PERCEPTIONS OF AGRICULTURAL SUSTAINABILITY
HELD BY CALIFORNIA SECONDARY
AGRICULTURE TEACHERS

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Audrey Lyn Denney
Spring 2014
PERCEPTIONS OF AGRICULTURAL SUSTAINABILITY

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Spring 2014

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ABSTRACT

PERCEPTIONS OF AGRICULTURAL SUSTAINABILITY HELD BY CALIFORNIA SECONDARY AGRICULTURE TEACHERS

By
Audrey Lyn Denney

Master of Science in Agricultural Education
California State University, Chico
Spring 2014

Modern agriculture is faced with many daunting challenges in its attempt to meet global food demand. Agricultural sustainability could be a key component of the solution. The purpose of this study was to explore and describe the perceptions of agricultural sustainability held by California secondary agricultural teachers. Perceptions and self-perceived knowledge levels of sustainable agriculture were examined using a researcher-developed instrument. A simple random sample of the population of California secondary agricultural teachers was used for this investigation. The study found teachers perceived themselves to be knowledgeable regarding sustainable agriculture practices. Additionally, perceptions held by teachers suggested a positive view toward agricultural sustainability, but may be misinformed on a few concepts relating to agriculture’s impact on the environment.
CHAPTER I

INTRODUCTION

Background

Challenge of Feeding the World

As the global population creeps toward a projected nine billion people in 2050, concern mounts over the ability of the global food system to meet rising food demand while conserving natural resources (Food and Agriculture Organization of the United Nations [FAO], 2009). The projected population growth will require a 70% increase in global food production by 2050 (FAO). Increasing constraints on global natural resources compound this already daunting challenge. The scarcity and degradation of the world’s land, water, and biodiversity constitute these constraints (FAO). The global agriculture industry will be asked to produce significantly more food with fewer resources than ever before. Additionally, the issues of climate change and food insecurity add layers of complexity to the task of feeding the world. The ecological repercussions of Green Revolution technologies, (Gold, 1999) coupled with their economic and social challenges, signal the need for a shift in the mainstream agriculture production paradigm (National Research Council, 2010).
Agricultural Sustainability

Despite daunting challenges, there is hope in the emergence of agricultural innovations and changing consumer consciousness that can improve agricultural sustainability (National Research Council, 2010). Increasing agricultural sustainability promises to help meet rising global food demand, while preserving natural resources, ensuring the economic viability of farms, and enhancing the quality of life for all people. The National Research Council (2010) described the broad concept of sustainability as “the ability to meet core societal needs in a way that can be maintained indefinitely without significant negative effects” (p. 4). The concept of agricultural sustainability defies a simple definition. Rather, sustainability is a multifaceted and dynamic concept that considers many ecological, economic, social, and resource-based issues (National Research Council, 2010). Agricultural sustainability encompasses broad goals and farmers utilize site-specific strategies to achieve those goals (Sustainable Agriculture Research and Education [SARE], 2012). The National Research Council (2010) delineated the four broad goals of agricultural sustainability:

- Satisfy human food, feed, and fiber needs, and contribute to biofuel needs.
- Enhance environmental quality and the resource base.
- Sustain the economic viability of agriculture.
- Enhance the quality of life for farmers, farm workers, and society as a whole (p. 4).
A sustainable farming system balances the four goals of agricultural sustainability (see Figure 1). Agricultural systems are complex with many interacting facets and practices. The sustainability of the entire system should be evaluated holistically, since no single farming practice can accomplish all four sustainability goals (National Research Council, 2010). Instead, a system comprised of many farming practices attempts to balance productivity, economic viability, ecological health, and social issues. Each of these broad goals of agricultural

![Figure 1. The four broad goals of agricultural sustainability.](image-url)
sustainability can be evaluated by a specific set of objectives, which are interrelated within and between the goals (see Figure 2). The complexity and ever-changing nature of agriculture requires a holistic view to assess sustainability.

<table>
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<td>• Productivity of farming practice or system</td>
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<td>• Farm and household viability</td>
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<td>• Community economic security</td>
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<th>Enhance the quality of life for farmers, farm workers, and society as a whole</th>
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<td>• Ensure farm operators and their households are able to maintain an acceptable quality of life, including access to health and retirement benefits</td>
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<tr>
<td>• Protect the health and welfare of farmers, farm workers, and society</td>
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<tr>
<td>• Enhance community or social well-being from the surrounding agriculture, including access to local food, sustained provision of ecological services, and maintenance of attractive landscapes</td>
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(National Research Council, 2010, p. 25)

**Figure 2.** Representative objectives associated with sustainability goals.

Statement of Problem

Dichotomy of Production Paradigms

The agricultural industry has become increasing polarized in terms of production paradigms. Beus and Dunlap (1990) described a growing schism between the mainstream, conventional paradigm of highly industrialized agriculture and an alternative agriculture movement focused on ecological sustainability. This dichotomy has been in the public eye over past several decades (National Research Council, 2010). Researchers used this view of a conventional-alternative farming systems continuum to examine differences in their production potential and impact on the environment. Increasing consumer consciousness surrounding food sources and production practices translated into increased market demand for local and organic products (National Research Council, 2010). This trend has further divided the agricultural industry.

The National Research Council (2010) rejected this severe dichotomy between nonsustainable or sustainable agricultural systems. All farming systems can contribute to different sustainability goals. “Sustainability is best evaluated not as a particular end state, but rather a process that moves farming systems along a trajectory toward greater sustainability on each of the four goals” (National Research Council, 2010, pp. 4-5). Practices for improving sustainability have been adopted on most, if not all farms. Yet, every farmer can do more to contribute to agricultural sustainability (National Research Council, 2010).
Transition to Agricultural Sustainability

The National Research Council (2010) recommended both incremental and transformative approaches to improving the sustainability of agriculture in the United States. Incremental changes include helping farmers adopt more sustainable agriculture practices. Many farmers have adopted some, but not all practices, and not to their full potential. The transformative approach encompasses development of new markets and legal frameworks, interdisciplinary research and extension, and creation of an integrated vision of a sustainable food system (National Research Council, 2010).

Barriers to Adoption

Many factors influence the decisions made by farmers, including the knowledge, skills, and values of the farmer, along with external factors such as markets, public policies, and resources (National Research Council, 2010). These factors can either influence a farmer to implement a practice or be a barrier to adoption. This study focused on internal factors, knowledge level and perceptions, that can be drivers or barriers to adoption. The knowledge and skill base of farmers develop from both formal education and practical farming experience. Their knowledge level and skills can either limit or enhance the degree to which they adopt sustainable agriculture practices (Bell, 2004). In addition to knowledge level, the perceptions, personal goals, and values held by farmers influence their decisions (National Research Council, 2010). Many studies have examined perceptions of
farmers and their influence on adoption of technologies. Perceptions of economic factors affect decision-making, but are not the only consideration (Nowak & Cabot, 2004; Drost, Long, Wilson, Miller, & Campbell, 1996). Prokopy, Floress, Baumgart-Getz, and Klotthor-Weinkauf (2008) reviewed 25 years of literature related to adoption of conservation best management practices (BMPs). They found that increased awareness of negative environmental ramifications of farming practices could increase the use of best management practices associated with conservation (Prokopy et al., 2008). Farmer perceptions of the agricultural industry and their knowledge level regarding sustainable agriculture influence decisions to adopt practices that enhance agricultural sustainability.

Theoretical Framework

Importance of Youth Education

Today’s high school agricultural students are the industry leaders of tomorrow (Boleman & Burrell Jr., 2003). They will be charged with the formidable, yet inspiring task of meeting global food demand. Educating the next generation of agriculturalists about the importance of economic, ecological, and social sustainability is of critical importance (Agbaje, Martin, & Williams, 2001). A lack of knowledge about sustainable agriculture appears to be a large barrier to its adoption (Drost, Long, Wilson, Miller, & Campbell, 1996; Carolan, 2005). Additionally, people’s attitudes affect their adoption of an innovation (Rogers, 2005). Rogers (2005) defined attitude as “a relatively enduring organization of an individual’s beliefs about an object that predisposes his or her action” (Rogers,
The attitudes and knowledge level of secondary students regarding agricultural sustainability may influence their adoption of sustainable agriculture practices as farmers later in life.

**Model for the Study of Classroom Teaching**

Dunkin and Biddle's (1974) model for the study of classroom teaching was used as a framework for this study. The model consists of four types of variables including presage, context, process, and product. The formative and training experiences of teachers, along with their properties, comprise presage variables. Attitudes and personality characteristics are considered teacher properties (Dunkin & Biddle, 1974). Context variables consist of: student formative experiences; attitudes and knowledge; along with community school, and classroom contexts. Process variables define the process of learning in the classroom and product variables are the end result, or outcomes, from teaching. Dunkin and Biddle (1974) theorized that presage variables and context variables have a causative relationship with process variables. Additionally, process variables have a causative relationship with product variables (see Figure 3). According to the framework provided by Dunkin and Biddle (1974), the attitudes and perceptions held by teachers affect their classroom teaching, thereby impacting student learning.
Figure 3. Model for the study of classroom teaching.


According to the National Research Council (2000), in order for effective classroom instruction to occur, teachers must have subject matter knowledge, pedagogical knowledge, and pedagogical content knowledge. Subject matter is what a teacher knows regarding the content being taught. Pedagogical knowledge includes strategies for and concepts relating to effective teaching, regardless of content area. Pedagogical content knowledge includes:

Information about typical difficulties that students encounter as they attempt to learn about a set of topics; typical paths students must traverse in order to achieve understanding; and sets of potential strategies for helping students overcome the difficulties they encounter. (National Research Council, 2000, p. 45)
According to Stripling and Roberts (2013), subject matter knowledge can be considered a presage variable. Additionally, Dunkin and Biddle (1974) cite the attitudes of teachers as a presage variable. According to the framework provided by Dunkin and Biddle (1974), the subject matter knowledge of teacher and their attitudes, as presage variables, influence the outcomes of learning experiences.

This study examined the perceptions and attitudes regarding agricultural sustainability held by secondary agricultural teachers and their self-perceived knowledge level of sustainable agricultural practices (subject matter knowledge). According to the framework provided by Dunkin and Biddle (1974), these variables will influence student learning outcomes regarding sustainable agriculture (see Figure 4). This study sought to describe the perceptions held by secondary agriculture teachers and their knowledge level, since those variables may affect the

![Figure 4. Conceptual framework of presage variables under investigation.](image-url)
knowledge and perceptions of students regarding sustainable agriculture. As the youth of today become the farmers of tomorrow, their knowledge level and perceptions of agricultural sustainability may impact their adoption of sustainable agriculture practices. In order to meet growing global food demand, all agriculture systems must become more sustainable (National Research Council, 2010). To accomplish this goal, tomorrow's farmers must be knowledgeable regarding sustainable agricultural practices and hold positive perceptions of agricultural sustainability (Williams & Wise, 1997).

Purpose of Study

The purpose of this study was to a) describe the perceptions of agricultural sustainability held by secondary agriculture teachers in California; b) describe the self-perceived knowledge levels regarding sustainable agriculture of California secondary agriculture teachers; and c) determine if relationships exist between characteristics of teachers (i.e., age, sex, years of teaching, production agriculture background, school location, teacher certification, and primary area of instruction) and their mean perceived knowledge level or their perceptions regarding agricultural sustainability.

Significance of Study

This research will contribute to the knowledge base regarding the attitudes of educators surrounding agricultural sustainability. Research addressing the perceptions of educators regarding agricultural sustainability is limited. Two
previous studies specifically address perceptions held by secondary agriculture instructors regarding sustainable agriculture. Williams and Wise (1997) surveyed 41 teachers in Iowa. Agbaje, Martin, and Williams (2001) studied teachers in the North Central Region. Their study was limited by a low response rate (49.6%) and a lower than desirable Cronbach’s alpha reliability coefficient for measured perceptions ($\alpha =0.62$).

This study will address a different geographical area than previous studies. Greater understanding of perceptions held by agricultural teachers may inform future efforts to increase the knowledge level of students.

**Objectives**

This study addressed the following objectives:

1. Describe the demographics of the sampled population (age, sex, years of teaching experience, production agricultural background, school location, teacher certification, and primary area of instruction).

2. Describe perceptions of agricultural sustainability held by California secondary agriculture teachers.

3. Describe the self-perceived knowledge levels regarding sustainable agricultural practices of California secondary agriculture teachers.

4. Determine the relationships between teacher characteristics (age, sex, years of teaching experience, production agriculture background, school location, teacher certification, and primary area of instruction) and their mean perceived knowledge level.
5. Determine the relationships between teacher characteristics (age, sex, years of teaching experience, production agriculture background, school location, teacher certification, and primary area of instruction) and their perceptions of agricultural sustainability.

Limitations

This study had a 54% response rate. Of the 738 secondary agricultural teachers in California, 29% participated in this study. The results from this study should not be generalized to a population beyond the secondary agricultural teachers in California. Measures were taken to control for non-response error. Responses from late and on-time respondents were compared and no significant differences were found. Non-respondents were contacted and their responses were compared to the result from respondents. Additionally, measures were taken to address potential threats to reliability.

Definitions of Terms

**Agricultural sustainability** - “the ability to meet core societal needs in a way that can be maintained indefinitely without significant negative effects” (National Research Council, 2010, p. 4).

**Attitudes** - “a relatively enduring organization of an individual’s beliefs about an object that predisposes his or her action” (Rogers, 2005, p. 174).

**Mainstream production paradigm** – a term used to describe the conventional, industrial model that dominates agricultural production today.
Subject matter knowledge – also called content knowledge - what a teacher knows about the discipline being taught.
CHAPTER II

REVIEW OF LITERATURE

Challenge of Feeding the World

Many serious challenges face agriculturalists in their quest to feed the world. The global population is projected to reach nine billion people by the year 2050 (FAO, 2009). Along with the sheer increase in number of mouths to feed, the corresponding dietary shifts will add increased pressure on the food system (FAO, 2011). Degraded and scarce global natural resources will see additional threats (FAO, 2012). Specifically, the global water supply and the available arable land base are already in short supply (FAO, 2012). Compounding the challenge are issues of water quality, soil fertility, and decreasing biodiversity. Climate change adds many unknowns to the equation and will complicate the task of increasing global food output (Backlund, et al., 2008). Even if agriculturalists are able to meet the rising food demand by increasing agricultural sustainability, unless the socioeconomic frameworks of inequality are addressed, a potential 400 million people may go hungry (FAO, 2009).

Increasing Global Food Demand

Population growth, increasing incomes, and dietary changes all contribute to
the rising global food demand (FAO, 2011). As income levels rise, nutrition standards and diets change. Diets generally shift toward more meat and dairy consumption (FAO). Meat and dairy production are water-intensive industries, thus an increase in production will further exacerbate the global water crisis. Furthermore, with the current system of production requires approximately three pounds of grain to produce one pound of meat (National Research Council, 2010). This creates additional pressure on farmers who must grow grain for livestock feed. According to the FAO (2011), global cereal production will need to increase an extra billion tons annually and an additional 200 million tons of livestock products will be demanded by 2050.

The growing market to produce crops for biofuels has placed further strain on the agricultural industry. The emerging soybean biodiesel and corn grain ethanol industries have increased demand for corn and soybeans (National Research Council, 2010). In 2007, 23% of the United States corn harvest was used for biofuel production. The impact of biofuel production upon food prices and its potential negative environmental externalities is a growing concern (National Research Council, 2010).

Natural Resource Scarcity

Water scarcity and available land for cultivation are issues that challenge the agricultural industry. Globally, water resources are distributed unevenly. Some countries struggle with an acute water shortage, while others have an abundant supply (FAO, 2012). Agriculture currently accounts for 70% of global water use, yet
is projected to have just 40% allocated for food and fiber production by 2050 (FAO, 2012). Additionally, the FAO (2011) estimated water withdrawals for irrigation will increase by 10% in developing countries currently facing a food deficit. Water scarcity will continue to be an issue for agriculture as the global supply decreases and competition from other sectors increases (National Research Council, 2010). As the supply decreases and the demand increases, the price of water will likely rise, increasing production costs for irrigated agriculture. Agricultural producers are challenged to conserve and recycle water or to adapt to dryland farming (National Research Council, 2010).

Land use is the second dimension of natural resource scarcity that limits agricultural production. According to the FAO (2011), most of the earth’s accessible land is cultivated (12%), or is comprised of forests or grasslands (63%). Forests and grasslands provide valuable economic and ecological services that would be lost if converted to farmland. Most of the earth’s remaining arable land that has potential for rain-fed crop production is located in sub-Saharan Africa and a few countries in Latin America (FAO, 2009). Many countries experiencing the fastest population growth are countries where land and water resources are the least abundant (FAO, 2011).

In the coming decades, land and water for agricultural production will face increased competition from fast-growing urban areas. Growing cities, along with increases in industry and tourism will likely lead to less water available to agricultural producers, causing additional loss of cultivated land (FAO, 2011). Much
of the growth in the United States in the last two decades has been at the expense of high quality farmland (National Research Council, 2010). Additionally, the pressure for urban development is areas of the country where high-value specialty crops are grown. An estimated 86% of U.S. fruits and vegetables are produced in areas threatened by urban development (National Research Council, 2010). Water and land scarcity, at home and abroad, constitute a daunting threat to meeting food production requirements.

**Natural Resource Degradation**

The global natural resource base is also severely degraded (FAO, 2009). Land degradation ensues when soil’s future ability to produce crops or support animal life decreases (Miller & Brewer, 2005). This can be either a natural or human-induced process. Soil quality can be degraded physically, chemically, or biologically (National Research Council, 2010). Examples of physical degradation are soil erosion, compaction, reduction in water infiltration, and desertification. Salinization, nutrient depletion, and contamination from pesticides and excessive fertilization are considered chemical degradation. Examples of biological degradation are loss of biodiversity of soil organisms and a decrease in soil carbon (National Research Council, 2010). Land degradation also accounts for damages to ecosystem functioning and loss of ecosystem services provided. The FAO (2012) estimated 25% of global arable land mass is already severely degraded. Soil health has declined across various types of cropping systems in both the developed and developing worlds (FAO, 2011).
Furthermore, several serious quality issues plague global water resources. When excessive nutrients and agrochemicals are carried from fields into nearby waterways, groundwater, surface, and coastal waters can be polluted (FAO, 2011). Excess nutrient accumulation in waterways may cause algal blooms, hypoxia, and eutrophication, which leads to decreased water oxygen levels and declining water quality. According to the United States Environmental Protection Agency (2005), agriculture runoff is the leading source that negatively affects water quality, the second largest source of wetlands damage, and a major contributor to estuary and groundwater contamination. Increased use of synthetic fertilizers and more concentrated livestock production are the primary causes of excessive nutrient accumulation (FAO, 2011). Additionally, agricultural pesticides that migrate off farm into local water sources become another threat to water quality (National Research Council, 2010).

A reduction in genetic biodiversity is the third dimension of natural resource degradation. Biodiversity is endangered by deforestation, conversion of wetlands, and pollution (FAO, 2009). During the last century, 75% of agricultural biodiversity was lost. Pollination, decomposition of organic matter, pest and disease regulation, and other critical ecosystem services are dependent on the diversity of the world’s plant and animal life. Only four staple crops (maize, rice, wheat and potato) account for 60% of global food energy intake (FAO, 2013). Preservation of the genetic diversity within those crops is critical. Genetic uniformity leads to greater vulnerability to pests and diseases. The greatest concern is the permanent loss of
plant genes that are critical for breeding (National Research Council, 2010). Genetic diversity allows farmers and researchers to breed crops that can tolerate increasing environmental stresses (National Research Council, 2010).

**Climate Change**

Altered rainfall patterns and increased temperatures and levels of carbon dioxide have affected the natural resource base and agricultural production (Backlund et al., 2008). The projected effects of climate change vary geographically. While developed countries in the Northern hemisphere historically have been the primary contributors of greenhouse gas emissions, developing countries to the south will most likely face a larger share of the negative repercussions (FAO, 2009). This damage may be seen through decreasing agricultural yields, as well as more severe and more frequent droughts and floods. Climate change may make the task of meeting rising food demand even more arduous.

**Food Insecurity**

Global food insecurity adds more complexity to challenge of feeding the world. The number of undernourished people in the world decreased from 1 billion in 1990 to 870 million in 2012 (FAO, 2012). A substantial effort has reduced global hunger. However, since the global economic crisis of 2008, the rate of hunger reduction tampered. Food security is much more complex than simply producing enough food (FAO, 2009). The root causes of poverty that contribute to hunger must be addressed to create a food secure country (Lappe’, Collins, & Rosset, 1998). According to the FAO (2009), if the requisite 70% increase in global food production
is met, there will still be 400 million hungry people. Those 400 million people will remain undernourished until the imbalances and inequalities of the socioeconomic frameworks are addressed (FAO, 2009). An increase in production will not eliminate hunger, without altering the socioeconomic frameworks. The tightly concentrated distribution of wealth, especially access to land and purchasing power, must be addressed (Lappe’ et al., 1998). Furthermore, other underlying factors contribute to food insecurity, including poorly maintained transportation systems, lack of credit, inefficient markets, unstable political systems, and war (National Research Council, 2010). The deep inequalities at the root of food insecurity must be addressed to successfully meet the challenge of feeding the world (Lappe’ et al., 1998).

Repercussions of the Mainstream Production Paradigm

In order to meet the essential increase in yields by 2050, the current mainstream agriculture production paradigm must become more sustainable (FAO, 2009). The unintended ecological repercussions of Green Revolution technologies threaten the ability to meet increasing food demand. These repercussions include: impact of agriculture on ecosystem functioning and services; decline in soil fertility; non-point source water pollution; stresses on pollinators; and pesticide-resistant insects, mites and fungi (Gold, 1999). These ecological concerns also have implications on human health created from the contamination of food and water by agrochemicals (National Research Council, 2010). Additionally, the nutritive value
and safety of the food produced is a growing concern (National Research Council, 2010). According to Savory (2012), “Agriculture is today not only producing more eroding soil than food, but also biodiversity loss and desertification, which in turn are producing: increasing droughts and flood, poverty, social breakdown, violence, emigration, cultural genocide, recruitment to dissident organizations” (p. 3).

In addition to ecological and human health dimensions, economic and social concerns with mainstream agriculture production paradigm exist. Declining farm income, consolidation, and increasing input costs are economic challenges that threaten the United States agricultural industry (National Research Council, 2010). The number of U.S. farms that reported a net positive income dropped from 57% in 1987 to 47% in 2007 (National Research Council, 2010). Social concerns compound the challenges faced by the mainstream agricultural system. These concerns include: just treatment of agricultural laborers; strength and health of rural communities; and quality of life for farm families (National Research Council, 2010). Serious and compelling issues face farmers in their challenge to feed the world (see Figure 5).
Agricultural Sustainability

The ability to address the ecological, economic, and social concerns of the mainstream agricultural production paradigm, while meeting the rising global food demand may reach by increasing agricultural sustainability (National Research Council, 2010). The concept of agricultural sustainability is so dynamic and complex it resists a simple definition. Strategies and practices used by farmers all over the world to enhance sustainability address common, broad goals. The Sustainable Agriculture Research and Education program (SARE) of the USDA defines those broad goals as: “Stewardship of our nation’s land, air, and water; profit over the long term; and quality of life for farmers, their families, and communities” (p. 2). The Nation Research Council (2010) added a production goal to the list; to “satisfy
human food, feed, and fiber needs, and contribute to biofuel needs” (p. 4). The broad goals of agricultural sustainability are further explained by the specific objectives used for assessment. For example, protecting and enhancing soil, air, and water quality, and biodiversity are examples of specific objectives that address the goal of ecological sustainability (National Research Council, 2010). Farmers use innovative and varied practices across the world to address these sustainability objectives (Sustainable Agriculture Research and Education [SARE], 2012).

Sustainable Agriculture Practices

Practices that contribute to agricultural sustainability are as diverse as the farms where they are utilized. Some techniques, such as Zai holes, only correspond to a small-scale subsistence agriculture paradigm in developing countries (Denney, 2013). Other sustainable agriculture practices, such as precision agriculture and reduced-tillage systems, dovetail with large-scale production found in developed countries. Many sustainable agriculture practices can be productively utilized across all agricultural contexts (National Research Council, 2010). A few examples of production practices that contribute to the environmental sustainability of a farming system are: cover cropping; crop rotations; efficient water use; nutrient management plans; integrated pest management; and the use of manure, compost and green manure as fertilizer (National Research Council, 2010). Farmers utilize several strategies to promote the economic sustainability of their operations. Selling products directly to consumers, through farmer’s markets, farm share programs, or Community Supported Agriculture (CSA) programs, allows farmers to
capture more of the consumer food dollar (National Research Council, 2010). The diversification of farming systems also allows farmers to protect and enhance their income. The more products a farmer sells, the more protected they are from market fluctuations (National Research Council, 2010). Furthermore, processing products on farm can add value to farm incomes by creating new product lines.

Economic and ecological strategies intersect at several points, further displaying the complexity of agricultural sustainability. For example, increasing diversity of production not only can safeguard a farm income, it also enhances the biodiversity of the farming system (National Research Council, 2010). The production of on-farm inputs (energy, compost, pest control) can be less expensive than purchasing inputs and is a more ecologically sound model.

Strategies that contribute to social sustainability can be the most difficult to define, as this component is the least concrete (National Research Council, 2010). Several strategies lead to fair, safe working conditions and security for farm workers. Just compensation of employees, year-round work, and traditional and non-traditional benefits all contribute to positive working conditions on farms (National Research Council, 2010). Examples of traditional benefits are healthcare and retirement plans, while non-traditional benefits could be personal loans or access to food from the farm. Agri-tourism and farm-to-school programs enhance agricultural literacy and lead to a more educated consumer base. An increased knowledge of nutrition, coupled with access and affordability of healthful foods can
contribute to the well being of individuals and communities (National Research Council, 2010).

**Rate of Adoption of Sustainable Agricultural Practices**

Sustainable agriculture practices could play an important role in meeting food demand while conserving the planet's resources. However several barriers to adoption have impacted the diffusion of these practices. According to the National Research Council (2010), the ability of the agricultural system to meet global food demand and the ability to meet “societal expectations for greater sustainability will depend on the ability and willingness of American farmers to adopt appropriate farming practices and systems” (p. 271). Rogers (2005) defined the rate of adoption of an innovation as “the relative speed with which an innovation is adopted by members of a social system” (p. 221). The perceived attributes of an innovation help explain the rate of adoption for an innovation (Rogers, 2005). Five attributes account for most of the variance: relative advantage, compatibility, complexity, trialability, and observability (Rogers). Many studies examine the factors behind farmers’ adoption of sustainable agriculture practices. Understanding these factors is essential to successfully promoting the diffusion of sustainable agriculture practices.

Algone and Martin (1995) used a descriptive survey design to analyze the adoption of sustainable agriculture practices of 150 Iowa farmers. Adoption of specific sustainable agriculture techniques including, crop rotation, use of green
manure, and reduced rates of herbicides and nitrogen fertilizer rates were examined along with farmer’s perceptions of those practices. The majority of farmers surveyed had positive perceptions about sustainable agriculture, but felt negatively about the compatibly or profitability of one or more techniques (Algone & Martin, 1995). Traditional descriptors of early adopters including: farm size, age, and education appeared to be poor predictors of adoption. Conversely, the farmer’s views of the compatibility of these practices on their farm and their access to information were significant predictors of adoption. Algone and Martin (1995) recommend more educational programming focusing on the compatibility and profitability of sustainable agriculture practices.

Saltiel, Bauder, & Palakovich (1994) observed the diffusion of sustainable agriculture practices in Montana by studying perceptions of 1,135 farmers. Farmers were surveyed on adoption of specific practices, perceptions of alternative agriculture practices in their communities, access to information from farmers and extension agents, and attitudes toward issues thought to be important to the adoption of sustainable agriculture practices. Perceived profitability played the greatest role in farmers' adoption of these practices (Saltiel, Bauder, & Palakovich, 1994). Yet, consistent with the diffusion model, the access to information and the demographics of the community (observability) were also significant. Saltiel et al. (1994) recommend increasing educational efforts in specific strategies, such as building soil tilth, to improve adoption.
Drost, Long, Wilson, Miller, and Campell (1996) examined the attitudes of Utah farmers regarding sustainable agriculture practices and the effect those attitudes had on the farmers’ rate of adoption. Economic factors, availability of information, and Federal farm programs were identified as the primary barriers to adoption (Drost, Long, Wilson, Miller, & Campbell, 1996). “Older farmers were more resistant to adoption of low-input practices and perceived them to be unfeasible or impractical” (Drost, Long, Wilson, Miller, & Campbell, 1996, para. 16). Perceptions of agricultural practices and the knowledge level of the farmer played a role in the adoption of sustainable agricultural practices.

Precision agriculture can play an important role in environmental sustainability by reducing soil and water contaminants up to 90% (Aubert, Schroder, & Grimaudo, 2012). Research by Aubert et al. (2012) viewed the adoption of seven specific precision agriculture (PA) techniques among Quebec cereal and oil crop farmers. Adoption of PA technology was dependent on perceived usefulness and ease of use. More educated farmers were more likely to use PA technologies, while the lack of trialability dissuaded some farmers (Aubert et al., 2012). Increasing education about the compatibility of PA techniques with existing equipment and operations is recommended, as the more farmers knew about the technology’s compatibility the more useful they perceived it to be.

Integrated pest management (IPM) is a key component of a sustainable farmer’s toolbox. The ability to deal with pest issues biologically, physically, and chemically helps farmers reduce their use of pesticides (National Research Council,
This reduction has both environmental and economic benefits. Malone, Herbert, and Pheasant (2004) examined the rate of adoption of IPM among grain farmers in Virginia. The results from the survey signified that farmers understood the importance of IPM (Malone, Herbert, & Pheasant, 2004). However, "lack of familiarity, time, and resources were recurring reasons for the non-use of IPM practices" (Malone, Herbert, & Pheasant, 2004, para. 14).

As can be seen in the preceding paragraphs, the perceptions farmers hold regarding sustainable agriculture can influence the rate of adoption of these practices. Additionally, a lack of knowledge or access to information has been perceived to be a barrier to adoption. According to the National Research Council (2010):

Options that farmers have and their decisions to use a particular practice or type of production system are thus shaped by the availability of appropriate technologies or techniques, and by their understanding of the impacts of the practices on their farm, the environment, their community, and the nation as a whole. (p. 307)

Farmers decide to implement strategies and practices in a complex environment where broad contextual factors can act as both drivers of and constraints to change (see Figure 6). Understanding these complexities, and the perceptions and knowledge level of farmers regarding agricultural sustainability, is essential to creating strategies to promote diffusion.
Figure 6. Many factors can affect farmer behavior.


Measuring Perceptions of the Agricultural Industry

Agricultural Paradigms

The polarization of the agricultural industry, as evidenced by the dichotomy between “ecologically based” and “conventional” farming systems, has become increasingly pronounced in the past few decades (National Research Council, 2010). Researchers and social scientists use this dichotomy to explore differences in
production, environmental, and social effects of farming systems. According to the National Research Council (2010),

these terms should be used with great caution because farming enterprises found in the United States clearly reflect a potentially infinite set of combinations of particular farming practices, organizational forms, and management strategies (p. 20).

Instead, they recommend the approach of helping each farmer increase their economic, environmental, and social sustainability.

Philosopher Paul Thompson (2010) postulated the root of the polarization of the agricultural industry could be from opposing views relating to the purpose and structure of the industry. The industrial philosophy of agriculture and the agrarian philosophy of agriculture are at opposing ends of the spectrum (Thompson, 2010). The industrial philosophy views agriculture as part of a larger industrial puzzle, the purpose of which is to meet food and fiber needs. This philosophy lends itself to the mainstream agricultural production paradigm. The efficiency of large-scale monocultures and the increasing consolidation of the industry help this system capture economies of scale (Thompson, 2010). In contrast, an agrarian philosophy believes agriculture to have important social function, like the provision of ecosystem services, fair treatment of labor, and the maintenance of rural communities.

Beus and Dunlap (1990) proposed that conventional agriculture and alternative agriculture are two fundamentally different paradigms. They reviewed
the writings of leaders from each paradigm and found divergent perspectives on a wide range of agricultural issues (Beus & Dunlap, 1990). The differing perspectives were synthesized into six major dimensions (see Figure 7).

![Diagram showing six dimensions of paradigms]

**Figure 7.** The six dimensions of paradigms.


**ACAP Scale.** Beus and Dunlap (1992) analyzed perceptions of agriculturalists and educators through the lens of these agricultural paradigms. They created a 24-item alternative-conventional agriculture paradigm (ACAP) scale that was used to analyze the paradigmatic preferences of land grant university agriculture faculty and farmers in Washington. Faculty members were found to be slightly more
conventional than the overall sample of farmers (Beus & Dunlap, 1992). Farmers sampled were categorized as known alternative farmers or known conventional farmers. The faculty members were slightly less conventional than the known conventional farmers and substantially more conservative than the alternative farmers (Beus & Dunlap, 1992).

**Extension Agents.** Sanagorski, Murphrey, Lawver, Baker, and Linder (2013) revised, updated, and piloted the ACAP scale. Participants were chosen to participate in the study that could be identified as strongly sustainably or strongly conventionally oriented. The conventional group had a statistically significant lower sustainability score than the group that was known to be sustainably oriented. The Cohen's d measure was interpreted to mean a large magnitude of relationship (Sanagorski et al., 2013). The revised ACAP scale discriminated between the known groups effectively. Authors suggested to the ACAP could be used to collect data on attitudes of extension agents toward agricultural practices. Additionally, it was recommended that extension agents could use the instrument to gain a better understanding of the background and views of workshop participants (Sanagorski et al., 2013).

Several additional studies utilizing different instruments have been conducted to assess the views agriculture extension agents hold regarding sustainable agriculture. Boone, Hersman, Boone, and Gartin (2007) examined the knowledge and perceptions regarding sustainable agriculture of extension agents in Ohio, Pennsylvania, and West Virginia. Extension agents were familiar with the
basic terms related to agricultural sustainability and believed it to be a priority for present and future clients (Boone, Jr. et al., 2007). The authors considered sustainable agriculture research to be in its very early stages and identified a need for more training in specific sustainable agriculture strategies.

Additionally, research has been conducted regarding the attitudes of extension agents that could influence their promotion of sustainable agriculture. Minarovic and Mueller (2000) conducted a descriptive study of the attitudes of North Carolina Cooperative Extension Service professionals regarding sustainable agriculture. A total of 369 questionnaires were analyzed which reflected a response rate of 73% (Minarovic & Mueller, 2000). Instead of examining specific perceptions regarding the efficacy of sustainable agriculture practices, this study examined attitudes held by employees of the Cooperative Extension that promote sustainable agriculture. Researchers identified five such attitudes, including shared vision, systems thinking, teamwork grassroots involvement, and knowledge. Results indicated respondents had a strong commitment to sustainable agriculture through their shared vision (Minarovic & Mueller, 2000). However, the data suggested social sustainability was not a high priority. Respondent attitudes signaled they “understood that agriculture sustainability involved more than the development of new technologies, but participants mixed responses indicated indecisiveness about some sustainable concepts” (Minarovic & Mueller, 2000, para. 26). Additionally, many participants were unsure of the meaning of sustainable agriculture, while others applied their own definition. This study mirrored diverse perceptions of
sustainable agriculture found as a common theme in the research related to rate of adoption.

**Secondary Education**

Few studies have been conducted that assess the perceptions that secondary school agricultural instructors and their students hold toward agricultural sustainability. Williams and Wise (1997) studied Iowa agriculture teachers and their students. Perceived knowledge levels of eleven sustainable agriculture practices were examined. Additionally, the perceived impact of sustainable agriculture was measured. Teachers perceived themselves as having limited knowledge regarding sustainable agriculture (Williams & Wise, 1997). Teachers displayed the least knowledge of agroforestry and allelopathy and the most knowledge of rotational grazing. Teachers believed the greatest impacts of sustainable agriculture were conservation of soil, greater management requirements, reduced use of chemicals, and protection of groundwater.

Agbaje, Martin, and Williams (2001) examined the perceptions of agriculture teachers regarding sustainable agriculture and the extent that sustainable agriculture topics were taught in schools. They surveyed teachers in 12 states of the North Central Region (Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin). "Respondents valued sustainable agriculture only if the practices were profitable and perceived that farmers would only use practices that were economically sound" (Agbaje, Martin, & Williams, 2001, p. 41). Teachers were neutral about the value of including
sustainable agriculture in their curriculum. Teachers were asked the extent to which they taught eight different sustainable agriculture topics. All eight topics were taught to some extent, with soil testing, soil erosion control, and crop rotation being taught to a high extent (Agbaje et al., 2001). Agbaje, et al. (2001) concluded that sustainable agriculture had a limited impact on programs and teachers.

**Students.** Williams and Wise (1997) found Iowa agriculture students had limited knowledge about sustainable agriculture. Students knew the least about e allelopathy and agroforestry. Those practices also received the lowest mean knowledge scores for their teachers (Williams & Wise, 1997). Additionally, they knew the most about rotational grazing, which also corresponded with the results from their teachers. However, perceptions of students regarding the impacts of sustainable agriculture were somewhat different than their teachers. Students perceived the greatest impacts from sustainable agriculture to be conservation of soil, changes in equipment, protection of groundwater, safer food, protection of wildlife, and protection of woodlands (Williams & Wise, 1997).

Williams (2000) studied the views secondary agriculture students held regarding sustainable agriculture. Self-perceived knowledge levels of nineteen sustainable agriculture practices and the expected impacts from sustainable agriculture were examined. Students perceived themselves as having additional things to learn about sustainable agriculture (Williams, 2000, p. 20). Sixteen of the 19 practices had mean knowledge level scores below the midpoint of the four point Likert scale. Students knew the most about no-till, rotational grazing, and livestock
manure management (Williams, 2000). Students had limited knowledge, yet were positive about the impacts of sustainable agriculture. “Student belief that sustainable agriculture has the potential to have a positive impact on agriculture provides a foundation for additional learning” (Williams, 2000, p. 22). Williams (2000) concluded a better understanding of student knowledge and views on sustainable agriculture would help develop teaching and learning experiences. Common themes arose in the limited available research conducted regarding the knowledge and perceptions of secondary agricultural teachers and their students regarding agricultural sustainability. The responses of students and teachers alike suggested a need to learn more about the topic. Additionally, students and teachers were generally positive about potential impacts of sustainable agriculture.

Increasing Knowledge and Impacting Perceptions of Students

Perceptions held by youth regarding agriculture, and their knowledge of agriculture, can be changed through educational programming (Luckey, Murphrey, Cummins, & Edwards, 2013). Luckey et al. (2013) examined perceptions and knowledge of agriculture held by youth participating in the agricultural literacy program, AgVenture. Fourth graders who attended the AgVenture program were surveyed with a pre- and post-test design. The instrument included a knowledge component, perceptions component, and demographic information. Researchers saw observed increased appreciation of agriculture and its importance to their
community as a result of the AgVenture educational program (Luckey et al., 2013). There was a significant increase in mean knowledge score between the pre- and post-tests. Additionally, students indicated they “learned the most” from the hands-on components of the program (Luckey et al., 2013). This study suggests effective education programming can alter the perceptions of agriculture held by young people while increasing student knowledge.

Educational Programs to Increase Youth Agricultural Knowledge

Today’s high school agricultural students are tomorrow’s industry leaders. They will be charged with the formidable, yet inspiring task of meeting the global food demand. Educating the next generation of agriculturalists about the importance of economic, ecological, and social sustainability is of critical importance (Agbaje, Martin, & Williams, 2001). Many educational programs exist that are designed to increase young people’s knowledge of agriculture.

Land-Grant Universities. The Morrill Act established public universities in every state in 1862 (National Research Council, 2010). These Land-Grant Universities have a three-pronged mission of teaching, research, and extension. “Many Land-Grant Universities and other colleges and university departments have established programs to support agricultural research that focus on one or more goals of sustainability” (National Research Council, 2010, p. 318). Additionally, an increasing number of university agriculture program funds have been allocated to teaching and researching a systems approach to agriculture. Land Grant University
research initially focused on economic and production goals, but now includes environmental and social goals (National Research Council, 2010).

**USDA Research and Extension.** The United States Department of Agriculture (USDA) is responsible for a large amount of publicly funded agriculture research and education (National Research Council, 2010). The Cooperative Extension System is an educational network run through the USDA's Research, Education, and Economics division. In 2009 2,900 extension offices nationwide delivered a wide range of agricultural education programming to youth and adults. (National Research Council, 2010). The 4H program is the premier youth education program coordinated by the Cooperative Extension Service. “The program combines the cooperative efforts of youth, volunteer leaders, state land-grant universities, state-local governments, and the National Institute of Food and Agriculture (NIFA) of the U.S. Department of Agriculture” (4H Overview, para. 2). The 4H program has more than 6 million members in 50 states and 80 countries (National Research Council, 2010). The dynamic program educates youth ages five through 19 about agriculture.

**Next Generation of Farmers.** Roughly 40% of farmers in the United States were 55 or older in 2008 (National Research Council, 2010). There is growing concern surrounding the fate of the land owned by older farmers facing retirement. Beside the efforts of university agriculture programs and the Cooperative Extension Service (including 4H), several other programs focused on engaging and preparing the next generation of farmers. The American Farm Bureau Federation Young
Farmers and Ranchers Program, the National Young Farmer Educational Association, the International Farm Transition Network, the American Farmland Trust, and the Land Trust Alliance are examples of programs working to prepare the next generation of farmers (National Research Council, 2010). Perhaps the most well known program that targets potential agriculturalists is the National FFA Organization. With more than half a million members enrolled in secondary agricultural programs across 50 states, their mission is to promote premier leadership, personal growth, and career success within their members (National FFA Organization, 2014).

**Including Sustainable Agriculture in Secondary Curriculum**

One way to increase young people’s knowledge of agricultural sustainability is to incorporate the subject into secondary agricultural curriculum. Williams and Dollisso (1998) stated:

Including sustainable agriculture in the high school agricultural education curriculum would allow the agricultural education profession to become a partner in achieving the goals of a sustainable agriculture industry and at the same time enhance the scientific nature of the curriculum (p. 54).

The complex and dynamic concept of agricultural sustainability lends itself to a multidisciplinary educational approach. “The study of sustainability issues encourages the use of a holistic and integrative approach to education” (Williams & Dollisso, 1998, p. 53). Students can explore all aspects of agricultural continuum
from production, processing, and distribution to consumption through ecological, economic, and social lenses.

Williams and Wise (1997) found “teachers perceived themselves as having additional things to learn about sustainable agriculture” (p.19). Curriculum materials, instructional aids, and innovative approaches to teaching needed to be created to address this lack of knowledge (Williams & Wise, 1997). In a similar study, Agbaje et al. (2001) found teachers had neutral perceptions about agriculture sustainability and limited incorporation of the subject in their courses. The authors urged that “opportunities for decision-making that concurrently consider economic, environmental, and social factors should be developed to facilitate learning related to sustainable agriculture systems” (p. 42). Williams and Dollisso (1998) suggested that research be conducted to determine how sustainable agriculture can fit into a secondary curriculum that includes discovery, integration, application, and teaching.

**Attitudes of Teachers Impact**

**Knowledge Acquisition**

Teachers can play an important role in student development and content of learning. As agricultural sustainability becomes integrated into secondary agricultural curriculum, the attitudes of teachers and their preparation within the subject matter could influence student learning outcomes. Park and Osbourne (2007) built upon Dunkin and Biddle’s (1974) model for classroom teaching to examine the effect different variables had on student reading in agriscience. They evaluated teacher variables such as: teacher’s values; attitudes; behaviors;
preparation and culture (Park & Osbourne, 2007). The researchers reviewed 57 resources containing research around content area reading. They found that a teacher’s attitude about the subject affected student performance. Research supported the need for teachers to be enthusiastic about the subject matter (Park & Osbourne, 2007). “Agriscience teachers’ attitude toward reading, personal reading habits, expectations for reading, knowledge of reading strategies, and teachers preparation in content area reading strategies affect student performance” (Park & Osbourne, 2007, p. 25). The authors suggested that further research be conducted to examine the attitudes of agriscience teachers regarding reading and their level of preparation in the subject matter. Teacher attitudes and perceptions regarding agricultural sustainability and their knowledge level of the content may impact student learning of sustainable agriculture. This study describes the perceptions of California secondary agricultural teachers regarding agricultural sustainability and their self-perceived knowledge levels of sustainable agriculture practices.
CHAPTER III

METHODOLOGY

Population and Sample

This study was designed as a quantitative descriptive study. The target population of this study included secondary agricultural teachers in California \((N = 746)\). The methodology was a simple random sample of the entire population. The frame was selected from the agriculture teacher directory for the 2013-2014 year provided by the California Agriculture Teachers Association. Teachers were assigned unique teacher codes based on their position in the directory. According to Krejcie and Morgan (1970) a sample size of 396 was needed to generalize the population \((N = 746)\) with a 95\% confidence level and a 3.5\% margin of error. A random number generator was used to select 396 random numbers between 1 and 746. The teachers with those codes were selected to be part of the sample.

Treatment

Instrument

A researcher-designed survey was used to assess the perceptions and perceived knowledge levels of secondary agricultural teachers in California
regarding agricultural sustainability. Teachers were prompted to reflect on agriculture and share their opinion. The survey contained 20 questions to ascertain perceptions. For each perception statement, teachers identified their level of agreement by responding to a 7-point Likert scale (1 = strongly disagree to 7 = strongly agree). The statements were worded to convey different opinions regarding sustainable agriculture and cover a breadth of issues. Agabaje, Martin, and Williams (2001) used a similar instrument to measure the perceptions of agriculture teachers in the North Central Region of the United States. They used a 5-point Likert scale and listed 16 perception statements.

The second component of the instrument included 10 questions to survey the self-perceived knowledge level of various sustainable agriculture practices. The sustainable agriculture practices included crop rotation, cover crops, conservation tillage, mulch, integrated pest management, precision agriculture, biodiversity, nutrient management, community supported agriculture, and rotational grazing. Participants responded to a 5-point Likert scale that indicated their self-perceived level of knowledge (1 = not knowledgeable to 5 = very knowledgeable). Williams and Wise (1997) used a similar instrument to examine perceived knowledge levels of students and teachers of secondary agriculture programs in Iowa. Additional demographic information was collected, including sex, years of teaching experience, age, urban or rural area, teacher certification, and primary subject matter taught.

**Reliability and Validity**

A pilot study was conducted to estimate reliability prior to utilizing the
instrument. The instrument was piloted with a similar population \((n = 80)\). Reliability of the instrument was estimated using Cronbach’s alpha. The pilot test resulted in a Cronbach’s alpha level \(\alpha = 0.75\) \((n = 80)\). The Cronbach’s alpha coefficient for reliability was deemed to be within the range of fair reliability (Reinard, 2006). No adjustments to the instrument were determined to be necessary as a result of the pilot study.

A panel of subject matter experts reviewed the instrument for face and content validity. The panel consisted of a sustainable agriculture development specialist, a sustainable farmer, a conventional farmer, and a professor of agricultural education. The panel supported the face and content validity of the instrument. Due to the use of a new instrument, post-hoc reliability was also calculated \(\alpha = 0.77\) \((n = 191)\).

**Data Collection**

The data collection period of this study was during the fall academic semester of 2013. Data collection followed Dillman’s (2007) recommendations to include three electronic contacts. Teachers selected for the study were contacted via electronic mail and informed they would be receiving a second email with a link to an important survey in a few days. Three days later, teachers received a second email with a link to the survey. SurveyMonkey was used to collect the responses from teachers. Agricultural teachers agreed to participate with an informed consent question on the electronic survey. The Institutional Review Board of California State
University, Chico, approved the instrument. Of the 396 teachers who received the survey, 214 responded, generating a 54.04% response rate.

To control for the threat of nonresponse error, two follow-up protocols, as suggested by Linder, Murphy, and Briers (2001), were followed. These methods were followed to confirm data collected could be extrapolated to the entire population. First, early respondents were compared to late respondents. As suggested by Linder et al. (2001), late respondents were defined as responses generated by the last stimulus in follow-ups to the survey, in this case, the third contact. A paired t-test was performed and no significant differences were found between on-time and late respondents. Additionally, respondents were compared with non-respondents. Ten percent of the non-respondents were contacted via telephone. Their responses to the survey were compared with those of the respondents and no significant differences were found. Due to this protocol, non-response error was controlled for this study, and the results of the study can be extrapolated to the entire population of California secondary agriculture teachers.

Data Analysis Procedures

Data were analyzed using the Statistical Package for Social Sciences (SPSS v. 21.0). The alpha level was set a priori at 0.05. Descriptive statistics, including mean, median, mode, standard deviation, and frequencies, were calculated for each of the 20 perception statements to address the second research objective. Additionally, five statements that reflected negatively on agricultural sustainability were re-
coded and a summative perception mean was calculated. The same descriptive statistics were calculated for the self-perceived knowledge levels of teachers. A summative mean knowledge score was calculated. The Shapiro-Wilk test was preformed to test the normality of the data. The data were found to be nonparametric. The Kruskal-Wallis one-way analysis of variance (ANOVA) was used to determine if differences existed between the summative mean knowledge level scores of teachers and their demographic characteristics to address objective four. Additionally, a Kruskal-Wallis one-way ANOVA was used to determine if differences existed between each perception statement and teacher demographic characteristics to address objective five. In both cases, a post-hoc Dunn’s pairwise comparison test was performed on nominal variables with multiple categories.
CHAPTER IV

RESULTS AND DISCUSSION

Presentation of Findings

Objective One

The first research objective sought to determine the demographic characteristics of teachers in terms of sex, years of teaching experience, age, production agriculture background, school location, teacher certification, and primary area of instruction (see Table 1). There were more female teachers (56.10%) than male teachers. Most teachers had been teaching for one to five years (29.90%). The teachers were balanced across the age categories, although most teachers were over 40 years old (36.40%), followed by 30 – 40 years (33.20%), and the fewest number of teachers were under 30 years of age (29.90%). The sample predominantly had a production agriculture background (61.20%). More teachers taught in urban areas, as defined by towns that had more than 10,000 people (58.40%). Teachers were almost exclusively traditionally certified (94.04%), with only 10 (4.70%) alternatively certified teachers. Most teachers categorized their primary area of instruction as agriculture science (48.60%). Agriculture mechanics teachers were the next largest group (16.40%). Fourteen (6.50%) teachers taught across all three disciplines, agriculture science, agriculture mechanics, and
horticulture. The combination of agricultural mechanics and horticulture was the smallest group, with only three teachers (1.40%).

Table 1

Demographic Characteristics of California Secondary Agricultural Teachers (n = 214)

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<tr>
<td>Female</td>
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<td>Years of Teaching Experience</td>
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<td>33.20</td>
</tr>
<tr>
<td>Over 40</td>
<td>78</td>
<td>36.40</td>
</tr>
<tr>
<td>Production Agricultural Background</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>131</td>
<td>61.20</td>
</tr>
<tr>
<td>No</td>
<td>81</td>
<td>37.90</td>
</tr>
<tr>
<td>School Location</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban (more than 10,000 people)</td>
<td>125</td>
<td>58.40</td>
</tr>
<tr>
<td>Rural (less than 10,000 people)</td>
<td>89</td>
<td>41.60</td>
</tr>
<tr>
<td>Teacher Certification</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traditional</td>
<td>202</td>
<td>94.04</td>
</tr>
<tr>
<td>Alternative</td>
<td>10</td>
<td>4.70</td>
</tr>
<tr>
<td>Primary Area of Instruction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ag Science (only)</td>
<td>104</td>
<td>48.60</td>
</tr>
<tr>
<td>Mechanics (only)</td>
<td>35</td>
<td>16.40</td>
</tr>
<tr>
<td>Horticulture (only)</td>
<td>12</td>
<td>5.60</td>
</tr>
<tr>
<td>Ag Science &amp; Horticulture</td>
<td>26</td>
<td>12.10</td>
</tr>
<tr>
<td>Ag Science &amp; Mechanics</td>
<td>20</td>
<td>9.30</td>
</tr>
<tr>
<td>Mechanics &amp; Horticulture</td>
<td>3</td>
<td>1.40</td>
</tr>
<tr>
<td>All three areas</td>
<td>14</td>
<td>6.50</td>
</tr>
</tbody>
</table>
Objective Two

The purpose of research objective two was to describe the perceptions held by secondary agricultural teachers toward agricultural sustainability. Perception statements that reflected negatively on agricultural sustainability were re-coded for the summated perception score (see Table 2). After the five perception statements that reflected negatively on agricultural sustainability were codified, the teachers' summative perception score indicated they somewhat agreed with the perception statements ($M = 5.33; SD = .52$).

Three perception statements addressed the value teachers placed upon aspects of sustainability (economic, environmental, and social). Teachers agreed that they valued all three aspects. They had the highest level of agreement for value of economic sustainability, as defined by *providing a stable and prosperous farm income* ($M = 6.25; SD = 1.32$). Of the three value statements, teachers had the second highest level of agreement with social sustainability, as defined by *promoting stable and healthy working and living conditions for farm families, farm workers, and their communities* ($M = 6.22; SD = 1.20$). Of the value statements, teachers had the lowest level of agreement toward environmental sustainability, as defined by *protecting and improving soil quality, reducing dependence on non-renewable resources, and minimizing negative impacts on environmental resources* ($M = 6.12; SD = 1.16$).

Perception statements also addressed priorities of teachers in regards to the three aspects of agricultural sustainability. Teachers had the highest level of
Table 2

*Summated Scores for Perceptions Regarding Agricultural Sustainability of Teachers (n = 214)*

<table>
<thead>
<tr>
<th>Perceptions</th>
<th>Mean</th>
<th>SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Summative Perception (Codified)</strong></td>
<td>5.33</td>
<td>.52</td>
<td>2.95–6.50</td>
</tr>
<tr>
<td><strong>Perception Statements</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Efficiency in water use in farming operations is of critical importance.</td>
<td>6.48</td>
<td>.78</td>
<td>1.00–7.00</td>
</tr>
<tr>
<td>I value economic sustainability.</td>
<td>6.25</td>
<td>1.32</td>
<td>1.00–7.00</td>
</tr>
<tr>
<td>I value social sustainability.</td>
<td>6.22</td>
<td>1.20</td>
<td>1.00–7.00</td>
</tr>
<tr>
<td>I value environmental sustainability.</td>
<td>6.12</td>
<td>1.16</td>
<td>1.00–7.00</td>
</tr>
<tr>
<td>Declining soil quality decreases yields.</td>
<td>6.08</td>
<td>.95</td>
<td>1.00–7.00</td>
</tr>
<tr>
<td>I believe long-term economic and environmental sustainability are equally important for a farming operation.</td>
<td>5.99</td>
<td>1.10</td>
<td>1.00–7.00</td>
</tr>
<tr>
<td>Long-term economic sustainability highest priority for a farming operation.</td>
<td>5.87</td>
<td>1.18</td>
<td>1.00–7.00</td>
</tr>
<tr>
<td>I believe long-term economic, environmental, and social sustainability are equally important for a farming operation.</td>
<td>5.80</td>
<td>1.25</td>
<td>1.00–7.00</td>
</tr>
<tr>
<td>Biodiversity is important on farms.</td>
<td>5.72</td>
<td>1.09</td>
<td>2.00–7.00</td>
</tr>
<tr>
<td>Increasing energy efficiency in farming operations is of critical importance.</td>
<td>5.70</td>
<td>1.03</td>
<td>1.00–7.00</td>
</tr>
<tr>
<td>Sustainable agriculture leads to healthier California communities.</td>
<td>5.41</td>
<td>1.34</td>
<td>1.00–7.00</td>
</tr>
<tr>
<td>The purpose of farmland is to produce as much food as possible.</td>
<td>4.63</td>
<td>1.52</td>
<td>1.00–7.00</td>
</tr>
<tr>
<td><em>Agriculture accounts for only a small amount of polluted runoff water.</em></td>
<td>4.60</td>
<td>1.47</td>
<td>1.00–7.00</td>
</tr>
<tr>
<td>The government should not promote particular farming strategies.</td>
<td>4.32</td>
<td>1.63</td>
<td>1.00–7.00</td>
</tr>
<tr>
<td>I believe tax dollars should be spent on government programs that promote the use of sustainable agriculture practices.</td>
<td>4.16</td>
<td>1.67</td>
<td>1.00–7.00</td>
</tr>
<tr>
<td>Reducing the use of synthetic (man-made) fertilizers and pesticides leads to healthier soil and ecosystems.</td>
<td>4.07</td>
<td>1.54</td>
<td>1.00–7.00</td>
</tr>
<tr>
<td><em>Most sustainable farming practices are not doable for large-scale conventional farmers.</em></td>
<td>3.43</td>
<td>1.57</td>
<td>1.00–7.00</td>
</tr>
<tr>
<td><em>Employing sustainable agriculture practices will result in less profits for farmers.</em></td>
<td>3.23</td>
<td>1.33</td>
<td>1.00–7.00</td>
</tr>
<tr>
<td><em>People who promote sustainable agriculture are “anti-farmer.”</em></td>
<td>2.31</td>
<td>1.19</td>
<td>1.00–7.00</td>
</tr>
<tr>
<td><em>Sustainable agriculture and organic farming are the same thing.</em></td>
<td>2.22</td>
<td>1.25</td>
<td>1.00–7.00</td>
</tr>
</tbody>
</table>

*Note.* Scale: 1 = strongly disagree; 2 = disagree, 3 = somewhat disagree, 4 = neutral/no opinion, 5 = somewhat agree, 6 = agree, 7 = strongly agree. * Values were reversed on these statements before summing perceptions.
agreement with the statement that economic and environmental sustainability are equally important ($M = 5.99; SD = 1.10$). Of the priority statements, the second highest level of agreement was seen through their value of economic sustainability, their highest priority ($M = 5.87; SD = 1.18$). Of the priority statements, teachers had the least agreement with the statement that economic, environmental, and social sustainability were of equal importance to a farming operation ($M = 5.80; SD = 1.25$).

Teachers agreed with four of the fourteen remaining perception statements. The highest level of agreement of all 20 statements regarded the critical nature of water use efficiency in farming operations ($M = 6.48; SD = .78$). Teachers also agreed that declining soil quality decreases yields ($M = 6.08; SD = .95$). Teachers perceived biodiversity to be important on farms ($M = 5.72; SD = 1.09$). and increasing energy efficiency was critical for farming operations ($M = 5.70; SD = 1.03$).

Teachers somewhat agreed with three perception statements: sustainable agriculture leads to healthier California communities ($M = 5.41; SD = 1.34$); the purpose of farmland is to produce as much food as possible ($M = 4.63; SD = 1.52$); and agriculture accounts for only a small amount of polluted runoff water ($M = 4.60; SD = 1.52$).

Teachers were neutral or held no opinion about three statements. Two of those statements related to the government’s role in agriculture, including: the government should not promote particular farming strategies ($M = 4.32; SD = 1.63$);
and tax dollars should be used to promote sustainable agriculture practices ($M = 4.16; SD = 1.67$). They also held no opinion regarding the reduction in use of synthetic fertilizers and pesticides leading to healthier soil and ecosystems ($M = 4.07; SD = 1.54$).

Teachers somewhat disagreed with two perception statements that reflected negatively on agricultural sustainability, including: most sustainable agriculture practices are not doable for large-scale conventional farmers ($M = 3.43; SD = 1.57$); and employing sustainable agriculture practices will result in less profits for farmers ($M = 3.23; SD = 1.33$).

Additionally, teachers disagreed with the remaining two statements that reflected negatively on sustainable agriculture, including: people who promote sustainable agriculture are “anti-farmer” ($M = 2.31; SD = 1.19$); and sustainable agriculture and organic farming are the same thing ($M = 2.22; SD = 1.25$).

**Objective Three**

The third research objective was to describe the self-perceived knowledge levels regarding sustainable agriculture practices of secondary agriculture teachers. Table 3 shows the summated knowledge score for all 10 sustainable agriculture practices ($M = 3.10; SD = .86$). Teachers described themselves as being knowledgeable about all sustainable agriculture practices. Crop rotation had the highest mean knowledge score ($M = 3.45; SD = 1.03$). Management intensive grazing or rotational grazing had the second highest mean ($M = 3.38; SD = 1.16$). Cover crops ($M = 3.25; SD = 1.07$), mulch ($M = 3.15; SD = 1.19$), Integrated Pest
Management (IPM) ($M = 3.15; SD = 1.19$), and precision agriculture ($M = 3.12; SD = 1.09$) ranked in the middle in terms of the perceived knowledge levels of teachers. Biodiversity ($M = 3.04; SD = 1.00$), conservation tillage ($M = 3.03; SD = 1.24$), nutrient management ($M = 2.91; SD = 1.06$), and Community Supported Agriculture (CSAs) ($M = 2.56; SD = 1.27$) had the lowest mean scores.

Table 3

<table>
<thead>
<tr>
<th>Practice</th>
<th>Mean</th>
<th>SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summated Knowledge Practice</td>
<td>3.10</td>
<td>.86</td>
<td>1.00 – 5.00</td>
</tr>
<tr>
<td>Crop rotation</td>
<td>3.45</td>
<td>1.03</td>
<td>1.00 – 5.00</td>
</tr>
<tr>
<td>Management intensive grazing or rotational grazing</td>
<td>3.38</td>
<td>1.16</td>
<td>1.00 – 5.00</td>
</tr>
<tr>
<td>Cover crops</td>
<td>3.25</td>
<td>1.07</td>
<td>1.00 – 5.00</td>
</tr>
<tr>
<td>Mulch</td>
<td>3.15</td>
<td>1.19</td>
<td>1.00 – 5.00</td>
</tr>
<tr>
<td>Integrated Pest Management (IPM)</td>
<td>3.15</td>
<td>1.19</td>
<td>1.00 – 5.00</td>
</tr>
<tr>
<td>Precision agriculture</td>
<td>3.12</td>
<td>1.09</td>
<td>1.00 – 5.00</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>3.04</td>
<td>1.00</td>
<td>1.00 – 5.00</td>
</tr>
<tr>
<td>Conservation tillage</td>
<td>3.03</td>
<td>1.24</td>
<td>1.00 – 5.00</td>
</tr>
<tr>
<td>Nutrient management</td>
<td>2.91</td>
<td>1.06</td>
<td>1.00 – 5.00</td>
</tr>
<tr>
<td>Community Supported Agriculture (CSAs)</td>
<td>2.56</td>
<td>1.27</td>
<td>1.00 – 5.00</td>
</tr>
</tbody>
</table>

*Note.* Scale: 1 = not knowledgeable; 2 = slightly knowledgeable, 3 = knowledgeable, 4 = somewhat knowledgeable, 5 = very knowledgeable.
Objective Four

The fourth research objective sought to determine relationships between the mean knowledge level of teachers and their characteristics including, age, sex, years of teaching experience, production agriculture background, school location, teacher certification, and primary area of instruction. Since the data were found to be nonparametric, a Kruskal-Wallis one-way analysis of variance was calculated to test the relationships the demographic characteristics had with the mean knowledge level of teachers. A Dunn’s pairwise comparison test was performed on nominal variables with multiple categories (age, years of teaching experience, instruction area). A significance level of 0.05, using the Chi-squared approximation was used, and five significant relationships were found (see Tables 4, 5 & 6).

Table 4
Kruskal-Wallis One-Way Nonparametric Analysis of Variance Comparing School Location and Self-Perceived Mean Knowledge Level of Sustainable Agriculture Practices (n = 208)

<table>
<thead>
<tr>
<th>School Location</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>121</td>
<td>3.00</td>
<td>.86</td>
<td>.04*</td>
</tr>
<tr>
<td>Rural</td>
<td>87</td>
<td>3.25</td>
<td>.83</td>
<td></td>
</tr>
</tbody>
</table>

* p-value, using Chi-squared approximation.
Table 5
Kruskal-Wallis One-Way Nonparametric Analysis of Variance Comparing Production Agriculture Background and Self-Perceived Mean Knowledge Level of Sustainable Agriculture Practices (n = 208)

<table>
<thead>
<tr>
<th>Production Agricultural Background</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>128</td>
<td>3.25</td>
<td>.83</td>
<td>.00*</td>
</tr>
<tr>
<td>No</td>
<td>78</td>
<td>2.83</td>
<td>.82</td>
<td></td>
</tr>
</tbody>
</table>

* p-value, using Chi-squared approximation.

Table 6
Kruskal-Wallis One-Way Nonparametric Analysis of Variance Comparing Sex and Self-Perceived Mean Knowledge Level of Sustainable Agriculture Practices (n = 208)

<table>
<thead>
<tr>
<th>Sex</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>91</td>
<td>3.23</td>
<td>.82</td>
<td>.03*</td>
</tr>
<tr>
<td>Female</td>
<td>116</td>
<td>3.00</td>
<td>.88</td>
<td></td>
</tr>
</tbody>
</table>

* p-value, using Chi-squared approximation.

There were no significant differences in mean knowledge level found for teacher certification (p = .45) or instruction area (p = .14). However, differences in the mean knowledge level score between school location (p = .04), production agriculture background (p = .00), sex (p = .03), and age (p = .00) were found to be
statistically significant. Although the initial Kruskal-Wallis ANOVA returned an insignificant result \( p = .058 \) for years of teaching experience, the Dunn's pairwise comparison test showed significant differences between groups.

Teachers in rural towns had a statistically significant higher mean perceived knowledge level \( (M = 3.25; SD = .83) \) than teachers in urban areas \( (M = 3.00; SD = .86) \). Teachers with a production agriculture background had a statistically significant higher mean perceived knowledge level \( (M = 3.25; SD = .83) \) than teachers without a production agriculture background \( (M = 2.83; SD = .82) \). Male teachers had a statistically significant higher mean perceived knowledge level \( (M = 3.23; SD = .82) \) than female teachers \( (M = 3.00; SD = .88) \).

As reported in Tables 7 and 8, differences were found between age and years of teaching experience. Teachers over 40 had a statistically significant \( (p = .00) \) higher mean perceived knowledge level \( (M = 3.35; SD = .91) \) than teachers under 30 \( (M = 2.84; SD = .80) \). Additionally, teachers possessing over 20 years of teaching experience had a statistically significant higher mean perceived knowledge level than teachers who had been teaching for one to five years. Teachers with one to five years of teaching experience \( (M = 2.91; SD = .86) \) had significantly \( (p = .00) \) lower perceived mean knowledge level than teachers with more than 20 years experience \( (M = 3.35; SD = .83) \).
Table 7
Kruskal-Wallis One-Way Nonparametric Analysis of Variance Comparing Age and Self-Perceived Mean Knowledge Level of Sustainable Agriculture Practices (n = 207)

<table>
<thead>
<tr>
<th>Age</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 30</td>
<td>63</td>
<td>2.84a</td>
<td>.80</td>
</tr>
<tr>
<td>30 – 40</td>
<td>69</td>
<td>3.08ab</td>
<td>.79</td>
</tr>
<tr>
<td>Over 40</td>
<td>75</td>
<td>3.35b</td>
<td>.91</td>
</tr>
</tbody>
</table>

a,b Categories without common superscripts differ (p < .05)

Table 8
Kruskal-Wallis One-Way Nonparametric Analysis of Variance Comparing Years of Teaching Experience and Self-Perceived Mean Knowledge Level of Sustainable Agriculture Practices (n = 206)

<table>
<thead>
<tr>
<th>Years of Teaching Experience</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 – 5</td>
<td>63</td>
<td>2.91a</td>
<td>.86</td>
</tr>
<tr>
<td>6 - 10</td>
<td>44</td>
<td>3.10ab</td>
<td>.87</td>
</tr>
<tr>
<td>11 – 20</td>
<td>54</td>
<td>3.12ab</td>
<td>.84</td>
</tr>
<tr>
<td>Over 20</td>
<td>46</td>
<td>3.35b</td>
<td>.83</td>
</tr>
</tbody>
</table>

a,b Categories without common superscripts differ (p < .05)

Objective Five

The fifth research objective was to determine relationships between demographic characteristics including, age, sex, years of teaching experience, production agriculture background, school location, teacher certification, and
primary area of instruction and their perceptions of agricultural sustainability due to nonparametric data, a Kruskal-Wallis one-way analysis of variance was conducted to examine the differences between individual perception statements and the demographic characteristics. Eight perception statements were found to interact significantly with demographic characteristics that had two variables (sex, production agriculture background, school location, and teacher certification (see Table 9).

Women had a statistically significant higher level of agreement that tax dollars should be spent on government programs that promote the use of sustainable agriculture ($M = 4.40; SD = 1.57$) than men ($M = 3.84; SD = 1.77$). Additionally, women had a higher level of agreement that the three components of agricultural sustainability are equally important ($M = 5.89; SD = 1.29$) than men ($M = 5.67; SD = 1.20$).

A teacher’s production agricultural background had a significant impact on the mean knowledge level scores for four of the 20 perceptions statements. Teachers with a production agricultural background valued economic sustainability significantly more ($M = 6.34; SD = 1.30$) than teachers without a production agricultural background ($M = 6.07; SD = 1.36$).

Additionally, teachers with a production agricultural background had a statistically significant lower level of agreement with the statement reducing the use of synthetic fertilizers and pesticides leads to healthier soil and ecosystems ($M = 3.84$;
SD = 1.58) than teachers without a production agriculture background (M = 4.43; SD = 1.40).

Table 9
Kruskal-Wallis One-Way Nonparametric Analysis of Variance Comparing Demographic Characteristics and Perceptions Regarding Agricultural Sustainability of Teachers

<table>
<thead>
<tr>
<th>Perception Statement</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>I believe long-term economic, environmental, and social sustainability are equally important (n = 211)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>92</td>
<td>5.67</td>
<td>1.20</td>
<td>.036</td>
</tr>
<tr>
<td>Female</td>
<td>119</td>
<td>5.89</td>
<td>1.29</td>
<td></td>
</tr>
<tr>
<td>I believe tax dollars should be spent on government programs that promote the use of sustainable agriculture practices (n = 211)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>92</td>
<td>3.84</td>
<td>1.77</td>
<td>.021</td>
</tr>
<tr>
<td>Female</td>
<td>119</td>
<td>4.40</td>
<td>1.57</td>
<td></td>
</tr>
<tr>
<td>I value economic sustainability (n = 210)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Production agricultural background</td>
<td>130</td>
<td>6.34</td>
<td>1.30</td>
<td>.011</td>
</tr>
<tr>
<td>No production ag background</td>
<td>80</td>
<td>6.07</td>
<td>1.36</td>
<td></td>
</tr>
<tr>
<td>Reducing the use of synthetic (man-made) fertilizers and pesticides leads to healthier soil and ecosystems (n = 212)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Production agricultural background</td>
<td>131</td>
<td>3.84</td>
<td>1.58</td>
<td>.006</td>
</tr>
<tr>
<td>No production ag background</td>
<td>81</td>
<td>4.43</td>
<td>1.40</td>
<td></td>
</tr>
<tr>
<td>The purpose of farmland is to produce as much food as possible (n = 211)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Production agricultural background</td>
<td>130</td>
<td>4.85</td>
<td>1.46</td>
<td>.003</td>
</tr>
<tr>
<td>No production ag background</td>
<td>81</td>
<td>4.25</td>
<td>1.54</td>
<td></td>
</tr>
<tr>
<td>Sustainable agriculture and organic farming are the same thing (n = 210)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Production agricultural background</td>
<td>130</td>
<td>2.12</td>
<td>1.30</td>
<td>.015</td>
</tr>
<tr>
<td>No production ag background</td>
<td>80</td>
<td>2.40</td>
<td>1.15</td>
<td></td>
</tr>
<tr>
<td>Most sustainable farming practices are not doable for large-scale conventional farmers (n = 211)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Production agricultural background</td>
<td>131</td>
<td>3.27</td>
<td>1.56</td>
<td>.044</td>
</tr>
<tr>
<td>No production ag background</td>
<td>80</td>
<td>3.68</td>
<td>1.53</td>
<td></td>
</tr>
<tr>
<td>I value social sustainability (n = 212)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traditionally certified</td>
<td>202</td>
<td>6.27</td>
<td>1.14</td>
<td>.026</td>
</tr>
<tr>
<td>Alternatively certified</td>
<td>10</td>
<td>5.30</td>
<td>1.89</td>
<td></td>
</tr>
</tbody>
</table>
Furthermore, teachers with a production agricultural background possible ($M = 4.85; SD = 1.46$), whereas teachers without a production agricultural background held no opinion ($M = 4.25; SD = 1.54$). Lastly, teachers with a production agricultural background had a statistically significant lower level of agreement that sustainable agriculture and organic farming are the same thing ($M = 2.12; SD = 1.30$) than teachers without a production agricultural background ($M = 2.40; SD = 1.15$). Teachers who were alternatively certified placed a lower value on social sustainability ($M = 5.30; SD = 1.89$) than teachers who were traditionally certified ($M = 6.27; SD = 1.14$).

The Kruskal-Wallis one-way analysis of variance was conducted to examine the differences between the demographic characteristics with more than two variables (age, years of teaching experience, and primary area of instruction) and the perceptions that teachers held regarding sustainable agriculture. A post-hoc Dunn’s pairwise comparison test was then performed to find significant differences between groups. There was no significant difference between areas of instruction for any of the 20y perception statements. Differences were found between age and years of teaching for a few statements (see Tables 10, 11, 12 & 13).
Table 10
*Kruskal-Wallis One-Way Nonparametric Analysis of Variance Comparing Years of Teaching Experience and Teachers’ Perceived Value of Aspects of Sustainability* (n = 211)

<table>
<thead>
<tr>
<th>Years of Teaching Experience</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 – 5</td>
<td>63</td>
<td>6.05&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.04</td>
</tr>
<tr>
<td>6 – 10</td>
<td>44</td>
<td>5.50&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.36</td>
</tr>
<tr>
<td>11 – 20</td>
<td>57</td>
<td>5.93&lt;sup&gt;ac&lt;/sup&gt;</td>
<td>1.21</td>
</tr>
<tr>
<td>Over 20</td>
<td>47</td>
<td>5.57&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>1.39</td>
</tr>
</tbody>
</table>

<sup>a,b,c</sup> Categories without common superscripts differ (p < .05)

*Note.* Perception statement read: I believe long-term economic, environmental, and social sustainability are equally important for a farming operation.

---

Table 11
*Kruskal-Wallis One-Way Nonparametric Analysis of Variance Comparing Years of Teaching Experience and Teachers’ Perception of Government Spending* (n = 211)

<table>
<thead>
<tr>
<th>Years of Teaching Experience</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 – 5</td>
<td>63</td>
<td>4.33&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.57</td>
</tr>
<tr>
<td>6 – 10</td>
<td>45</td>
<td>4.20&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>1.66</td>
</tr>
<tr>
<td>11 – 20</td>
<td>56</td>
<td>4.43&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.55</td>
</tr>
<tr>
<td>Over 20</td>
<td>47</td>
<td>3.53&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.87</td>
</tr>
</tbody>
</table>

<sup>a,b</sup> Categories without common superscripts differ (p < .05)

*Note.* Perception statement read: I believe tax dollars should be spent on government programs that promote the use of sustainable agriculture practices.
Table 12
Kruskal-Wallis One-Way Nonparametric Analysis of Variance Comparing Age and Teachers’ Perceptions of Feasibility of Sustainable Farming Practices (n = 212)

<table>
<thead>
<tr>
<th>Age</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 30</td>
<td>64</td>
<td>3.59&lt;sub&gt;ab&lt;/sub&gt;</td>
<td>1.56</td>
</tr>
<tr>
<td>30 - 40</td>
<td>71</td>
<td>3.63&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.63</td>
</tr>
<tr>
<td>Over 40</td>
<td>77</td>
<td>3.08&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.45</td>
</tr>
</tbody>
</table>

<sup>a, b</sup> Categories without common superscripts differ (p < .05)

*Note.* Perception statement read: Most sustainable farming practices are not doable for large-scale conventional farmers.

Table 13
Kruskal-Wallis One-Way Nonparametric Analysis of Variance Comparing Age and Teachers’ Perceptions of the Purpose of Farmland (n = 212)

<table>
<thead>
<tr>
<th>Age</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 30</td>
<td>64</td>
<td>4.77&lt;sub&gt;ab&lt;/sub&gt;</td>
<td>1.52</td>
</tr>
<tr>
<td>30 - 40</td>
<td>71</td>
<td>4.32&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.55</td>
</tr>
<tr>
<td>Over 40</td>
<td>77</td>
<td>4.80&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.48</td>
</tr>
</tbody>
</table>

<sup>a, b</sup> Categories without common superscripts differ (p < .05)

*Note.* Perception statement read: The purpose of farmland is to produce as much food as possible.

Teachers with one to five years experience placed a higher value (M = 6.05; SD = 1.04) on the equal importance of all three aspects of sustainability than
teachers with 6-10 years experience \((M = 5.50; SD = 1.36)\) and teachers with over 20 years of experience \((M = 5.57; SD = 1.39)\). Additionally, teachers with 11-20 years experience \((M = 5.93; SD = 1.21)\) had a higher level of agreement with that perception statement than teachers with 6–10 years experience \((M = 5.50; SD = 1.36)\). Teachers possessing one to five years experience \((M = 4.33; SD = \) and teachers with 11-20 years experience \((M = 4.43; SD = 1.55)\) had a higher level of agreement than teachers with over 20 years experience \((M = 3.53; SD = 1.87)\) that tax dollars should be spent on government programs that promote the use of sustainable agriculture practices.

Teachers between 30 – 40 years of age \((M = 3.63; SD = 1.63)\) had a higher level of agreement that most sustainable farming practices were not realistic for large scale conventional farmers than teachers over 40 years old \((M = 3.08; SD = 1.45)\). Additionally, teachers between 30 - 40 years of age \((M = 4.32; SD = 1.55)\) had a lower level of agreement that the purpose of farmland is to produce as much food as possible than teachers over 40 years old \((M = 4.80; SD = 1.48)\).

Discussion of the Findings

Research objective one described the demographic characteristics of the sample. Research objective two examined the perceptions California secondary agriculture teachers held regarding agricultural sustainability. Perceptions held by teachers suggest a positive view toward agricultural sustainability, but may be misinformed on a few issues. The summative score of perceptions held by teachers
suggests agricultural teachers hold a somewhat positive view of agricultural sustainability ($M = 5.33; SD = .52$). Furthermore, four of the five negative statements regarding sustainability had the lowest means, which indicates teachers hold a positive view of the concept. Yet, perceptions held by teachers regarding agricultural sustainability vary greatly. Responses for 19 of the 20 perception statements ranged from strongly disagree to strongly agree.

While perceptions vary, teachers displayed a clear value for all three components of agricultural sustainability (economic, environmental, and social). Teachers agreed most with the idea that efficiency in water use is critical to farming operations. “While substantial technological innovation has increased the efficiency of irrigated agriculture over the past several decades, significant potential exists for continued improvement” (Schaible & Aillery, 2012, p. 4). Data suggests agriculture teachers recognize the past successes in irrigation efficiency and the continuing challenge of water scarcity. The neutral level of agreement for both the statements regarding government involvement in agriculture suggests that issues surrounding the government’s role are particularly divisive.

Despite generally positive perceptions of sustainability, teachers may be misinformed on two concepts relating to agriculture’s impact on the environment. Teachers somewhat agreed that agriculture accounts for only a small amount of runoff water. The United States Environmental Protection Agency (2002) reported, “agricultural nonpoint source (NPS) pollution was the leading source of water quality impacts on surveyed rivers and lakes, the second largest source of
impairments to wetlands, and a major contributor to contamination of surveyed estuaries and ground water” (p. 3). Teachers hold a misperception regarding the agricultural industry’s impact on water quality. Additionally, teachers had no opinion regarding whether reducing synthetic fertilizers and pesticides would lead to healthier soils and ecosystems. According to the National Research Council (2010), chemical degradation of soil occurs by toxification from pesticides and excessive fertilization. Additionally, conventional systems:

- lead, more often than not, to a decrease in soil quality, as indicated by the soil’s ability to infiltrate and hold water, to maintain particle structure for optimal root habitat, and to hold and recycle nutrients. Less-than-optimal soil quality raises production costs in the long term, lowers production potential, and accentuates production variability (Harwood, 1994, p. 34).

The effect of synthetic fertilizers and pesticides on soil quality appears to be another misconception held by agriculture teachers.

The third research objective described the self-perceived knowledge levels of sustainable agriculture practices held by agriculture teachers. Summative mean scores indicated teachers perceive themselves to be knowledgeable regarding sustainable agriculture practices. This implies teachers perceive that there are aspects of sustainable agriculture with which they are not familiar. Knowledge levels vary among teachers. The responses ranged from not knowledgeable to very knowledgeable for each practice.

There was a significant difference ($p = .000$) between knowledge levels of
crop rotation, the practice with the highest summative mean, \((M = 3.45; SD = 1.03)\) and Community Supported Agriculture, the practices with the lowest summative mean \((M = 2.56; SD = 1.27)\). The relative age of the agriculture practices and the vast difference in the level of adoption could explain the difference in the knowledge level of teachers. The environmental benefits of crop rotation have been well documented for three decades (National Research Council, 2010). Additionally, it is a farming technique that has been in practice since ancient times. “Most major crop production involves rotational cropping of some form, with the exception of cotton” (National Research Council, 2010, p. 101). Conversely, the concept of CSA’s was brought to the United States from Switzerland in 1984 (National Research Council, 2010). While it has been a growing trend in recent decades, it is estimated that between 4,000 and 6,000 CSA programs currently operate in the United States (Woods & Ernst, 2013).

The fourth research objective sought to determine relationships between teacher characteristics and their perceived mean knowledge level of sustainable agriculture practices. While there were significant differences between some demographic characteristics, the teachers’ mean self-perceived knowledge scores were all in the knowledgeable range. Rural teachers likely have more exposure to production agriculture than urban teachers, which might explain why rural teachers have a higher perceived mean knowledge score. Teachers with a production agriculture background perceived themselves as having more knowledge of sustainable agriculture practices than teachers without a production agriculture
background. Intuitively, teachers from a production agriculture background would know more about specific agriculture practices than teachers without production experience.

Additional differences were seen in knowledge level based on age and years of teaching experience. Teachers over 40 years old had a higher perceived knowledge mean than both groups of younger teachers. This could be accounted for by more years of experience in both teaching and production agriculture. Furthermore, teachers with more than 20 years of experience had a higher perceived knowledge mean than teachers with one to five years of experience. This suggests that teachers with more experience either know more about agriculture than teachers with less experience or more experience teachers feel more confident in their knowledge than younger teachers.

The fifth research objective sought to determine relationships between demographic characteristics including, age, sex, years of teaching experience, production agriculture background, school location, teacher certification, and primary area of instruction and their perceptions of agricultural sustainability. Teachers with a production agriculture background had a lower level of agreement with the statement that reducing the use of synthetic fertilizers and pesticides leads to healthier soil and ecosystems. This signifies that teachers with a production background may have a more traditional, conventional mindset. Additionally, teachers with a production agriculture background somewhat agreed that the purpose of farmland is to produce as much food as possible, whereas teachers
without a production agriculture background held no opinion. Teachers over 40 had a higher level of agreement with that statement than teachers age 30 – 40. This may signify that teachers with a production background and older teachers are more likely to have an industrial philosophy of agriculture than an agrarian philosophy (Thompson, 2010).

Finally, alternatively certified teachers placed a lower value on social sustainability than traditionally certified teachers. This may indicate that alternatively certified teachers are more likely to hold an industrial view of agriculture, which focuses on production and yield rather than social ramifications of agriculture.
CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

Modern agriculture is faced with many daunting challenges in its attempt to meet global food demand. The global population is projected to be 9 billion by 2050, requiring a 70% increase in food production worldwide (FAO, 2009). Natural resource constraints, water and soil quality issues, and global climate change will make meeting growing demand difficult. If the agricultural industry can successfully increase food output enough to meet global demand, the socioeconomic frameworks that perpetuate inequalities must change before hunger will end (FAO, 2009; Lappe', Collins, & Rosset, 1998). Additionally, the ecological, economic, and social ramifications of the mainstream agricultural production paradigm further complicate the challenge of feeding the world (National Research Council, 2010). In order to overcome these obstacles, it is critical to increase the sustainability of agricultural production systems worldwide (National Research Council, 2010).

Incremental changes that enhance agricultural sustainability can be made on all farms, across all contexts, around the globe (National Research Council, 2010). Many factors influence the decisions made by farmers, including the knowledge,
skills, attitudes, and values of the farmer (National Research Council, 2010). These factors can either influence a farmer to implement a practice or be a barrier to adoption. Tomorrow's production agriculturalists are high school agriculture students today. Their perceptions and attitudes regarding agricultural sustainability and their knowledge of sustainable agriculture practices may influence their adoption of those techniques as the farmers of the future. A student’s knowledge level and perceptions may be shaped in their high school agriculture classroom. According to Dunkin and Biddle (1974), a teacher’s perceptions and subject matter knowledge act as presage variables. The presage variables can influence what happens in the classroom (process variables), and thus impact student learning (product variables). This study sought to describe the perceptions held by secondary agriculture teachers and their knowledge level, since those variables may affect the knowledge and perceptions of students regarding agricultural sustainability.

A simple random sample was taken of the entire population of California secondary agricultural teachers. A researcher-designed survey that addressed teacher perceptions of the concept of agricultural sustainability, self-perceived knowledge levels of sustainable agriculture practices, and teacher demographics, was administered using SurveyMonkey. Of the 396 teachers who received the survey, 214 responded, generating a 54.04% response rate. Steps were taken to limit non-response error.
Conclusion

The study found teachers perceived themselves to be knowledgeable regarding sustainable agricultural practices. Teachers knew the most about crop rotation and the least about Community Supported Agriculture programs. Additionally, perceptions held by teachers suggested a positive view toward agricultural sustainability. Teachers indicated they valued economic, environmental, and social sustainability. Data suggested teachers might be misinformed on a few concepts relating to agriculture’s impact on the environment, including the effect of synthetic fertilizers and pesticides on soil quality, and agriculture’s impact on water quality.

Implications

Given teachers perceive themselves as having more to learn; methods to increase teacher knowledge of sustainable agriculture should be examined. Comprehensive curriculum could be developed to provide opportunities for teachers to incorporate this subject matter into their courses. Additionally, teacher preparation programs should incorporate additional emphasis on agricultural sustainability. Younger, urban teachers without a production agriculture background could be targeted for sustainable agriculture in-service training, as they perceived themselves to be less knowledgeable. Additional emphasis on agriculture’s impact on the environment may be warranted.
Recommendations

This study was limited by the use of a new instrument. The instrument had fair reliability, as the pilot test resulted in a Cronbach’s alpha level $\alpha = 0.75$ ($n = 80$) (Reinard, 2006). The researcher recommends the instrument be modified to include constructs; this could simplify and further clarify the views of teachers regarding agricultural sustainability. Constructs could be created around the different aspects of agricultural sustainability as identified by the National Research Council (2010):

- **Production**: Satisfy human food, feed, and fiber needs, and contribute to biofuel needs.
- **Environmental**: Enhance environmental quality and the resource base.
- **Economic**: Sustain the economic viability of agriculture.
- **Social**: Enhance the quality of life for farmers, farm workers, and society as a whole (p. 4).

The perception statements of the instrument could be sorted into those constructs. Additionally, the sustainable agriculture practices identified in the instrument used were primary practices related to environmental sustainability. Practices could be added that addressed the other aspects of sustainability, and those practices could also be organized into constructs.

Little is known about the factors that account for the perceptions regarding agricultural sustainability of teachers and their knowledge level. What
characteristics of teachers account for variance in perceptions? What factors contribute to the knowledge level of teachers regarding sustainable agriculture practices?

Limited research has been conducted on perceptions of secondary teachers regarding agricultural sustainability. The results of this study are limited to the population of California teachers. Further research should be conducted in different geographical regions of the country. Additionally, research should examine the perceptions and knowledge of secondary agriculture students regarding agricultural sustainability. The relationship between perceptions of secondary agriculture teachers and those of their students should be explored. Additionally, the relationship between the teacher’s knowledge of sustainable agriculture and the knowledge of their students could be evaluated. Lastly, research could examine methodologies to change perceptions of young regarding sustainable agriculture. Additionally, efficacy of teaching methods and the ability to change perceptions of agricultural sustainability should also be explored. The sustainability of the agricultural industry is a key component of meeting rising global food demand. Educating the next generation of agriculturalists regarding agricultural sustainability is of critical importance.
References


1. This survey is part of a research project being conducted by Audrey Denney at California State University, Chico. You are invited to participate in this research project because you are a secondary school agriculture teacher in California. You will be asked to reflect on the agriculture industry and answer questions about your views. The results from the study will help us better prepare our students for playing a role in the ever-changing agriculture industry.

Your participation in this research study is voluntary. You may choose not to participate. If you decide to participate in this research survey, you may withdraw at any time. If you decide not to participate in this study or if you withdraw from participating at any time, you will not be penalized.

The procedure involves filling an online survey that will take approximately 5 minutes. Your responses will be confidential. All data is stored in a password protected electronic format. To help protect your confidentiality, the surveys will not contain information that will personally identify you. The results of this study will be used for scholarly purposes only and will be released only in summaries where no individual's answers can be identified. The names, schools, or districts of the teachers will not be released in any form. There are no foreseeable risks, discomforts, or repercussions for you as a participant related to this research.

If you have any questions about the research study, research subject's rights, or in case of research-related injury, please contact Audrey Denney at adenney@csuchico.edu or (805) 550-4239. This research has been reviewed according to California State University, Chico IRB procedures for research involving human subjects.

ELECTRONIC CONSENT: Please select your choice below.

Clicking on the "agree" button below indicates that:

• You have ready the above information
• You voluntarily agree to participate

If you do not wish to participate in the research study, please decline participation by clicking on the "disagree" button.

Next
APPENDIX B
Please consider the topic of agriculture and share your opinion. Choose the degree to which you agree or disagree with the following statements.

2. I value economic sustainability (providing a stable and prosperous farm income).
   - Strongly disagree
   - Disagree
   - Somewhat disagree
   - Neutral/ No opinion
   - Somewhat agree
   - Agree
   - Strongly agree

3. I value environmental sustainability (protecting and improving soil quality, reducing dependence on non-renewable resources, and minimizing negative impacts on environmental resources).
   - Strongly disagree
   - Disagree
   - Somewhat disagree
   - Neutral/ No opinion
   - Somewhat agree
   - Agree
   - Strongly agree

4. I value social sustainability (promoting stable and healthy working and living conditions for farm families, farm workers, and their communities).
   - Strongly disagree
   - Disagree
   - Somewhat disagree
   - Neutral/ No opinion
   - Somewhat agree
   - Agree
   - Strongly agree
5. Long-term economic sustainability (providing a stable and prosperous farm income) is my highest priority for a farming operation.

- Strongly disagree
- Disagree
- Somewhat disagree
- Neutral/ No opinion
- Somewhat agree
- Agree
- Strongly agree

6. I believe long-term economic (providing a stable and prosperous farm income) and environmental sustainability (protecting and improving soil quality, reducing dependence on non-renewable resources, and minimizing negative impacts on environmental resources) are equally important for a farming operation.

- Strongly disagree
- Disagree
- Somewhat disagree
- Neutral/ No opinion
- Somewhat agree
- Agree
- Strongly agree

7. I believe long-term economic (providing a stable and prosperous farm income), environmental (protecting and improving soil quality, reducing dependence on non-renewable resources, and minimizing negative impacts on environmental resources) and social (promoting stable and healthy working and living conditions for farm families, farm workers, and their communities) sustainability are equally important for a farming operation.

- Strongly disagree
- Disagree
- Somewhat disagree
- Neutral/ No opinion
- Somewhat agree
- Agree
- Strongly agree
8. Sustainable agriculture and organic farming are the same thing.

9. Sustainable agriculture leads to healthier California communities.

10. Employing sustainable agriculture practices will result in less profits for farmers.

11. Reducing the use of synthetic (man-made) fertilizers and pesticides leads to healthier soil and ecosystems.
12. I believe tax dollars should be spent on government programs that promote the use of sustainable agriculture practices.

13. Most sustainable farming practices are not doable for large-scale conventional farmers.

14. Efficiency in water use in farming operations is of critical importance.

15. The purpose of farmland is to produce as much food as possible.
16. The government should not promote particular farming strategies.
   - Strongly disagree
   - Disagree
   - Somewhat disagree
   - Neutral/ No opinion
   - Somewhat agree
   - Agree
   - Strongly agree

17. Increasing energy efficiency in farming operations is of critical importance.
   - Strongly disagree
   - Disagree
   - Somewhat disagree
   - Neutral/ No opinion
   - Somewhat agree
   - Agree
   - Strongly agree

18. Agriculture accounts for only a small amount of polluted runoff water.
   - Strongly disagree
   - Disagree
   - Somewhat disagree
   - Neutral/ No opinion
   - Somewhat agree
   - Agree
   - Strongly agree

19. Declining soil quality decreases yields.
   - Strongly disagree
   - Disagree
   - Somewhat disagree
   - Neutral/ No opinion
   - Somewhat agree
   - Agree
   - Strongly agree
20. **Biodiversity is important on farms.**
- Strongly disagree
- Disagree
- Somewhat disagree
- Neutral/ No opinion
- Somewhat agree
- Agree
- Strongly agree

21. **People who promote sustainable agriculture are “anti-farmer.”**
- Strongly disagree
- Disagree
- Somewhat disagree
- Neutral/ No opinion
- Somewhat agree
- Agree
- Strongly agree

---

**Teacher Survey**

**Agricultural Practices Knowledge**

Rate your knowledge of the following agricultural practices.

22. **Crop rotation**
- Not knowledgeable
- Slightly knowledgeable
- Knowledgeable
- Somewhat knowledgeable
- Very knowledgeable

23. **Integrated Pest Management (IPM)**
- Not knowledgeable
- Slightly knowledgeable
- Knowledgeable
- Somewhat knowledgeable
- Very knowledgeable
24. Mulch
- Not knowledgeable
- Slightly knowledgeable
- Knowledgeable
- Somewhat knowledgeable
- Very knowledgeable

25. Conservation tillage (no-till, reduced tillage, contour tillage)
- Not knowledgeable
- Slightly knowledgeable
- Knowledgeable
- Somewhat knowledgeable
- Very knowledgeable

26. Precision agriculture (using technology to improve efficiency)
- Not knowledgeable
- Slightly knowledgeable
- Knowledgeable
- Somewhat knowledgeable
- Very knowledgeable

27. Cover crops
- Not knowledgeable
- Slightly knowledgeable
- Knowledgeable
- Somewhat knowledgeable
- Very knowledgeable

28. Management intensive grazing or rotational grazing
- Not knowledgeable
- Slightly knowledgeable
- Knowledgeable
- Somewhat knowledgeable
- Very knowledgeable
29. Community Supported Agriculture (CSA)
- Not knowledgeable
- Slightly knowledgeable
- Knowledgeable
- Somewhat knowledgeable
- Very knowledgeable

30. Nutrient management
- Not knowledgeable
- Slightly knowledgeable
- Knowledgeable
- Somewhat knowledgeable
- Very knowledgeable

31. Biodiversity
- Not knowledgeable
- Slightly knowledgeable
- Knowledgeable
- Somewhat knowledgeable
- Very knowledgeable

Teacher Survey

Demographic Information

Please select the appropriate response.

32. Sex:
- Male
- Female

33. How many years have you been teaching?
- 1-5
- 6-10
- 11-20
- Over 20
34. How old are you?
- Under 30
- 30-40
- Over 40

35. Do you have a production agriculture background?
- Yes
- No

36. Where do you teach?
- Urban area (town with more than 10,000 people)
- Rural area (town with less than 10,000 people)

37. Teacher certification:
- Traditional university teacher preparation program
- Alternatively certified

38. What is your primary area of instruction? (Mark all that apply)
- Ag Science
- Mechanics
- Horticulture

Powered by SurveyMonkey
Check out our sample surveys and create your own now!
Contact Emails

First Contact

Dear <first name>,

I hope the semester is going well for you at <high school name>! A few days from now I will be sending you a request to fill out a brief questionnaire. The questionnaire concerns your views on agriculture. We are looking at teachers’ perceptions of the agriculture industry and how they influence students’ perceptions. I would greatly appreciate your help collecting this information so we can better serve our students!

I am writing in advance because we have found that many people like to know ahead of time that they will be contacted. If you would not like to be contacted again, please let me know by responding to this email. If you have any questions please feel free to contact me by email or the telephone numbers listed below.

Thank you for your time and consideration! Hopefully, the information we collect will help us positively impact our students’ education.

Best wishes,

Audrey

Audrey Denney
Outreach Coordinator/Graduate Student– College of Agriculture
California State University, Chico
Office: (530) 898-4262
Cell: (805) 550-4239
Second Contact

Dear <first name>,

Thank you for considering filling out my brief questionnaire! You will be asked to reflect on the agriculture industry and answer questions about your views. The results from the study will help us better prepare our students for playing a role in the ever-changing agriculture industry.

Your answers are completely confidential and will be released only in summaries where no individual’s answers can be identified. The survey has 30 content questions and 7 additional demographic questions. It should take only 5 minutes to complete. Please complete the survey by <date>.
The link to the survey can be found here: <link>

If you would like to opt out of the survey and receive no further communication, please click here: <link>

If you have any questions please feel free to contact me by email or the telephone numbers listed below. Thank you so much for your valuable time and the work that you do for students every day!

Best wishes,

Audrey

Audrey Denney
Outreach Coordinator/Graduate Student – College of Agriculture
California State University, Chico
Office: (530) 898-4262
Cell: (805) 550-4239
Dear <first name>!

Last month a link to a survey was sent to you. I know you are especially busy as the semester winds to a close! The survey will only take 5 minutes to complete and your time is greatly appreciated. My graduate research project seeks to examine the perceptions held by agriculture teachers regarding our industry. You were selected from a list of all California agriculture teachers. You will be asked to reflect on the agriculture industry and answer questions about your views. The results from the study will help us better prepare our students for playing a role in the ever-changing agriculture industry. Your answers are completely confidential and will be released only in summaries. Individual’s answers will not be identified.

The link to the survey can be found here: <link>

If you would like to opt out of the survey and receive no further communication, please click here: <link>

Please feel free to contact me by email or the telephone numbers listed below if you have any questions. Additionally, if there is anything Chico State or I can do for you – please let me know! Thank you so much for your valuable time and the work that you do for students every day!

Best wishes,

Audrey

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Cell: (805) 550-4239