations between variables because it would inaccurately distort the regression line.

In answer to the question, “For what percentage of customers do you test soil,” only about 11 percent of the sample indicated that they test soil for more than ten percent of their customers (See Table 5.3). The results from this question are highly correlated ($r = .71^{***}$) with those of *soil test frequency*. Given this high correlation, only *soil test frequency* was examined as a dependent variable. The reported outlier of a 5 for *soil test frequency* was removed from subsequent analysis because it represents an anomalous case that would disproportionately affect regression lines in subsequent tests.

Table 5.3. For what percentage of customers do you test soil?

Percentage of Customers	Response Frequency	Response Percentage	Cumulative Percentage
0%	7	25.9%	25.9%
1%	3	11.1%	37.0%
3%	1	3.7%	40.7%
5%	6	22.2%	63.0%
10%	7	25.9%	88.9%
25%	1	3.7%	92.6%
100%	2	7.4%	100.0%

To probe why lawn care companies do not test soil more often, a follow-up question was used that asks “What prevents you from performing more soil tests? (Check all that apply).” Options were provided that were derived from the interviews in the first phase of the research, and include the reasons listed in Table 5.4.

Table 5.4. What prevents you from performing more soil tests? (check all that apply)

Reason	Response Frequency	Response Percentage
Customers are not willing to pay for it	20	57.1% of respondents
We know soil composition	11	31.4% of respondents
Don't fertilize enough to require	8	22.9% of respondents
It is not necessary	4	11.4% of respondents
Costs too much	1	2.9% of respondents
Other: “We are just too busy”	1	
Other: “We refer them to MSU”	1	

The most commonly cited reason provided by over half of lawn care companies for why they do not perform more soil tests is that “customers are not willing to pay for it.” At the same time, only three companies reported that they test less often because the test “costs too much.” A participant added a comment that offers one explanation for this perspective:

Most people have a hard time paying for soil tests. They often don't understand enough to pay for the test, even when it is carefully explained. They go with companies with the lowest bottom line to save money (including money on soil tests).

At least one of the other three reasons, “we know soil composition,” “don’t fertilize enough to require,” and “it is not necessary,” was cited by 60 percent of the respondents (even more than “customers are not willing to pay for it”). These beliefs that soil tests are not necessary highlight the perceived lack of importance placed on testing soil and the false sense of confidence that many fertilizer applicators possess. Write-in responses were also provided by participants in the “Other” section, with one lawn care company stating, “We are just too busy,” and another explaining that “[we] refer them to MSU,” suggesting that soil testing is the responsibility of the customer. When asked about testing soil in the interviews, the most typical response was “not on every property.” Lawn care companies suggested that they “do it by request,” or “if there is a problem.” One company stated that they test soil “not all of the time, only if there is a specific problem. It costs us to have it done, and we must pass it on to customers.” Although this provides important insight into why certain companies may be testing soil less often, it does not help explain what might help predict soil testing or other preferred practices, which is examined next.

Predicting preferred practices

The purpose of this section is to examine the role of each of three groups of independent variables (*company characteristics*, *psychological factors*, and *information sources*) in their relation to the preferred practices, *preferred fertilizers* and *soil test frequency*. The independent variables were entered as independent groups into forward regression analyses to test their individual relationship with each dependent variable. Significant predictor variables from each group were then entered into the next step of the analysis, hierarchical regression analyses. This section provides an overview of the first step, individual contributions in each independent variable group.

Company characteristics

The *amount of training offered* was the only *company characteristic* significantly related with either of the *preferred practices* (Table 5.5). This variable accounted for almost 27

percent of the variance in explaining *soil test frequency*. One plausible explanation for this finding is that lawn care companies that offer more training may be more concerned with both seeking and sharing information. Offering more training opportunities suggests a certain cultural component that values more information. Performing soil tests can be another way of gathering important information as a part of this approach. Use of *preferred fertilizers*, on the other hand, is not predicted by any of the *company characteristics*.

	Fertilizer practices (Dependent Variable)	
	Preferred fertilizers	Soil test frequency
Individual Contribution	B	B
Number of years in business		
Number of employees		
Amount of training offered		.54**
Percent residential		
Adjusted R²	0	.27**
* significant at p<.05, ** significant at p<.01, *** significant at p<.001.		

Psychological Factors

The *psychological factors* included in Table 5.6, relating to *beliefs, motivations, and sense of responsibility*, were presented in Chapter Four. The consideration by the lawn care company that it is more responsible for taking action to reduce environmental impacts is significantly associated with choosing and using *preferred fertilizers*, as shown in Table 5.6. *Psychological factors* are, however, not associated with *soil testing frequency*

	Fertilizer practices (each an individual regression)	
	Preferred fertilizers	Soil test frequency
Individual Contribution	B	B
Business considerations		
Beyond regulations		
Government regulation		
Company as more responsible	.49*	
Adjusted R²	.21*	0
* significant at p<.05, ** significant at p<.01, *** significant at p<.001.		

The choice of fertilizer may be perceived as being more within the realm of responsibility for lawn care companies, as they can make choices that do not involve substantial

procedural changes. In the case of soil testing, it is important to note that the most common reason reported for not testing soil more frequently was that customers are not willing to pay for it, connecting the perception of this action for some lawn care companies with the responsibility of customers. Most lawn care companies, however, ranked customers lower than either themselves or government or both, suggesting either a differentiated sense of responsibility or a belief that soil testing is not necessary for reducing impacts.

Information sources

The use of *information sources* (See Chapter Four) is significantly associated with both of the dependent variables. Table 5.7 shows that *industry-promoting* sources are significantly associated with the use of *preferred fertilizers*, explaining 19 percent of the variance. This relationship might be explained by the effectiveness of these sources in conveying the message of the importance of using these kinds of products. Many vendors emphasize *slow-release* on their products and in their product sheets. MaxLawn's "Lawn Food" lists as one of three bullet points, "Slow-release nitrogen for a longer lasting green lawn." The first bullet point for "Nature Safe" is, "A 90% slow-release organic fertilizer, which promotes excellent residual color and density with even slower growth." *Slow-release* is emphasized to the point where it seems almost ubiquitous. Although the use of *low/no phosphorus* products was reported as being less commonly used, regional efforts aimed at healthy lawns including that of the Michigan Green Industry Association have emphasized their use. According to a focus group conducted in 1999, a problem lawn care companies had run into was finding fertilizers with low levels or no phosphorus. Lawn care products and trade publications are now offering more options in low and no phosphorus lawn care products.

The *frequency of soil testing*, on the other hand, is not significantly associated with any specific information source, but is significantly related to using a larger number of sources. A plausible explanation for this relationship is that those lawn care companies who are in search of more information to guide their work may also seek more information by conducting soil tests more regularly.

Table 5.7. Relationship of information sources with fertilizer practices		
	Fertilizer practices (each an individual regression)	
	Preferred fertilizers	Soil test frequency
Individual Contribution	B	B
Environmental/ local sources		
Industry-promoting sources	.47*	
State government sources		
Number of information sources		.44*
Adjusted R²	.19*	.16*

* significant at p<.05, ** significant at p<.01, *** significant at p<.001.

Hierarchical regression analysis

Building a model of significant predictors for each of the dependent variables was the next step in the analysis. This involved hierarchical regression analysis in which the significant variables from each variable group identified in the previous analyses were entered sequentially. The independent variables were entered in a specific order, first controlling for *company characteristics* (if any show significance), followed by *psychological factors* (if any), and then *information sources* in the final step. This method is appropriate because it examines the additional variance explained by each independent variable group. With this method, it is possible to examine the additional variance that use of *information sources* offers in explaining each dependent variable and it is possible to compare the relative significance of each significant independent variable. Tables 5.8 and 5.9 show the results for this analysis for *preferred fertilizers* and *soil test frequency*, respectively. The tables are set up to mark the addition of each independent variable group and show the contribution of that variable to predicting each dependent variable.

Preferred fertilizers

Table 5.8 shows the regression results for use of *preferred fertilizers*. As none of the *company characteristics* and only a single variable for the *motivations* grouping and for *information sources* were significant, the model has two steps. The results show that both variables from the prior analyses play a significant role in the combined analysis. Jointly, the use of *industry-promoting* sources and the belief that the lawn care company is more responsible for taking action to reduce impacts explain about 34 percent of the variance

in the use of *preferred pesticides*. Each of these variables holds a relatively similar influence in explaining the variance, shown by their similar Beta values in Step 2.

Table 5.8. Significant predictors of preferred fertilizers

Independent Variable type	Significant Independent Variable	Psychological factors	Adding Information sources
		Step 1 (B)	Step 2 (B)
Psychological Factors	Company as more responsible	.49*	.42*
Information Sources	Industry-promoting sources		.40*
	Adjusted R²	.21*	.34**
	R² Change		.16*

* significant at p<.05, ** significant at p<.01, *** significant at p<.001.

Soil Test Frequency

The analysis for *soil test frequency* also included only two steps, because a single variable was found significant with respect to *company characteristics* and *information sources*. As shown in Table 5.9, the amount of training offered is a strong predictor of this practice. However, the *number of information sources* added little to the model.

Table 5.9. Significant predictors of soil test frequency

Independent Variable type	Significant Independent Variable	Company characteristics	Adding Information sources
		Step 1 (B)	Step 2 (B)
Company characteristics	Amount of training offered	.61***	.54**
Information sources	Number of information sources		.22
	Adjusted R²	.35***	.37**
	R² Change		.04

* significant at p<.05, ** significant at p<.01, *** significant at p<.001.

This lack of significant additional contribution might be explained partly by the relationship between *amount of training* and *number of information sources*. In Chapter Four, it was revealed that *amount of training* explains 21 percent of the variance in the *number of information sources* that a lawn care company uses. This relationship may overshadow the relationship that number of information sources has with *soil testing frequency*. Because training is associated with both using more *information sources* and *testing soil*, the lack of additional variance explained by number of information sources

may suggest that offering more training opportunities reflects a culture of seeking and sharing information. More training can be considered a way to share more information within the organization, providing a more fully informed personnel, whereas using more information sources is related to seeking more information, but possibly for only a small portion of the workforce. Testing soil may best represent a combination of seeking and sharing information, and those companies that offer more training opportunities may be the same companies that are inclined to seek and share information. Although they may test soil more frequently, it must be remembered that the frequency is relatively low across the sample.

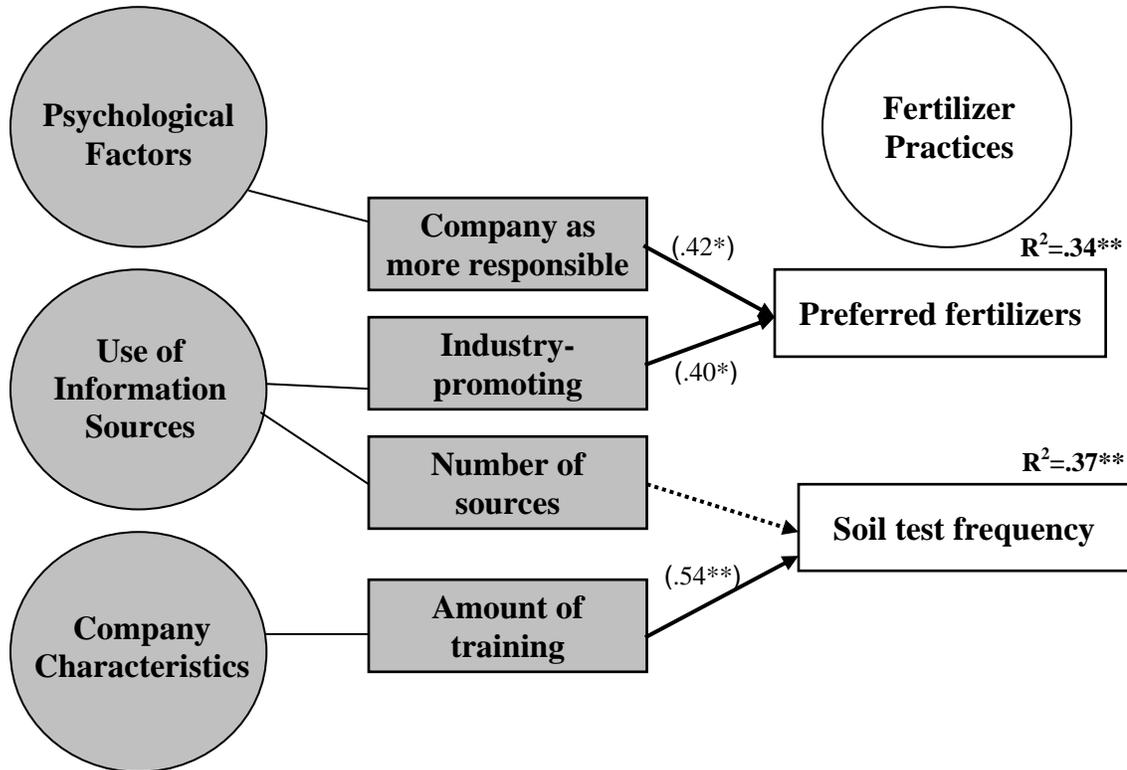
Conclusions

While the use of *low/no phosphorus* fertilizers is somewhat common (one-third of companies in this sample use it in all three seasons), using *slow-release* fertilizer is slightly more common (four-fifths use it in any one season). Together, these *preferred fertilizers* represent decisions that lawn care companies make about their practices that are not regulated, and can be perceived as product replacement choices.

Most companies reported that they do not frequently test soil before choosing a fertilizer (97 percent sometimes or less), and test soil only for a small percentage of their customers (89 percent of companies for 10 percent or less of their customers). A majority suggest that they do not test soil more often because the customers are not willing to pay for it, even though they recognize that it costs very little. These actions are also not regulated, and for many, carry the perception of not being necessary. They may also be perceived as requiring procedural adjustments to perform on a regular basis.

The *amount of training offered* is significantly related to a lawn care company's decision to test soil more frequently. While it is not likely that training causes testing, these actions may say something about the culture of a lawn care company and its approach to sharing information. More socially responsible companies that offer more training opportunities are also more likely to take the uncommon environmentally responsible step of testing soil. Certain companies may be more likely to engage in both more training for employees and more soil testing to ensure they are using the correct grades.

Figure 5.1 Relationships of independent variables with fertilizer practices



(B values in parentheses; * significant at $p < .05$, ** significant at $p < .01$, *** significant at $p < .001$.)
 ---dotted line represents initially significant relationships no longer significant in hierarchical regression.

The use of more *information sources*, although significant in its relationship with *soil test frequency*, however, does not explain variance beyond what is explained by offering more training. In other words, the desire for more information does not translate easily to soil testing perhaps because both procedural changes and a financial cost are perceived. Although it might have been hypothesized that the variable *company as more responsible* would play a role in this action, this lack of relationship is reasonable, as the most suggested barrier in this study is that customers are not willing to pay for soil tests. The perception by many that customers are not willing to pay suggests that customers are often seen as responsible for incurring these costs.

The result with respect to *soil test frequency* offers an interesting contrast to the use of *preferred fertilizers*. For the latter, where procedural changes may be perceived as not necessary, a significant relationship was found with having a sense that the lawn care company is more responsible. In other words, having a greater *sense of responsibility* translates into being more likely to use *preferred fertilizers*, an area in which the lawn care company can make decisions about what products to use. This highlights the substantial role that a *sense of responsibility* can play in encouraging lawn care practices that have less of an environmental impact. Given that this makes a significant difference in lawn care managers' decisions to use different products, finding ways to increase the perception that lawn care companies are more responsible may be part of an important strategy to encourage less impacting lawn care practices. Additionally, since the use of *industry-promoting sources* was a significant predictor of using *preferred fertilizers*, it would seem reasonable to encourage these information sources to guide lawn care companies to see these practices as a way to express their *sense of responsibility*.

CHAPTER SIX

PESTICIDE PRACTICES

Lawn care practices involving the application of pesticides can have negative impacts on water quality, environmental health and human health. The extent to which lawn care companies engage in various pesticide practices can be influenced by factors explored in the Phase II survey, including *company characteristics*, *psychological factors*, as well as use of *information sources*. *Pesticide practices* in this study include engagement in *damaging pesticide practices*, engagement in *preferred pesticide practices*, and average number of *applications per year*. This chapter explores how *company characteristics*, *psychological factors*, and use of *information sources* are related to each of these *pesticide practices*.

Sample

Out of the 65 lawn care companies that completed the survey, 27 companies apply pesticides as one of their services¹³. Table 6.1 displays the various services offered by these companies.

Apply pesticides, apply fertilizers and cut grass	20 companies
Apply pesticides and apply fertilizers	5 companies
Apply pesticides and cut grass	2 companies

In some cases, the respondents did not answer all of the questions relevant to the analysis. A One-way ANOVA suggests that the type of lawn care services offered does not play a significant role in explaining variance among the dependent variables.

Description of dependent variables

The first two dependent variables are responses to the question, “To what extent do your pest control applications involve each of the following,” and use a 5-point Likert scale

¹³ Although this sample size is small, and some caution should be taken in interpreting results, the study produced significant findings for this group of lawn care professionals.

with 1=Never, 2=Rarely, 3=Sometimes, 4=Somewhat regularly, and 5=Always, and an additional option for “Don’t Know.”

Damaging pesticide practices

Damaging pesticide practices is a scale variable that resulted from a factor analysis (Cronbach’s $\alpha=.80$). It is comprised of two items: 1) Using a *broadcast* method to apply the pesticides (rather than targeting weeds or spot-treating pests), which often results in overuse of pesticides, and 2) using *weed-n-feed* products, which combine fertilizer and pesticide into one product—often leading to poorly timed applications and overuse of chemicals (SOCWA, 2005; Steinberg, 2006). Although these are not desired practices (MDEQ, 1992; Steinberg, 2006; USEPA, 2004), they appear to be quite common in this sample, with 65 percent of the sample engaging in these practices at least sometimes, and more than 50 percent doing so either somewhat regularly or always.

Preferred pesticide practices

The variable, *preferred pesticide practices*, is also a scale variable that resulted from factor analysis (Cronbach’s $\alpha = .60$), and is a combination of two items, engagement in *Integrated Pest Management(IPM)*, and use of *buffers* between application and any water surface. *IPM* is a systematic approach to controlling pests that reduces the amount of chemicals used by encouraging mechanical, physical, biological, and preventative measures, and is therefore more desirable due to its smaller impact on the environment (USEPA, 2004). About 58 percent of the lawn care companies in this sample claim to always engage in *IPM*, with another 23 percent reporting that they perform *IPM* somewhat regularly. A minority of the group (19 percent) claims to use the *IPM* approach sometimes, rarely, or never. Compared with *IPM*, a smaller percentage (36 percent) of companies claim to always use *buffers*, and 18 percent report using them somewhat regularly. A greater percentage (46 percent) reports using them sometimes, rarely, or never¹⁴. Overall, about 50 percent of those who use pesticides claim to engage

¹⁴ Whether the lack of buffer use is due to having fewer properties near water bodies, or because some lawn care companies do not consider it necessary to use them is not known. However, using buffers in most instances is preferred as they can reduce runoff of pesticides and fertilizers (see Cole et al. 1997) and limit drift to other properties.

in *preferred pesticide practices* sometimes or less, and 50 percent claim they in engage in them more than sometimes.

Contradiction of IPM and damaging pesticide practices

Although the practice of *IPM* conflicts with engagement in *damaging pesticide practices*, several lawn care companies claimed to engage in both on a somewhat regular basis.

Integrated Pest Management, by its definition, avoids the use of *broadcast* spraying of pesticides or the application of *weed-n-feed* products. To examine this discrepancy in greater detail, lawn care companies claiming to “always” engage in *IPM* were identified. About two-thirds (10 out of 14) of this group also claimed to engage at least sometimes in *damaging pesticide practices*, with nearly half of this group engaging at the levels of somewhat regularly or always. Several plausible explanations for this discrepancy exist. One is that lawn care companies have different treatments for customers who have different demands. Customer demand may be driving lawn care companies to treat some lawns with *IPM* and others with more conventional broadcast methods, or perhaps they use *IPM* for certain activities like tree maintenance, but not on the lawn. It is also possible that some lawn care companies do not know what *Integrated Pest Management* entails.

Applications per year

The third dependent variable, average number of *applications per year*, is a single-item response to the stem question, “What is the average number of applications that you make at each site per year.” This variable is represented on a scale with 1= no applications per year, 2= 1-2 applications per year, 3= 3-5 applications, 4= 6-8 applications, and 5= greater than 8 applications per year. Fewer applications are suggested by organizations seeking to limit use of pesticides in lawn care (eg. MDEQ, 1992). Although applying fewer rounds of pesticides is suggested, the trend revealed in this study is toward more applications, with 70 percent of the sample applying more than three treatments per year (40 percent of them in the 3-5 range, and 30 percent over 5 applications per year).

Predicting pesticide practices

Separate analyses were performed to examine the roles of *company characteristics*, *psychological factors*, and *information sources* (See Chapter Four) with respect to the pesticide-related dependent variables. As in the previous chapter, forward regression analyses were used. Subsequently, significant predictor variables were entered into the next step of the analysis, hierarchical regression analyses. This section provides an overview of the first step, individual contributions in each independent variable group.

Company characteristics

The *number of years* a lawn care company has been in business predicts engagement in *damaging pesticide practices* (Table 6.2) such that the older the company, the more likely it is to engage in *damaging practices*. This is in contrast to what was expected. One plausible explanation for this is that older lawn care companies have become familiar with approaches that involve *weed-n-feed* or *broadcast* applications, and because these products and processes have suited their needs, they have not changed their practices. They have developed practices that make sense to them but happen to be more harmful approaches, and through inertia, the companies do not make changes.

	Pesticide Practices (Dependent Variable)		
	Damaging pesticide practices	Preferred pesticide practices	Applications per year
Individual Contribution	B	B	B
Number of years in business	.48*		
Number of employees		-.55**	.60**
Amount of training offered			
Percent residential			
Significant variable contribution			
Adjusted R²	.19*	.28**	.33**

* significant at p<.05, ** significant at p<.01, *** significant at p<.001.

Table 6.2 also shows that the *number of employees* is a significant predictor of both environmentally *preferred pesticide practices* and the average number of *applications per year*. The relationship with *preferred pesticide practices* is negative, indicating that the smaller the company, the more likely it is to engage in the preferred practices of *IPM* and using *buffers*. This is also in contrast to what was expected. Although larger companies are more likely to belong to professional organizations that expose them to more

information, this might not translate into certain *preferred pesticide practices*. It is possible that larger companies also have more efficient approaches in order to reach more customers that make practices such as *IPM* difficult. Indeed, in this study, a greater percentage of small companies than large companies reported that they “always tailor applications to each individual property.” Larger companies were also found to be more likely to apply more pesticide *applications per year*. This may be related to offering application packages, such as a six-step program, designed to satisfy customer demands and maximize profit. In the end, larger companies appear to be contributing a more negative impact on the environment, by being less likely to engage in *preferred pesticide practices* and delivering more *applications per year* of pesticides.

Psychological factors

No significant relationships were found between *motivations*, *beliefs*, and *sense of responsibility* and the dependent variables. This finding is somewhat surprising given that choosing to engage in *preferred pesticide practices* such as *Integrated Pest Management* has an inferred logical connection with *business considerations* because these practices seem to make good business sense and seem to also be related to decisions for *going beyond regulations*. These practices, similar to choosing *preferred fertilizers* (see Chapter Five) are not regulated, although unlike *preferred fertilizers*, they require a very different approach to lawn care. Similarly, avoiding *damaging pesticide practices* is also not regulated, and requires different approaches. Perhaps having a *sense of responsibility* provides only limited motivation with behaviors that require greater levels of engagement—and for changing practices to the point of engaging in *IPM* or avoiding *weed-n-feed* products, a *sense of responsibility* is not enough.

It is also possible that awareness about risks associated with various *pesticide practices* is perceived differently than that for *fertilizer practices*. Two belief statements (See Table 6.3)¹⁵ were presented in the survey with a Likert scale of 1=strongly disagree and 5=strongly agree.

¹⁵ This table presents findings for the entire sample. If the sample is reduced to only lawn care companies that both apply fertilizer and apply pesticides, the results are similar, with the environmental impacts from fertilizer statement showing a mean of 2.83 and the health risk from pesticide use showing a 4.08 (t=5.32***, df=23, 1=strongly disagree, 5=strongly agree).

Table 6.3 Statements of belief about problems and risks	Mean
Excessive fertilizer creates environmental problems	4.13
Using chemicals such as pesticides in lawn care creates a health risk	3.12
Significantly different: $t=6.34^{***}$, $df=59$ 1=strongly disagree, 5= strongly agree	

The means of these two belief questions suggest that risk associated with pesticide use is less commonly considered to be a problem compared to those problems perceived as being associated with overusing fertilizers. The difference in significance between responses to the two statements may be related to less information communicated by organizations on how and why to reduce use of pesticides than information related to impacts due to fertilizer overuse. This finding may also reflect that lawn care managers do not want to believe that pesticide use is putting their employees at risk (Coppin et al., 2002; Robbins, 2007). Those who are more familiar with using pesticides are more likely to downplay the risk level (Coppin et al., 2002). Although risks of pesticide use may be communicated in popular media (eg., Carson, 1962), lawn care companies are constantly reassured by various industry sources of the safety of these products if directions are followed (see Blessing, 1999). With the perception that something such as pesticide use might not be a problem, the possibility for feeling responsible to solve the problem decreases dramatically. In the end, these *psychological factors* did not play a role in explaining variance in engagement in *pesticide practices*.

Information sources

Information sources, presented in Table 6.4, play significant roles in predicting two of the dependent variables, with *industry-promoting sources* related to both *damaging pesticide practices* and average *applications per year*. In addition to *industry-promoting sources*, the use of *state government sources* significantly predicts avoiding *damaging pesticide practices*¹⁶.

The finding that use of *information sources* plays a significant role in engagement in *damaging pesticide practices* confirms what was hypothesized. Messages suggesting the avoidance of *weed-n-feed* and *broadcast* applications are not common in *industry-*

¹⁶ The Beta values associated with these information sources are slightly inflated due to a statistical phenomenon known as “suppression” (see Tzelgov and Henik, 1991).

promoting literature. Instead, most fertilizer brands have a *weed-n-feed* type product, and *broadcast* applications are regularly suggested on pesticide labels provided by vendors. Given their mission, *industry-promoting* sources would be expected to limit messages that call for reductions in use of these products. This may also explain why *industry-promoting* sources are associated with more *applications per year*.

Table 6.4. Relationship of information sources with pesticide practices			
	Pesticide practices		
	Damaging pesticide practices	Preferred pesticide practices	Applications per year
Individual Contribution	B ^a	B	B
Environmental/ local sources			
Industry-promoting sources	.73**		.39*
State government sources	-.50*		
Number of information sources			
Significant variable contribution			
Adjusted R²	.30**		.13**
* significant at p<.05, ** significant at p<.01, *** significant at p<.001. ^a Beta values inflated due to suppression (see Tzelgov and Henik, 1991).			

The negative relationship of *state-government* sources with *damaging pesticide practices* is somewhat puzzling¹⁷, since applying *weed-n-feed* products or applying pesticides using *broadcast* method rather than spot treating weeds are not regulation compliance issues. Although state government sources do not focus great attention on *broadcast* applications or *weed-n-feed* as being problematic, a Best Management Practices publication by the *state government* source Michigan Department of Environmental Quality discourages broadcast applications by stating “Where possible, apply pesticides only to those areas which are known to be impacted by the pest. Avoid applying to areas not affected by the

¹⁷ *Environmental/ local* sources were expected as the most likely sources to be related to limiting *damaging practices*, as many publish information related to limiting practices such as *broadcast* methods and *weed-n-feed* products. Although these sources do not show a significant relationship in Table 6.4, if *state government* sources are not included in the analysis, *environmental/local* sources show an equally significant negative relationship with *damaging pesticide practices*. The reason they do not appear in the initial analysis is because forward regression analysis enters variables one at a time based on what is most significant. The minute difference between the two for this relationship shows *state government* sources as being more significant, but only by a minor fraction.

pest.”(MDEQ, 1992). The publication also suggests that *buffers* are a recommended Best Management Practice, and outlines an extensive set of strategies for engaging in *IPM*. Although many *state government* publications are associated with the legality of practices, others focus on *preferred practices* and help predict variance in *damaging pesticide practices* among lawn care companies. Given this, it is also surprising that there is a lack of relationship between *state government* sources and *preferred practices*.

Hierarchical regression analysis

Building a model of significant predictors for each of these dependent variables was the next step in the analysis. As in previous chapters, this involved hierarchical regression analyses in which significant variables from each independent variable group were entered sequentially to allow the examination of the additional variance explained by each independent variable of the model. The *company characteristics* were entered first, followed by *information sources*. (Since none of the *psychological factors* were significant in the first analyses, these were omitted from the hierarchical regression analyses). Tables 6.5 and 6.6 show the results from these analyses for *damaging pesticide practices* and *applications per year*, respectively. The tables are set up to mark the addition of each independent variable group and show the contribution of that variable to predicting the dependent variable. No separate analysis is shown for the *environmentally preferred practices* dependent variable, as the only significant predictor was from the *company characteristics* set.

Damaging pesticide practices

Table 6.5 shows that the addition of the use of *information sources* variable significantly increases the predictive power of the model, building on *number of years* that a company has been in business, to explain the variance in reported engagement in *damaging pesticide practices*. Together, these variables explain 62 percent of the variance, an increase of 43 percent over *number of years* in business alone. The relationship is such that use of *industry-promoting* sources is positively associated with *damaging pesticide practices* and use of *state government* sources is negatively associated with *damaging pesticide practices*. These are relatively equal in weight and each slightly more related

than the *number of years* in business to the dependent variable, demonstrated by the higher Beta values, although suppression is playing a role in relative values¹⁸.

Independent Variable type	Significant Independent Variable	Company characteristics	Adding Information sources
		Step 1 (B)	Step 2 (B)^a
Company characteristics	Number of years in business	.48*	.61***
Information sources	Industry promoting sources		.72***
	State government sources		-.74***
	Adjusted R²	.19*	.62***
	R² Change		.43***

* significant at p<.05, ** significant at p<.01, *** significant at p<.001.
^a Beta values inflated due to suppression (see Tzelgov and Henik, 1991).

Applications per year

Table 6.6 presents results for variables predicting engagement in the average number of *applications per year*. The variable *industry-promoting sources* does not explain additional variance in *applications per year* beyond the influence of the *number of employees*. This is an unexpected finding given that *industry-promoting sources* can be thought of as encouraging more *applications per year* as a part of profit seeking. In Chapter Four, it was revealed that size of company is related to use of information sources such that larger companies are more likely to use industry-promoting sources, so the variance explained may overlap. Larger companies are associated with more *applications per year* (Table 6.6), as well as being less likely to engage in *preferred pesticide practices* (Table 6.2).

Independent Variable Type	Significant Predictors	Company characteristics	Adding Information sources
		Step 1 (B)	Step 2 (B)
Company characteristics	Number of employees	.60**	.53**
Information sources	Industry-promoting sources		.22
	Adjusted R²	.33**	.36**
	R² Change		.05

* significant at p<.05, ** significant at p<.01, *** significant at p<.001.

¹⁸ The increases in the Beta value associated with *number of years in business* as well as *state government sources* are due to “suppression” (see Tzelgov and Henik, 1991).

Fertilizer and pesticide practices: Preferred practices

Of the lawn care companies surveyed, 25 reported that they apply both fertilizer and pesticides as part of their practices. In order to test the relationships between the independent and all five dependent variables, these 25 cases were selected to be analyzed with respect to their engagement in preferred fertilizer and pesticide practices (including *preferred fertilizer practices*, *soil test frequency*, *preferred pesticide practices*, avoidance of *damaging pesticide practices*, and fewer *applications per year*). A variable was created that represents the number of preferred practices performed at a higher level. In other words, respondents that reported using preferred fertilizers at a level greater than or equal to the midpoint (3) were scored with a one, and those less than the midpoint were scored zero. The cutoff point varied based on distribution and logic (ie. Test soil frequency greater than two, preferred pesticide practices greater than three, damaging pesticide practices less than or equal to three, and applications per year less than three). These scores were then tallied to provide an overall *preferred practices* score.

Similar to previous analyses, forward regression analysis was performed to assess the relationships of all independent variables with this preferred practices measure. Although *psychological factors* and *information sources* were not found to play significant roles in explaining engagement in more preferred practices, the *company characteristic* of *number of employees* was found to play a role, and was the only variable to do so (Table 6.7). The *number of employees* is negatively associated with engagement in *preferred practices*.

Table 6.7. Relationship of company characteristics with preferred practices	
	Preferred practices
Individual Contribution	B
Number of years in business	
Number of employees	-.52*
Amount of training offered	
Percent residential	
Significant variable contribution	
Adjusted R²	.24*
* significant at p<.05	

This finding highlights the negative impact of larger lawn care companies as they are less likely to engage in *preferred practices* across a spectrum of fertilizer practices and pesticide practices. This result has implications for where to first intervene to reduce environmental impacts of lawn care practices. Larger lawn care companies engage in less desirable practices and service a large number of sites and acres. Thus, changing their practices, even a small amount, could have a substantial positive environmental impact.

Conclusions

Survey responses from lawn care companies show that many of these companies engage in *damaging pesticide practices* and several apply pesticides more than five times per year. At the same time, a majority of lawn care companies claim to always approach controlling pests using the *preferred pesticide practice, Integrated Pest Management*, a method incompatible with the above *damaging pesticide practices*. Engagement in, or avoidance of, these *pesticide practices* was found to be influenced by various factors and in some unexpected ways.

Company characteristics plays a significant role in explaining variance in certain *pesticide practices*. For two dependent variables, it is the only significant predicting variable group. *Number of employees* is negatively associated with *preferred pesticide practices*, while for number of *applications per year*, it is a positive predictor. In other words, companies with more employees are likely to apply pesticides more often and indicate a lower likelihood of using preferred approaches. This is contrary to the hypothesized outcome that larger companies, in particular, would be more likely to engage in practices such as *IPM* and practice using *buffers* because of their greater likelihood of belonging to professional organizations that might expose them to more information. A possible explanation could be related to the difficulty involved in engaging in such activities as *IPM*. Larger companies serve more customers, and perhaps related to their model of efficiency, they are less likely to take a slower, less automated approach.

The finding that *psychological factors* did not play a significant direct role in explaining variance in any *pesticide practices* is also surprising given that the ranking of the

company as more responsible was positively associated with engagement in *fertilizer practices* (See Chapter Five). This may be because the risk associated with pesticide practices is perceived differently from the perceived problems associated with overuse of fertilizer as discussed above. The relationships between *psychological factors* and *information sources* (detailed in Chapter Four) suggest that these variables may play an indirect role in *pesticide practice* outcomes, given the significant role of *information sources* in explaining variance in *pesticide practices*.

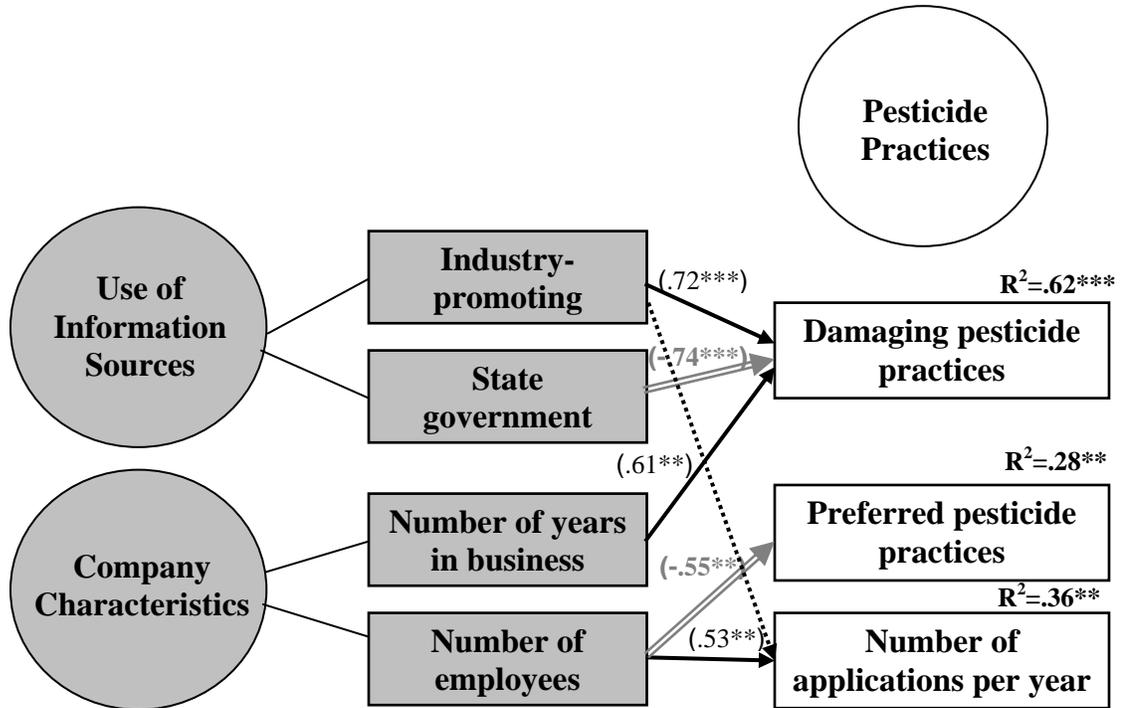
The influence of *information sources* on pesticide practices was also only partially as hypothesized, playing a role with respect to only one of the dependent variables. With respect to the use of *damaging practices*, information sources played a central role. Specifically, the use of *industry-promoting* sources is associated with greater likelihood of engaging in *damaging pesticide practices*, and use of *state government* sources is associated with much less likelihood of engaging in these practices. These findings support the connection between *information sources* and practices. The contents of *industry-promoting* sources are not likely to advise against using *broadcast* methods or *weed-n-feed* products. *State government* sources, on the other hand, make suggestions for avoiding these *damaging pesticide practices*.

The pattern of results is thus strikingly different with respect to *damaging practices* as opposed to the other two dependent variables used in analyzing pesticide practices (see Figure 6.1, based on the final analyses for each variable). The finding that smaller companies are more likely to use *preferred pesticide practices* and initiate less *applications per year*, with *information sources* not playing a role may say something about the ability of smaller companies to better tailor their services to the customer. They may be in a better position to practice *Integrated Pest Management* and use *buffers*, as their prescription are likely to be more flexible across customers.

Because those lawn care companies that are more likely to use *industry-promoting* sources are also more likely to engage in *damaging practices*, such as *broadcast*

applications and *weed-n-feed* products, it would be sensible to target these information sources to try to change these *pesticide practices*.

Figure 6.1 Relationships of independent variables with pesticide practices



(B values in parentheses; * significant at $p < .05$, ** significant at $p < .01$, *** significant at $p < .001$)

See notes on “suppression” in previous tables and Tzelgov and Henik (1991).

---dotted line represents initially significant relationship no longer significant in hierarchical regression.

⇒ Grey arrows indicate negative relationships.

Recognizing that the size of the company (*number of employees*) also matters (see Figure 6.1), it would be useful to target larger organizations that may be having a greater impact on the environment because of the increased chance that they will be less likely to engage in *preferred pesticide practices* and will deliver, on average, more *applications per year*. The finding that overall, size of company is the main factor determining likelihood of engaging in preferred practices across both fertilizer and pesticide use (Table 6.7) presents a very strong case for focusing on larger companies, as they are the ones most likely to be engaging in practices which have greater impacts on the environment.

Concluding thoughts about IPM

The models developed suggest some interesting patterns with respect to the incompatible practices of *preferred pesticide practices* such as *IPM* and *damaging pesticide practices*. It is possible that certain lawn care companies are offering both *IPM* and practices involving products such as *weed-n-feed* to meet different customer demands. In one interview, a lawn care company stated, “we broadcast spray on lawns and use *IPM* on trees and shrubs.” It is also likely that there exists an inadequate understanding of what constitutes *IPM* among certain lawn care companies. Because the practice of *IPM* is not standardized, various information sources can offer different interpretations of what it entails. In addition, lawn care companies can claim to use *IPM* without really knowing what it is. Given this potential for confusion and for *IPM* to more holistically address many pesticide concerns, it may make sense for future communication to focus on standardizing an understanding of what *IPM* entails. This communication can involve those who are practicing as well as those who hope to change practices to reduce impacts on the environment. The same can be said for using *buffers*. Finding agreement on what is an acceptable buffer by involving those who are applying pesticides may be an important first step in raising awareness about the importance of buffers while at the same time providing lawn care professional the opportunity to participate in crafting consensus on what constitutes *preferred pesticide practices*.

CHAPTER SEVEN

CONCLUSIONS AND RECOMMENDATIONS

Lawn care companies, in response to the cultural aesthetic of a green, weed-free lawn, are servicing lawns in ways that can negatively impact both ecological and human health. It is important to understand factors that are related to lawn care companies' practices in order to reduce environmental impacts. The companies are close to the problem, are relied on for expert decisions, are growing in number, and have a widespread impact because they care for multiple properties. This study examined the roles that *use of information sources, psychological factors, and company characteristics* play in influencing lawn care companies' practices with respect to fertilizer and pesticide application decisions. This chapter provides an overview of the findings and details recommendations for organizations that intend to influence lawn care practices, concluding with a discussion about future research.

Overview of study

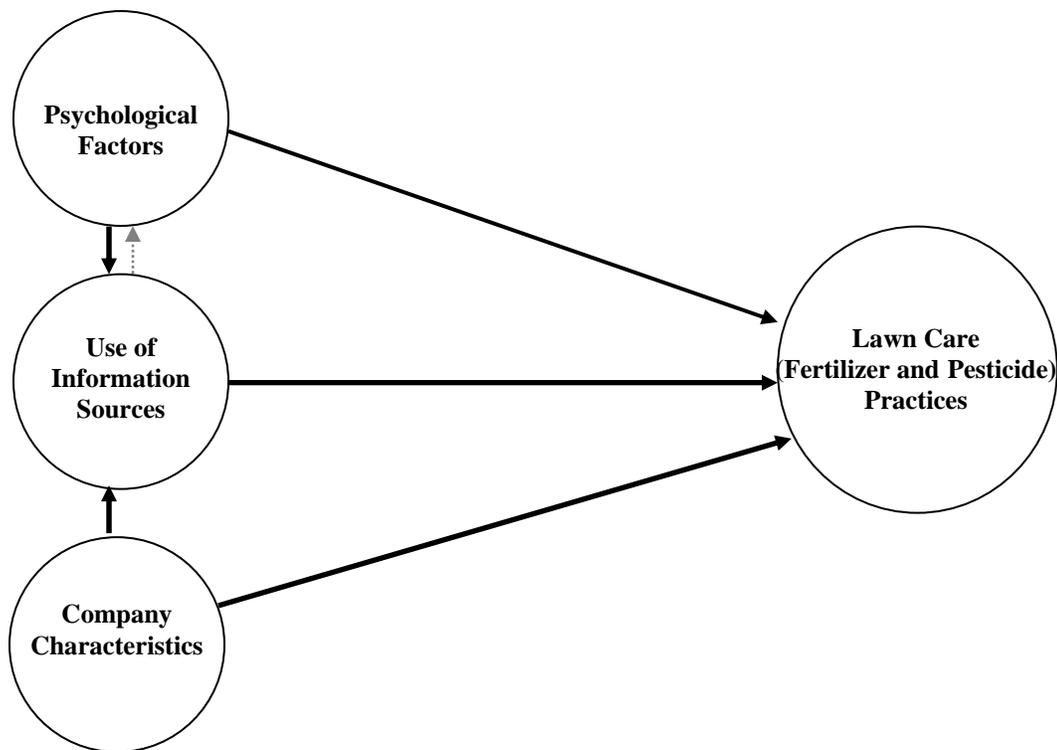
This study used a series of interviews followed by a survey to explore factors related to the reduction of environmental impacts among lawn care professionals in southern Michigan. The study examined how *psychological factors* including *beliefs, motivations, and a sense of responsibility* were related to lawn care companies' *use of information sources*, including *industry-promoting* sources (such as vendors and trade associations), *state government* sources and *environmental/local* information sources (such as watershed councils). In addition, the study presented an analysis of how these *psychological factors* and *use of information sources*, along with characteristics of the company (such as its size and number of years in business), influence lawn care practices related to fertilizer and pesticide use. The intentions of this study were to explore factors that may be associated with reduction of impacts, and to identify strategies for improving communication with lawn care companies in order to influence practices.

The study sought to answer three main questions:

- 1) To what extent do psychological factors and company characteristics influence a lawn care company's use of information sources? (Chapter 4);
- 2) To what extent do these psychological factors, company characteristics and use of information sources explain fertilizer practices among lawn care companies? (Chapter 5); and
- 3) To what extent do psychological factors, company characteristics and use of information sources explain pesticide practices? (Chapter 6).

Figure 7.1 presents a path diagram to show the various relationships that were tested.

Figure 7.1 Path diagram of study



Summary of results

1) *Psychological factors* were tested as antecedents to the *use of information sources*, a direction that is not commonly tested in the literature. Consistent with what was predicted, the *psychological factors* were each significantly associated with the expected

information source. In other words, being motivated by *business considerations* was associated with likelihood of using *industry-promoting* information sources; being motivated by *government regulation* was associated with likelihood of using *state government* sources, and being motivated to go *beyond regulations* was related to likelihood of using *environmental/local* information sources. In addition, professionals who indicated that they consider that the *company* holds *greater responsibility* were more likely to use *more information sources*. *Use of information sources* was also influenced by *company characteristics*, with larger companies more likely to use *industry-promoting* sources, older companies more likely to use *state government* sources, and companies that offer *more training* more likely to use *environmental/ local* sources and more *information sources*.

2) Fertilizer practices were measured by two key practice decisions, the extent to which the lawn care company uses environmentally *preferred fertilizers* (including low/no phosphorus and slow-release nitrogen fertilizer), and the frequency with which the company *tests soil* before choosing a fertilizer grade. These practices were shown to be influenced either by *psychological factors* (sense of responsibility) and *information sources* (industry-promoting sources), or by *company characteristics* (amount of training offered). Those professionals that reported being more likely to use *preferred fertilizers* also were more likely to report that the lawn care company has greater *responsibility* and that they use *industry-promoting* sources. The study also determined that soil testing is not common among these lawn care companies, and a majority of the companies reported that they do not test soil more often because the “customers are not willing to pay for it,” even though most recognize that it does not “cost too much.” *Soil test frequency* was most significantly predicted by the *amount of training offered*, which may suggest that company culture that favors providing more training may also favor action to reduce environmental impacts (even if incurring a small cost), representing a form of social and environmental responsibility.

3) Pesticide practices involved three measures, *damaging pesticide practices*, *preferred pesticide practices*, and *number of applications per year*, and were shown to be most

strongly related to *company characteristics* in most cases. *Damaging pesticide practices*, which include activities such as *broadcast* applications of pesticides or using *weed-n-feed*—practices and products that can lead to overuse of chemicals—were reported as being common among the lawn care companies in this study. *Information sources* played a role in explaining variance within *damaging pesticide practices*: the use of *industry-promoting* sources was found to be associated with *damaging pesticide practices*, and the use of *state government* sources was determined to be associated with less likelihood of damaging practices. *Preferred pesticide practices* include 1) engaging in *Integrated Pest Management (IPM)*, a practice that reduces overall use of chemicals by first using biological, cultural and physical pest controls, and 2) establishing *buffers* between areas of application and any connection to waterways or sensitive areas. These practices showed a negative relationship with the *number of employees*, contrary to the hypothesis regarding larger companies being more likely to be able to reduce environmental impacts. Although fewer *applications per year* can reduce impacts on the environment, many companies were found to treat lawns with more applications than are recommended by organizations seeking to reduce environmental impacts of lawn care companies. Again, it was larger companies that were found to be more likely to apply more lawn chemicals per year.

Key themes

Based on these analyses and findings, three key themes have emerged. These themes concentrate on the influence of the size of the company, the importance of *industry-promoting sources*, and the role that the *psychological variables* were found to play in predicting *use of information sources*. In the following section, these themes serve as bases for a set of recommendations for organizations communicating with lawn care professionals.

Larger companies contribute larger impact

Although it was hypothesized that larger companies would have access to more information, and as a result of using more sources be better prepared to take action to reduce environmental impacts, this was not supported by the findings. Companies with more employees were found to be less likely to engage in *preferred pesticide practices*;

furthermore they reported significantly more *applications per year*. While it is important to recognize that many larger companies may be taking actions to reduce their impacts that were not measured such as proper pesticide storage or keeping fleet tires inflated, larger companies were found to be less likely to engage in some very critical practices that could reduce their impact on ecological and human health, including *Integrated Pest Management* and using *buffers*. This combined with what might be an excessive number of pesticide *applications per year* suggests that larger companies are having a greater negative impact on the environment than smaller companies. Finally, this study demonstrated that larger companies engage in fewer *preferred practices* across all five fertilizer and pesticide practice variables.

Industry-promoting sources are critical players

In general, lawn care company professionals reported being much more likely to use *industry-promoting* sources than to use *environmental/ local* sources. At the same time, these sources were related to a seemingly conflicting set of practices. It was found that *industry-promoting* information sources are related to both preferred practices (in the case of fertilizers) and damaging practices (in the case of pesticide use). For *preferred fertilizers*, it was shown that the use of *industry-promoting* sources accounted for about 17 percent of the variance, such that those who reported being more likely to use these sources were also more likely to use *preferred fertilizers*. Yet simultaneously, those lawn care professionals who reported being more likely to use these sources were also more likely to engage in *damaging pesticide practices* such as *broadcast applications* and use of *weed-n-feed* products.

These diverging relationships might be explained by the actions necessary to accomplish each of these practices and the likelihood of *industry-promoting* sources to encourage or discourage such practices. In this study, *preferred fertilizer* practices consist of using *slow-release* and *low/no phosphorus* products that are readily marketed by fertilizer companies. *Damaging pesticide practices* consist of *broadcast* treatment of pesticides, something also commonly promoted by pesticide companies for products such as pre-emergence herbicides, and use of *weed-n-feed*, a product line that most lawn care chemical companies carry. When viewed from this perspective, it is less surprising that

use of *industry-promoting* sources is associated with both preferred and damaging practices.

Motivations match use of information sources but not practices

A striking finding from Chapter Four is that *psychological factors* predicted likelihood of using *information sources* in logical relationships such that *government regulation* motivations were associated with use of *state government* information sources. This finding supports the hypothesis that information sources are chosen that reflect the learning structures and motivations that are already in place in the information seekers. Thus, those who consider themselves as more responsible will be likely to seek more information, those who want to go *beyond regulation* in their practices will be more likely to seek information from *environmental/ local* sources, and those motivated by *business considerations* will be more likely to use *industry-promoting* sources.

Although *psychological factors* showed fundamental relationships with *use of information sources*, they did little to explain variance in lawn care *practices*, with one exception. The perception of the *company as more responsible* was shown to be positively associated with *preferred fertilizer practices*. In Chapter Six, it was demonstrated that the discrepancy in sense of responsibility predicting *preferred fertilizers* and not *preferred pesticide practices* may be because risk associated with pesticide practices is perceived differently from problems perceived with overuse of fertilizer. In other words, this finding highlights the conditions in which a greater sense of responsibility is a significant predictor. Overall, the findings suggest that *psychological factors* play an indirect role in *lawn care practice* outcomes, through *use of information sources*.

Recommendations for communicating with lawn care companies

The insights gained from this research are valuable for organizations interested in communicating with lawn care professionals in efforts to reduce environmental impacts. Given the wide range of organizations communicating with lawn care professionals about practices, identifying lawn care company targets and venues for those targets may prove

useful. The population in this dissertation, lawn care professionals, is one that is not commonly studied in formal academic research. Although academic studies have examined customers of lawn care (eg. Robbins, 2007; Shern, 1994), and professional studies have compared a variety of variables such as communication programs and legislation with respect to their effectiveness in influencing the impacts of lawn care (eg. Jermyn, 2005; Kassirer et al., 2004), this study has extended that research to tap into the lawn care professionals themselves. The lawn care professionals provided information that can be translated into recommendations for better ways to reach them and influence the reduction of environmental impacts. The following offers a set of recommendations based on the findings that can be realized by watershed councils, non-profit environmental organizations, and many other organizations. Because the relationships will be different based on the type of organization, slightly different approaches may have to be adopted that recognize strengths such as local connections, or weaknesses such as lack of trust.

Target larger companies

Since larger companies were found to be significantly less likely to use *preferred pesticide practices* and more likely to apply more lawn chemical *applications per year*, they are particularly important to target for reducing environmental impacts. It was identified in Chapter Six that larger companies may have a more difficult time engaging in practices such as *IPM* because they may have developed economies of scale that encourage efficiencies. At the same time, *IPM* may be the ultimate way for lawn care companies to continue to make multiple visits to each property each year while simultaneously having a smaller impact. While numerous applications of lawn chemicals can be problematic for the environment, repeated visits to monitor lawn conditions, and take other measures that *IPM* encourages, such as biological, cultural, or physical actions to control pests (such as hand weeding), can accomplish the goals of reducing overall impacts on the environment (ignoring the impacts related to travel) and staying in business.

In addition to having a lower likelihood of engaging in *preferred pesticide practices*, larger companies may be appropriate to target for three additional reasons—scale, access

and visibility. The amount of property that larger lawn care companies care for is greater than that serviced by smaller companies. Thus, it would be strategic to target those companies that are operating at the largest scale. In addition, larger lawn care companies may be easier to reach, as they are more visible and therefore easier to access. Targeting larger companies does not preclude efforts to reach smaller organizations, but in the common situation of limited resources, focus can be placed on larger organizations. Their visibility may allow them to serve as a model for other smaller companies.

At the same time, care must be taken to recognize the very largest firms in the industry can be controlled by a corporate headquarters in another state. Making change locally can be very difficult in these largest companies. In addition, as suggested in the interviews, some have their own research departments and are influential in determining what are considered environmentally preferred practices. Chen and Hambrick (1995) show how smaller companies can be more active in initiating strategic competitive moves than larger companies, and larger companies more commonly adapt when challenged. In the case of lawn care companies, the distinction is likely to be found between the larger and largest companies, as the smallest companies are not only less likely to be strategic (and instead may simply be trying to survive), but also may not be visible enough to challenge the largest companies. Diffusion of innovation literature consistently points to larger organizations as being more innovative and more likely to serve as early adopters and opinion leaders within social networks (Rogers, 2003). This finding is further supported in corporate greening literature (Hoffman, 2001). It may be prudent to target the larger but not largest firms to have the greatest chance of causing substantial change, as these smaller large firms can strategically challenge the status quo and the largest firms may follow. One way to target these larger companies is through *industry-promoting* sources, as managers in larger companies were found to be more likely to use these sources.

Utilize and collaborate with industry-promoting sources

The *industry-promoting* information sources, in addition to their greater reported use by larger organizations, were also very likely to be used by a majority of lawn care professionals in this study. Because of this, collaborations with the organizations that

serve as these information sources would reach a wider audience. Based on this more widespread use, the chances for acceptance of certain untried practices may be enhanced.

Industry-promoting sources are associated with both fertilizers and pesticides, but in very different ways. While the ability of these information sources to positively influence preferred (fertilizer) practices was demonstrated, the use of *industry-promoting* sources was also shown to be associated with *damaging pesticide practices*. *Industry-promoting* sources may be difficult to collaborate with in encouraging the decrease in use of practices such as *broadcast* applications and *weed-n-feed* because of the commercial success of these products and the identified likelihood of *broadcast* application for a variety of pre-emergence herbicides¹⁹. Given the focus of many *industry-promoting* sources, it may be challenging for them to advise against *weed-n-feed*, as this is a product line offered by a great number of lawn chemical companies and may serve as a source of revenue (through advertising and industry support) for a trade journal. Suggesting that lawn care companies eliminate an entire successful line of product may face great resistance from those who communicate through *industry-promoting* sources.

To overcome this potential resistance, it might be helpful to frame the messages so that they appeal to the *business considerations* motivation that was identified as being related to use of these sources. The idea of environmentally preferred practices could be used as a frame for appealing to the environmentally conscious consumer, and also could be a frame to create the first step in collaboration with *industry-promoting* sources. For instance, citing the growth of green markets (Land, 2007), a watershed council or an environmental non-profit could approach *industry-promoting* sources to suggest creating articles or workshops on environmental considerations that are good for business.

It is also important to recognize that *industry-promoting* sources include product vendors in addition to the trade groups like Michigan Turfgrass Foundation and Michigan Nursery and Landscape Association. These product vendors could be a very promising group with

¹⁹ Pre-emergence herbicides are designed to kill weeds before they emerge, and thus are more commonly applied through broadcast rather than spot treatment.

which to collaborate. Again, the communication would need to focus on its role as important information for lawn care professionals who want to respond to the *business considerations* of a growing concern for environmental issues. The approach to working with these groups would likely be very different, but communications could be framed as encouraging more environmentally friendly products and product instructions as ways to be ahead of or stay in business. While many lawn care product vendors are likely to have their own research and strategy for assessing risk, helping these companies understand the ways that the public (and therefore potential customers of their products) assess risk could assist them with building these expectations into their products and could position them to be leaders in the industry.

Lastly, opportunities exist with *industry-promoting* groups that may be outside of the more common modes of communication used by trade associations. The networks that are developed through trade shows, conferences, and workshops are an essential process to understand. These networks can be utilized to more effectively distribute information so that company managers are more likely to use it (Czepiel, 1975; Greenwood et al., 2002; Rogers, 2003). Although this study did not make attempts to model the networks to which lawn care professionals belong, it was apparent through interviews and attendance of lawn care events that *industry-promoting* sources serve the role of creating networks by bringing professionals together to discuss the latest technologies and innovations in lawn care products and practices. In many cases, people are able to discuss issues face-to-face in settings that encourage discussion and learning.

One study that examined information dissemination to achieve reductions in non-point source pollution among farmers suggests that one-on-one communication is far superior to mass dissemination of information for achieving behavior change (Shepard, 1999). To the extent that it would be possible, designing communications that allow this one-on-one communication with key decision-makers in larger companies could be part of a strategy to transform the industry.

Frame approach to meet psychological factors

The finding that *psychological factors* match likelihood of using *information sources* provides evidence for the argument that people are likely to trust (and therefore be more likely to use) information that confirms their way of seeing the world (Renn & Levine 1991; White et al. 2003). Literature at the intersection of trust and framing suggests that people use frames to evaluate information and decide what to pay attention to or ignore (Kaufman et al., 2003). While people will explore for information to go beyond what they are already familiar with, they tend to gravitate back to the familiar. Trust in information, an essential quality for using information sources, is enhanced when the information is framed such that it speaks to the recipient in ways that are not overly challenging of one's worldview. This research underscores the importance of recognizing underlying motivations in designing communications about lawn care practices. It will be important to frame the information in a way that will connect with the greatest number of information users.

Recognizing the high endorsement for *business considerations* further highlights the importance of using *industry-promoting* information sources and framing the information to speak to *business considerations*. While there may be a number of companies that have an ethic to go *beyond regulations*, this can not be counted on for the majority of lawn care professionals. In the end, the motivation of going *beyond regulations* did not translate into more *environmentally preferred practices* in this study. Framing information so that it captures how engaging in environmentally preferred practices will be good for business will enhance the likelihood of adoption for a greater percentage of lawn care companies. This information needs to be delivered through sources used and trusted by lawn care professionals.

Additional considerations

This study has shown that *use of information sources* can play a critical role in explaining variance in lawn care practices. However, it would be naïve to believe that information alone will solve the problems associated with lawn care practices. Additional factors should be considered to enhance the chances of success in more widespread reduction of environmental impacts in lawn care. This section details three considerations that could

contribute to reducing overall impacts related to lawn care: 1) the difficulty involved with several of the lawn care practices tested in this study, 2) challenges that the dominant social norm present with respect to the ideal aesthetic, and 3) the great potential for lawn care professionals to be agents of change in reducing impacts. Following these descriptions is an overview of research limitations and suggestions for future research.

Some practices may be difficult to change

Although this dissertation has identified variables that are correlated with lawn care practices, it is important to acknowledge the difficulty in changing certain lawn care practices. For instance, the difficulty in avoiding a *broadcast* method for pre-emergence herbicides has been mentioned. Asking lawn care companies to make fewer *applications per year* can be equivalent to asking them to make less money per year. One lawn care professional clearly stated that they are in business, and to that end, they need to be out on the lawns as much as possible. This, however, does not mean that they have to be out on the lawns making broadcast applications of herbicide. By making a better transition to *Integrated Pest Management*, lawn care companies can be out on the lawn identifying pests and devising alternative schemes to treat them such as cultural or biological approaches.

In addition, greater adoption of soil testing can add several other steps to a lawn care package. If a lawn care company tested soil more often, it would mean having to develop more individualized treatments for each lawn, which could require mixing on site, recalibration, and extra attention to detail that could become very expensive. The soil tests could also reduce the number of applications if the test showed that additional fertilizer was not necessary. This reduction in application, however, could ultimately improve the credibility and reputation of the lawn care company. At the same time, simple soil tests could be used to benefit the lawn care company as a way of demonstrating how nutrient levels can fluctuate over time. Understanding how the various barriers might influence a lawn care company can help in the encouraging of the practice by working with the companies to remove these barriers. This would go beyond overcoming the perceived barrier that customers are not willing to pay for the tests, and would demonstrate the importance of this practice.

Challenges of social norm/aesthetic on changing practices

Lawn care companies are operating within a culture that is demanding emerald green, closely cut, single-species, weed-free lawns that resemble golf courses (Steinberg, 2006). Therefore, encouraging the practice of waiting for the weed to appear before treating it may seem unacceptable to some. Because, as Robbins (2007) points out, a majority of residents will favor having a green lawn over reducing environmental impacts, more work needs to occur to encourage a transition to a different landscape aesthetic, one that will be appropriate for local conditions and require few, if any, inputs. To the extent that it is possible, organizations communicating with lawn care companies might enhance their effectiveness if they also work to change the cultural aesthetic of this green, weed-free, closely cut lawn. The more the culture changes, the easier it may be for lawn care companies to make changes in their practices. Organizations may reach out to landscapers and others capable of transforming landscapes to encourage this, while also working at the level of public outreach to begin to create ripples across society with respect to what is accepted and preferred in a residential or commercial landscape.

Chapter Two highlighted many such efforts ranging from freedom lawns to rain gardens that are already taking place. The acceptance of such alternative landscapes is growing in certain communities with lawn care in which only edges are mowed to provide necessary “cues to care” while converting land to alternatives such as prairie grasses or native plantings (Nassauer, 1995). Even some golf courses—a model for the lawn aesthetic—are taking actions to reduce their environmental impact (Depolo, 2005). Although this movement is currently taking place among a portion of the population, efforts to change the cultural aesthetic norm for the masses may take a long time, and waiting for this change may not be practical given the urgency of environmental issues associated with lawn care. This effort to change the cultural norm needs to occur simultaneously to the encouragement of changes in current practices.

Lawn care companies can be agents of change

Lawn care companies are relied upon by customers and may be in the best position to make sure that change occurs and reductions in the impact on the environment are made. While the responsibility for reducing impacts may reside across government, customers,

communities, environmental organizations, and companies, companies may be best situated to be agents of change. Even if the customers are demanding different practices, lawn care professionals can demonstrate how effective alternative practices can be. The majority of lawn care professionals surveyed in this study agreed with the statement, “lawn care companies should educate customers on making environmentally responsible lawn care choices.”

Being agents of change could add another level of meaning to the job of lawn care professional. As society shifts to wanting to be greener, the lawn care professionals are in a better position to know how to accomplish reductions in environmental impacts related to the lawn care industry. Being recognized as agents of change might also lead to better business relations with customers and professional relations with government agencies. Many larger corporations in other sectors have taken on corporate environmental and social responsibility and are making voluntary changes to reduce their impacts: this kind of change can occur among lawn care companies as well. Lawn care companies could transform their focus from “lawn care” to “soil and Integrated Pest Management,” and eventually to “ecosystem management.”

Efforts could be made to encourage the very largest organizations to set an example. Very large companies such as TruGreen Chemlawn and Scott’s are in the position of influencing the cultural aesthetic through their advertising (Steinberg, 2006). They could take the first steps in going beyond offering alternative practices, and begin to make them company policy. They could institute mandatory testing of soil and incorporate *Integrated Pest Management* on all properties that they service. Because these companies are in such high profile positions, they have the ability to contribute to substantial change across the industry.

At the same time, these largest companies may be the most resistant to change. One very large company when interviewed revealed that it was changing products to include no-phosphorus fertilizers only in areas where regulation instructed it to do so and was going to continue to use phosphorus in communities adjacent to these communities as the law

did not influence use of phosphorus there. It may be that working with large organizations (that are not the largest) can put pressure on the largest companies to do a better job as these large (but not largest) companies can also serve as opinion leaders in the lawn care industry. According to Zadek (2004), companies can be at various stages of corporate responsibility from defensive (not considering the company responsible) to compliance (doing the minimum necessary) to managerial (engaging in preferred practices as part of doing business), to strategic (for competitive advantage) to civic (encouraging others to do the same). It is important to recognize that companies may be at different stages of adoption of preferred practices, and working to create a culture of companies that are change agents can help influence the majority of companies to reduce their impacts and possibly redefine the cultural aesthetic of lawns.

Research limitations

Lawn care professionals are busy people, and may be skeptical of outside researchers who are trying to understand their situation. The interviews revealed that some feel they have been misquoted by journalists, and that their use of pesticides has come under attack by some in the media. Others may be skeptical of a university research project. Given these constraints, the difficulty in obtaining a larger sample size is understandable. Results from the smaller sample size, however, point to consistent patterns that permit useful and useable recommendations.

While data was not found that would allow a reasonable comparison with a larger population of lawn care companies, the diversity of companies sampled suggests that a great variety of sizes and ages are represented, and that comparisons within this sample can reflect differences among lawn care companies in similar contexts. To make the study more generalizable across both place and time, however, more research should be conducted to address regional differences and practices related to newly developed awareness about impacts of fertilizers and pesticides.

In addition, the study examined the likelihood of using information sources rather than actual use of information. Answers to the latter issue—what information sources lawn care professionals actually use—are, alas, elusive. Assessing information use in a real

world setting is difficult because of the complexity involved in how people use information sources. Information is provided through various means, both formal and informal, and can be acquired over time as a fusion of several exposures. Yet, much of the information that people are exposed to may not be heeded at all. Some of it may be heeded, though the person is not aware or does not recall the source. Assessing how this information is acquired, what parts are attended to, what is retained, and how it may translate into knowledge would be more feasible using an experimental laboratory setting. However, not only would it be difficult to gain the participation of many lawn care professionals in such efforts, the answers obtained through such systematic study may not be applicable in the real world, where perceived information use is not first subjected to tests of information memory.

Additional effort could be made, however, to understand with greater precision why lawn care professionals choose to use certain information sources over others. Uncovering the underlying reasons (e.g. access, trust) for choosing to use certain information sources over others would provide insights to more effectively communicate with lawn care professionals.

Future research directions

This study uncovered a number of questions to explore in future research. For instance, in combining information types through factor analysis, Michigan State University (MSU) was found to be correlated with both industry-promoting sources and state government sources. Developing a better understanding of the extent to which MSU is perceived as similar to these information sources would yield useful results for improving extension outreach efforts. In addition, larger companies were found to be correlated with greater environmental impact, but the specific attributes affecting this correlation were not identified, and would be important for understanding why larger companies may be contributing a larger environmental impact. The following identifies three additional fundamental areas that would be useful to study in future research.

Explore acceptance and effectiveness of phosphorus regulations

This research did not make recommendations for or against using regulation as part of a strategy to influence lawn care companies to reduce impacts on the environment. The survey asked two questions specifically about state and local bans on phosphorus in fertilizer. The responses to these questions included more “Don’t Know” responses than any other question, and because of this were not further analyzed. Interviewees expressed uncertainty because they did not know how either type of regulation would affect their business. Since the survey was administered, bans on phosphorus have been enacted in Ann Arbor and other communities in Michigan. An international cross-community study by Kassirer et al. (2004) as well as a research report conducted for Toronto Public Health (Jermyn, 2005) concluded that only communities who combine regulation with outreach achieve substantial reductions in chemical use on lawns. Given this finding, research should be conducted on companies that operate in communities where the new bans have been enacted, and these should be compared with companies that have continued to operate without regulation. The regulated companies could be asked about their acceptance of the ban and how it is impacting their business, and assessments could be made regarding awareness of environmental problems related to phosphorus and changes in practices. Taking this a step further, it would be useful to examine reductions in phosphorus levels in watersheds encompassing these communities since the enactment of the bans to help determine their effectiveness.

Differentiate role of company culture

This research suggested that an unmeasured variable focused on company culture (related to *amount of training* and the perception of the *company as more responsible*) may be playing a significant role in both *use of information* and *lawn care practices*. Efforts should be made to better measure a company culture variable, examining both its antecedents and the role that it may play in influencing the use of information and lawn care practices. This could be very useful for identifying better ways to work toward reductions in environmental impacts of lawn care companies by determining the relevant components of company culture and ways to promote it (if found to be coherent and important).

Examine understanding of IPM among lawn care professionals

Chapter Six identified the contradiction that was embraced by several lawn care companies that suggested they always engage in *IPM* and also always used *broadcast* methods to apply lawn chemicals, two incompatible practices. Speculations were made to explain this contradiction, suggesting that companies may use *IPM* on trees and shrubs but not on the lawn, or that there was confusion about what *IPM* entails. The answer to this question requires more research. Finding out how *IPM* is understood across a wide range of lawn care professionals could provide valuable insight for more effectively communicating about this important approach to reducing impacts on the environment.

Conclusion

Findings from this study and recommendations based on them can be useful for influencing the reduction of environmental impacts by lawn care companies. The ubiquity of lawns in suburban and urban landscapes and their associated impacts make this an extremely important issue to address. This study (intentionally) examined only impacts related to use of pesticides and fertilizers and ignored the many other environmental impacts associated with lawn care such as air pollution, noise pollution, fossil-fuel consumption, and water consumption. While changing the cultural norm that dictates desires for a green, weed-free, closely cut lawn may be a parallel goal that can also address some of the other impacts, the recommendations outlined above are necessary steps to most effectively reduce pesticide and fertilizer impacts given the current cultural constraints. Some lawn care companies are taking more actions to reduce impacts than others, and the public examples they present can be used by other lawn care companies as models for the possibility of achieving culturally acceptable lawns while minimizing health and environmental impacts. The greatest gains will be achieved as the largest companies change their practices. Whether they can be counted on to lead the way or need the impetus from the next largest companies is an unanswered question.

Clearly, targeting larger lawn care companies is important as is collaborating with *industry-promoting* sources in efforts to increase preferred practices and decrease damaging practices. The study highlights the necessity of approaching lawn care professionals by framing information that speaks to their motivations. It also suggests

that some change may prove to be difficult, but that the health of our ecosystems and children will benefit from the reduction of environmental impacts by lawn care companies. The change might not only be good for others, but may also be beneficial for the lawn care professionals themselves.

APPENDICES

APPENDIX A. Scripts for recruiting interviewees and for interviewing

Recruitment Materials for Phone Calls

Hello, How are you? My name is Keith McDade. I am a student at the University of Michigan studying information about lawn care practices and environmental concerns, with the hope of improving this information.

I am using a semi-structured interview to get perspectives on these issues, and I am hoping that someone in your company is willing to answer some questions.

The interview should take no longer than 30 minutes, and I would be happy to meet you, or someone else, wherever it is convenient.

I am hoping to interview people who either 1) are responsible for on-the-ground lawn care, or 2) are responsible for making management decisions for the company. Is this something that someone in your office is willing to participate in?

The information I gather will be used as a part of my dissertation, and will inform a survey a larger number of lawn care companies in the future. Again, the questions will be about information regarding lawn care practices.

Do you have any questions? If you have any questions at any point, please let me know. I'd be happy to answer your questions to the best of my knowledge.

Please let me know if you are willing to participate in such a study. Your participation is entirely voluntary and answers will be kept confidential.

Thank you very much!

Interviews with Lawn Care Professionals

Introduction and Consent

Hello, My name is Keith McDade. I am a student at the University of Michigan studying lawn care with the hope of improving information about certain practices. I am interviewing people in the lawn care industry to get perspectives on to what extent environmental concerns line up with other aspects of your business, and I am hoping that you are interested in answering some questions. The interview should take no longer than 30 minutes.

Before we get started, I need to have you sign a consent form that suggests your willingness to participate. All of your responses will be kept confidential. I will use your responses as a part of my study, and will use this to inform a later survey that I will send out to larger number of people in the lawn care industry in three counties in Michigan. At any point during the interview, you can feel free to ask questions for clarifications, or to stop participating altogether. Thanks, ahead of time, for your participation.

First, I want to ask a few questions about your business.

Business Characteristics/Customer Base

1. How many people work at your company? In your sector? What is your sector?

2. How long have you been in business?

3. Are you part of a franchise or an independent company? F/I

4. What are some characteristics of a typical customer of yours?

What is the range of customer types for your company?

5. How do your applications differ from customer to customer? Why?

(Prompt) Do you have customers that are adjacent to lakefronts? Do these customers require any different practices than those in other places? Are these practices requested by the customers?

6. Do your residential customers exist in new developments or older neighborhoods? Roughly, what percentages?

What is the average size (roughly) of places you maintain?

7. To what extent do customers know what they want from you? (If additional guidance is needed...)

Would you say that the customer tells you what they want in their lawn care, or that you tell the customer what they should have in order to maintain a nice lawn? What percentages (if appropriate)?

What do you do to inform you customers?

8. What type of training does your company offer to employees?

What does the training cover?

9. Are there professional lawn care groups or meetings that you attend, are a member of, or are active in?

10. In what ways do you see your work as being strategic or innovative or special (compared to others)?

Now, I'd like to ask some questions about your lawn care practices...

Environmental Behaviors (and Barriers/Capability)

GRASS CUTTERS

What determines the height of the grass you cut?

Is the height consistent across customers? Y/N

Height _____

What determines how often you cut the grass?

How often?

Could you talk about your mowers briefly?

Do you mulch? How big? How old?

What do you do with clippings? _____

CHEMICAL APPLICATORS

FERTILIZERS

What types of fertilizers do you use?

Do you test soil before applying fertilizers?

PESTICIDES

What types of pesticides does your company use?

Do you use general or restricted pesticides?

Do you use granular or liquid or both? What is used most?

How many applications of pesticides per year does your typical customer require?

Is this requested by the customer? Are your programs generic (5 step program), or customized for each lawn?

What is the range that people are willing to spend on their lawn applications?

Do you give free estimates? Does the homeowner ever question/challenge the estimate?

Do you do spot treatments or broadcast on the lawns?

What kinds of certifications do you have (ex. 3A –lawn care, 3B, 7A (aquatics))?

How long have you been certified

I have a few questions to ask about pollution...

Awareness/ Knowledge of Issues/Solutions/Practices

Do you think that lawn care relates to pollution or environmental quality? In what ways?

What do you consider to be pollution?

What are some of the main causes of pollution?

What are the best ways to prevent pollution in lawn care?

How about in your work? How does your work contribute to creating/preventing water pollution?

Are you aware of different practices that might prevent pollution? What are they?

Do you think lawn care companies could do a better job of preventing pollution? If so, how?

What does “healthy lawn care practices” mean to you?

Information Sources

Have you ever received information on pollution prevention (eg. ways to prevent pollution)?

What kinds of pollution prevention?

What did you do with this information?

Do you remember who/where it was from? Who?

To what extent are you familiar with the organization or agency that provided this information?

Trust of Information Source/ Trust of Agency

To what extent does the organization(s) (Provide name(s) offered by interviewee) influence your work?

What words would you use to describe this organization?

Rate this organization on the characteristics scale:

Competent	Very Low	1	2	3	4	5	Very High
Have your interests in mind		1	2	3	4	5	Very High
Predictable	Very Low	1	2	3	4	5	Very High
Honest	Very Low	1	2	3	4	5	Very High
Objective	Very Low	1	2	3	4	5	Very High
Trustworthy	Very Low	1	2	3	4	5	Very High

To what extent do these characteristics of this organization influence your use of their information?

How could information about pollution prevention be more useful for you?

LAWN CUTTERS

Does your company do anything different or special on ozone action days? What do you do?

CHEMICAL APPLICATORS

FERTILIZERS

Does your company offer your customers options for low impact lawns such as low-phosphorous/no-phosphorous products?

What precautions do you take to prevent runoff from lawns?

PESTICIDES

Does your company do anything different where there are children or pets?

Have you ever had contact with the Michigan Department of Agriculture?

Have you ever...initiated your own internal audit? Y/N

Ever had a road check inspection? Y/N

Ever participated in a planned use inspection?

(Would you be interested in one?)

---MDA list of recommendations---MDA comes out to inspect---

Have you ever had any complaints against your company? What for?

Ever involved in an investigation? Y/N

ALL

Do you ever work on or suggest alternatives to traditional turf lawns? Why?/Why not?

How are these received (or... How do you believe these would be received)?

What other pollution prevention practices have you adopted? Why?

On a scale of 1 to 5 (with explanation), to what extent do you engage in pollution prevention?

Very Low 1 2 3 4 5 Very High

What extent do you think your competitors engage in pollution prevention?

Very Low 1 2 3 4 5 Very High

What encourages or limits your ability to prevent pollution?

Do you consider yourself a steward of the environment?

Willingness to Learn/Adopt

Do you desire more information about pollution prevention practices?

How could pollution prevention information be made more useful for you?

What kinds of information are you more likely to trust or distrust?

Some communities have adopted bans on phosphorous in fertilizer with “no phosphorous ordinances.” On a scale of 1 to 5, how supportive of a local ordinance banning the use of phosphorous on lawns are you? Should this occur on the local or state level?

Not at all 1 2 3 4 5 Very supportive

If you could apply (for a fee) to get certified as an environmentally friendly lawn care company, would be interested in such a program. Why? Or why not? How supportive?

Not at all 1 2 3 4 5 Very supportive

Beliefs and Motivations

To what extent do you believe the following statements about water pollution. (On a scale of 1 to 5, with 5 meaning very much agree and 1 meaning very much disagree, and 3 as neutral). When I say “lawn care companies,” I want you to answer generally about them. With optional WHY or How?

1. Lawn care companies can play a major role in preventing water pollution. How?

1 2 3 4 5

2. Pollution prevention measures such as reducing phosphorous are unrealistic. WHY?

1 2 3 4 5

3. The safety concerns of using pesticides are overstated. WHY do you think this?

1 2 3 4 5

4. Customer concern about the environment is what drives lawn care companies to adopt different lawn care practices. Could you tell me more about this?

1 2 3 4 5

5. Alternative lawn care practices that emphasize pollution prevention are too expensive. WHY do you think this?

1 2 3 4 5

6. Pollution prevention practices are difficult to implement. WHY do you believe this?

1 2 3 4 5

7. Using chemicals in lawn care can create a health risk. WHY?

1 2 3 4 5

8. Customers need to be educated on the impacts of using too many chemicals. WHY?

1 2 3 4 5

9. Pollution prevention measures are not worth the risk if they might not produce perfect lawns.

1 2 3 4 5

10. Lawn care companies are in a good position to educate customers on healthy lawn care practices. WHY?

1 2 3 4 5

11. It is my role to educate customers on making environmentally responsible lawn care choices.

1 2 3 4 5

12. It is the role of the customer to demand services that prevent pollution.

1 2 3 4 5

13. It is the responsibility of the government to make sure that pollution is prevented.

1 2 3 4 5

Could you suggest the order of responsibility for preventing pollution among the following groups (with #1 being most responsible and 5 being least responsible of this group).

- 1) Customer
- 2) Lawn care company
- 3) State government
- 4) County government
- 5) Other entity such as watershed council

Could you briefly explain why you believe this?

I've been exploring your thoughts about water pollution prevention as it relates to lawn care. Is there anything that I missed that you think I should know?

Do you know which watershed you live/work in?

County?

THANK YOU FOR PARTICIPATING!

Interviews with Organization Leaders

Introduction and Consent

Hello, My name is Keith McDade. I am a student at the University of Michigan studying information about lawn care practices and pollution, with the hope of improving this information. I am interviewing people in the lawn care industry to get perspectives on to what extent environmental concerns line up with other aspects of their business, as well as people working in organizations related to lawn care information. Thank you for being interested in answering some questions. The interview should take no longer than 30 minutes.

Before we get started, I need to have you give verbal consent that suggests your willingness to participate. All of your responses will be kept confidential. I will use your responses as a part of my study, and will use this to inform a later survey that I will send out to larger number of people in the lawn care industry in three counties in Michigan. At any point during the interview, you can feel free to ask questions for clarifications, or to stop participating altogether. Thanks, ahead of time, for your participation.

I have a few questions to ask about pollution.

Awareness/ Knowledge of Issues/Solutions/Practices

Do you think that lawn care relates to pollution or water quality? In what ways?

What do you believe are some of the main causes of water pollution?

What are the best ways to prevent water pollution?

Are you aware of different practices that might prevent pollution? What are they?

Do you think lawn care companies could do a better job of preventing pollution? If so, how?

What does "healthy lawn care practices" mean to you?

Environmental Behaviors (and Barriers/Capability)

Is there a specific height that you suggest that people cut grass? Is this consistent across conditions?

What kinds of recommendations do you make regarding fertilizers? Do you believe the use of fertilizers may be problematic? In what ways?

Some lawn care companies provide up to six pesticide applications per year? Do you have suggestions on what might be a Best Management Practice regarding pesticide use? Are there specific pollution problems related to the use of pesticides? What might they be?

Have many lawn care companies in your county adopted pollution prevention practices? What percentage?

(If needed) Does the availability of products (eg. fertilizers) impact lawn care companies' ability to prevent pollution?

What else might limit their ability to prevent pollution?

If you were trying to measure best management practices in non-point source pollution prevention, what would you look at?

If you could make a checklist to measure how someone was performing, what would be on it for : a) lawn cutting companies, b) chemical applicators, and c) both?

IV3 Information Source

Do you provide lawn care businesses with information on pollution prevention (eg. ways to prevent water pollution)? Do you do this with other business types? Which ones?

What kinds of pollution prevention?

How do think this information is received?

Do you think many lawn care businesses know about your organization?

Trust of Information Source/ Trust of Agency

To what extent do you think your information influences others' work?

What words would you use to describe lawn care companies?

Rate lawn care companies on the characteristics scale:

Competent	Very Low	1	2	3	4	5	Very High
Have your interests in mind		1	2	3	4	5	Very High
Predictable	Very Low	1	2	3	4	5	Very High
Honest	Very Low	1	2	3	4	5	Very High
Objective	Very Low	1	2	3	4	5	Very High
Trustworthy	Very Low	1	2	3	4	5	Very High

To what extent do you think that lawn care companies trust your organization?

Trust of State/EPA/Others orgs

I want to ask some similar questions about your source of information on lawn care practices.

Where do you get information on lawn care practices? (EPA? State? Other?)

To what extent does the organization(s) (Provide name(s) offered by interviewee) influence your work?

What words would you use to describe this organization?

Rate this organization on the characteristics scale:

Competent	Very Low	1	2	3	4	5	Very High
Have your interests in mind		1	2	3	4	5	Very High
Predictable	Very Low	1	2	3	4	5	Very High
Honest	Very Low	1	2	3	4	5	Very High
Objective	Very Low	1	2	3	4	5	Very High
Trustworthy	Very Low	1	2	3	4	5	Very High

To what extent do these characteristics of this organization influence your use of their information?

Motivations and Beliefs

To what extent do you believe the following statements about water pollution. (On a scale of 1 to 5, with 5 meaning very much agree and 1 meaning very much disagree, and 3 as neutral). When I say "lawn care companies," I want you to answer generally about them. With optional WHY or How?

1. Lawn care companies can play a major role in preventing water pollution. How?
1 2 3 4 5
2. Pollution prevention measures such as reducing phosphorous are unrealistic. WHY?
1 2 3 4 5
3. The safety concerns of using pesticides are overstated. WHY do you think this?
1 2 3 4 5
4. Customer concern about the environment is what drives lawn care companies to adopt different lawn care practices. Could you tell me more about this?
1 2 3 4 5
5. Alternative lawn care practices that emphasize pollution prevention are too expensive. WHY do you think this?
1 2 3 4 5
6. Pollution prevention practices are difficult to implement. WHY do you believe this?
1 2 3 4 5
7. Using chemicals in lawn care can create a health risk. WHY?
1 2 3 4 5
8. Customers need to be educated on the impacts of using too many chemicals. WHY?
1 2 3 4 5
9. Pollution prevention measures are not worth the risk if they might not produce perfect lawns.
1 2 3 4 5
10. Lawn care companies are in a good position to educate customers on healthy lawn care practices. WHY?
1 2 3 4 5
11. It is my role to educate customers on making environmentally responsible lawn care choices.
1 2 3 4 5
12. It is the role of the customer to demand services that prevent pollution.
1 2 3 4 5
13. It is the responsibility of the government to make sure that pollution is prevented.
1 2 3 4 5

Could you suggest the order of responsibility for preventing pollution among the following groups (with #1 being most responsible and 5 being least responsible of this group).

- Customer
- Lawn care company
- State government
- County government
- Other entity such as watershed council

Could you briefly explain why you believe this?

I've been exploring your thoughts about water pollution prevention as it relates to lawn care. Is there anything that I missed that you think I should know?

THANK YOU FOR PARTICIPATING!

APPENDIX B. Survey

LAWN CARE COMPANIES and PERCEPTION OF ENVIRONMENTAL IMPACTS

SECTION I. QUESTIONS ABOUT YOUR COMPANY

Total number of employees in your lawn care company: Year-round _____ Seasonal _____

Number of years in business _____

Which of the following services does your company offer (check all that apply):

- | | | | | |
|--------------------------|----------------------------|---------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Grass cutting | Application of fertilizers | Application of pesticides | Landscaping services | Other? _____ |

Your company is:

- Independently owned and operated
- Sub-office of larger corporation
- Franchise of larger corporation
- Other? _____

Your customers are: _____% Residential and _____% Commercial

Which of the following professional associations do you belong (check all that apply):

- Michigan Green Industry Association
- Michigan Nursery and Landscape Association
- Michigan Turfgrass Foundation
- American Nursery and Landscape Association
- Project Evergreen
- Local/Regional lawn care group (Please provide name) _____
- Other _____

Your employee training involves (check all that apply):

- | | |
|--|--|
| <input type="checkbox"/> Outside training at workshops for all staff | <input type="checkbox"/> Showing safety videos |
| <input type="checkbox"/> Outside training for selected staff | <input type="checkbox"/> Showing technique videos |
| <input type="checkbox"/> Formal in-house training program | <input type="checkbox"/> One-on-one mentoring |
| <input type="checkbox"/> Informal in-house training program | <input type="checkbox"/> We do not have a training program |
- Other: _____

What is your title or job (the person filling out the survey) _____

What is the zip code of your business _____

In what communities do you have customers: _____

SECTION II. LAWN CARE PRACTICES

A. GRASS CUTTING

(NOTE: Only complete this section if your company cuts grass)

What height do you typically cut grass:

	<2"	2"- 3"	>3"	Other?	Don't Know
Spring	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> _____	<input type="checkbox"/>
Summer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> _____	<input type="checkbox"/>
Fall	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> _____	<input type="checkbox"/>

How often do you cut grass:

	Every week	Every two weeks	Only when needed	Other?	Don't Know
Spring	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> _____	<input type="checkbox"/>
Summer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> _____	<input type="checkbox"/>
Fall	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> _____	<input type="checkbox"/>

What do you do with your grass clippings? (Check all that apply):

Bag	Compost	Grasscycling	Leave to fertilize	Remove
<input type="checkbox"/>				

Other: _____

B. APPLYING FERTILIZERS

(NOTE: Only complete this section if your company applies fertilizers)

Which types of fertilizers does your company apply (check all that apply):

	Slow-release	Fast-release	Granular	Liquid	No/low-phosphorus	Organic	Other?	Don't Know
Spring	<input type="checkbox"/> _____	<input type="checkbox"/>						
Summer	<input type="checkbox"/> _____	<input type="checkbox"/>						
Fall	<input type="checkbox"/> _____	<input type="checkbox"/>						

What is the average fertilizer ratio used most commonly by your company:

	Nitrogen	Phosphorus	Potassium	Don't Know
Spring	_____ %	_____ %	_____ %	<input type="checkbox"/>
Summer	_____ %	_____ %	_____ %	<input type="checkbox"/>
Fall	_____ %	_____ %	_____ %	<input type="checkbox"/>

How often do you test soil before choosing a fertilizer?

Never	Rarely	Sometimes	Often	Always	Don't Know
<input type="checkbox"/>					

For what percentage of customers do you test soil: _____ %

What prevents you from performing more soil tests? (Check all that apply):

Costs too much	Don't fertilize enough to require	We know soil composition	It is not necessary	Customers are not willing to pay for it
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Other: _____

C. PEST CONTROL

(NOTE: Only complete this section if your company controls pests)

To what extent do your pest control applications involve each of the following:

Never	Rarely	Sometimes	Somewhat Regularly	Always	Don't Know	
	2	3	4	5	<input type="checkbox"/>	Weed-n-feed
	2	3	4	5	<input type="checkbox"/>	Broadcast treatment
	2	3	4	5	<input type="checkbox"/>	Spot treatment
	2	3	4	5	<input type="checkbox"/>	"Restricted" pesticides
	2	3	4	5	<input type="checkbox"/>	General pesticides
	2	3	4	5	<input type="checkbox"/>	Liquid form pesticides
	2	3	4	5	<input type="checkbox"/>	Granular form pesticides
	2	3	4	5	<input type="checkbox"/>	IPM (Integrated Pest Management)
	2	3	4	5	<input type="checkbox"/>	Spray buffers (areas at edges not sprayed)

Other: _____

What is the average number of applications that you make at each site per year?

0	1-2	3-5	6-8	>8	Don't Know
<input type="checkbox"/>					

Applications are typically:

- Consistent across customers
- Somewhat different across customers
- In most cases, tailored to each individual property
- Always tailored to each individual property

SECTION III. INFORMATION SOURCES

How likely are you to look at information from each of the following sources:

Not at all likely	Not likely	Somewhat likely	Very likely	Don't Know		
	2	3	4	5	<input type="checkbox"/>	Commercial Vendors
	2	3	4	5	<input type="checkbox"/>	DEQ (Michigan Department of Environmental Quality)
	2	3	4	5	<input type="checkbox"/>	MDA (Michigan Department of Agriculture)
	2	3	4	5	<input type="checkbox"/>	Federal EPA (Environmental Protection Agency)
	2	3	4	5	<input type="checkbox"/>	County Drain Commission
	2	3	4	5	<input type="checkbox"/>	Watershed Council
	2	3	4	5	<input type="checkbox"/>	MTF (Michigan Turfgrass Foundation)
	2	3	4	5	<input type="checkbox"/>	SOCWA Healthy Lawns and Gardens
	2	3	4	5	<input type="checkbox"/>	Environmental Education Group
	2	3	4	5	<input type="checkbox"/>	MNLA (Michigan Nursery and Landscape Association)
	2	3	4	5	<input type="checkbox"/>	MSU (Michigan State University)

Other: _____

How often do you use each of these sources to get information about lawn care?

		Somewhat			Always	Don't Know	
Never	Rarely	Sometimes	Regularly				
	2	3	4	5	<input type="checkbox"/>	Internet	
	2	3	4	5	<input type="checkbox"/>	Brochures	
	2	3	4	5	<input type="checkbox"/>	Printed Sheets	
	2	3	4	5	<input type="checkbox"/>	Videos	
	2	3	4	5	<input type="checkbox"/>	Workshops/Seminars	
	2	3	4	5	<input type="checkbox"/>	Trade Journals	
	2	3	4	5	<input type="checkbox"/>	Newsletters	
	2	3	4	5	<input type="checkbox"/>	Direct Personal Experience	
	2	3	4	5	<input type="checkbox"/>	Customers	

Other: _____

****Above, please CIRCLE your 3 most commonly used sources of information for lawn care.**



SECTION IV. LAWN CARE AND THE ENVIRONMENT

To what extent do you think lawn care practices can have impacts on environmental quality?

Not at all	Somewhat			Great deal	Don't Know
1	2	3	4	5	<input type="checkbox"/>

To what extent do you take action to prevent or reduce impacts on the environment?

Not at all	Somewhat			Great deal	Don't Know
1	2	3	4	5	<input type="checkbox"/>

What actions do you take?

- 1) _____
- 2) _____
- 3) _____

To what extent do the following motivate you to reduce environmental impacts:

		Somewhat			Very Much	Don't Know	
Not at all							
	2	3	4	5	<input type="checkbox"/>	Government regulations	
	2	3	4	5	<input type="checkbox"/>	Customer concern	
	2	3	4	5	<input type="checkbox"/>	Environmental ethics/values	
	2	3	4	5	<input type="checkbox"/>	Good business/reputation	
	2	3	4	5	<input type="checkbox"/>	Better equipment	
	2	3	4	5	<input type="checkbox"/>	Better information	
	2	3	4	5	<input type="checkbox"/>	Company standards	

Other: _____

****Above, please rank the #1 and #2 motivators.**



What limits your ability to engage in practices that reduce environmental impacts:

		Somewhat			Very Much	Don't Know	
Not at all							
	2	3	4	5	<input type="checkbox"/>	Lack of information	
	2	3	4	5	<input type="checkbox"/>	Lack of customer demand for such practices	
	2	3	4	5	<input type="checkbox"/>	Lack of appropriate products or equipment	

Other: _____

Please circle the number that corresponds to your level of agreement or disagreement.

Strongly Disagree	1	2	3	4	5	Strongly Agree	Don't Know	
	1	2	3	4	5		<input type="checkbox"/>	Customer concern about the environment is what drives lawn care companies to adopt different lawn care practices.
	1	2	3	4	5		<input type="checkbox"/>	Reducing use of pesticides in lawn care is desirable.
	1	2	3	4	5		<input type="checkbox"/>	Excessive fertilizer creates environmental problems.
	1	2	3	4	5		<input type="checkbox"/>	Lawn care companies should educate customers on making environmentally responsible lawn care choices.
	1	2	3	4	5		<input type="checkbox"/>	I am supportive of a statewide ban on phosphorus.
	1	2	3	4	5		<input type="checkbox"/>	If a pesticide is harmful, the government would not allow it to be sold.
	1	2	3	4	5		<input type="checkbox"/>	Using chemicals such as pesticides in lawn care creates a health risk.
	1	2	3	4	5		<input type="checkbox"/>	Local bans on phosphorus are an effective way to reduce environmental impacts.
	1	2	3	4	5		<input type="checkbox"/>	Most customers are willing to spend the extra money necessary to protect the environment.
	1	2	3	4	5		<input type="checkbox"/>	Regulation is what drives lawn care companies to adopt different practices.
	1	2	3	4	5		<input type="checkbox"/>	A statewide program that would certify environmentally responsible lawn care companies is something I desire.
	1	2	3	4	5		<input type="checkbox"/>	I would pay a fee to be recognized by a program that certifies environmentally responsible lawn care companies.
	1	2	3	4	5		<input type="checkbox"/>	Lawn care companies should engage in practices that go beyond regulations in order to reduce impacts on the environment.
	1	2	3	4	5		<input type="checkbox"/>	It is difficult to try new lawn care practices because this means risking the loss of customers.
	1	2	3	4	5		<input type="checkbox"/>	It is the responsibility of the lawn care company to choose practices that reduce environmental impacts.
	1	2	3	4	5		<input type="checkbox"/>	It is the responsibility of the government to develop regulations that reduce lawn care's environmental impacts.
	1	2	3	4	5		<input type="checkbox"/>	It is the responsibility of the customer to request services that reduce environmental impacts.

Please rank the following three in order (1,2,3) of who is most responsible for reducing environmental impacts related to lawn care (1 = most responsible).

_____ Customer
 _____ Lawn care company
 _____ Government

Thank you very much for taking the time to fill out the survey. Please feel free to add any comments.

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