Exploring the Role of Data Engagement in Intent to Change Management Practices for Improved Farm Sustainability

Dissertation

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Abstract

There are numerous factors that contribute to how farmers perceive the sustainability of their management practices, this research examines one factor, the influence of their own data. Farmers can engage with data on multiple levels. Some information is personalized such as farm soil tests, billing records and farm assessments while some data is more general such as best management practices and newsletter articles. My thesis is that the level of personalization and engagement of the data will improve the measurement of their farms’ management strategies which will in turn shape how farmers perceive their overall sustainability and ultimately guide their decision making on intent to change management practices for improved sustainability. This research examined how well farmers know the strengths and weaknesses of their management practices in terms of sustainability and explored how accessing information affected their intent to change management practices. I support this thesis in subsequent chapters with research that compares farmers’ overall assessment of the sustainability of their practices with objective measures of the sustainability of their practices, through comparing results from the RISE evaluation and a mail survey that I developed based on both RISE and readily available NRCS data. The correspondence between the subjective and objective measures can differ depending on consultation and examination of the underlying data. I further show differences in the farmers’ intent to change their practices as a function of distance to information, how well their current practices
contribute to their sustainability, either according to them or in an objective index, and the existence of barriers to change. I found that when farmers engaged in data such as billing and production records, they were more likely to assess the sustainability of their operations to be at about the same level as the more objective RISE assessment did. This was found for the themes soil use, material use and environmental protection, quality of life and economic viability. However, when they neglected or lacked data they were more likely to overestimate their sustainability which occurred in the themes water use, energy and climate, biodiversity and working conditions. The one theme farmers consistently underestimated their sustainability was animal husbandry, a theme that is paramount for them.
Dedication

“When everything goes to hell, the people who stand by you without flinching, they are your family” – Jim Butcher

Without my family and friends this wouldn’t have been possible. In the last six years things have certainly gone to hell, but thankfully returned, due to your love and support. Thank you Mom, Dad, Sissy, Aditi and Kathy. You helped me to find my will to fight to the end. You dried my tears, combated my doubt and guided me through my panic attacks. You celebrated my mini victories as though I had climbed Mt Everest. You served as co-advisors, gurus, and therapists. But perhaps most importantly you believed in me when I most certainly didn’t. Without your kind, loving and sometimes harsh words I would not have finished the greatest challenge I have attacked in my life. I am profoundly grateful for you!
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Field of Study

Major Field: Environmental Science
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Chapter 1: Introduction

Agriculture’s role in global society is more complex than just providing food, fiber and fuel. Its impacts and offerings are experienced at all levels of existence. In the last three decades significant effort has been put forth to quantify agriculture’s effects on global ecosystems, populations and economies (McLauchlan, 2006; Swinton et al, 2007; Foster et al, 2007; Belcher et al, 2004; Tilman et al, 2001; Tilman, 1999). Much progress has been made, however the complexities of these systems continue to challenge academia, industries, governments and the public/private sectors. Given the complexities inherent in agriculture, tools to assist farmers, researchers, business people and policy makers with making decisions are a focus of academic research.

The realization that anthropogenic impacts are depleting natural resources and altering the earth’s natural balance has led many to question the sustainability of our current path forward (FAO, 2017a; IPCC, 2014; Tilman, 1998). Many cite the Brundtland Commission’s report, Our Common Future, of the World Commission on Environment and Development (WCED), as a starting point for the global conversation on sustainability. In that report, sustainable development was defined as “meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED, 1987, p. 43). Since the release of the Brundtland Commission report, sustainability has been defined in many ways. Although the language differs, the
focus on sustainability encompassing environmental, social and economic factors with a commitment to ensuring future generations access to natural resources which are adequate to provide for their economic and social well-being remains constant (FAO, 2017a and 2017b, 2013; de Olde et al, 2016; Chand et al, 2015; Schader et al, 2014; Frater and Franks, 2013; Parent et al, 2013; Gerrard et al, 2012; Smith et al, 2011; Kuhlman and Farrington, 2010; Del Prado and Scholefield, 2008; Gasparatos et al, 2008; Meul et al, 2008; Vadrevu et al, 2008; Ghabban, 2007; van Calker et al, 2005; Figge and Hahn, 2004; van der Werf and Petitt, 2002; Gomez et al, 1996; Hansen, 1996).

Sustainability is a holistic and complex multi-dimensional concept encompassing economic, social and environmental issues, and its assessment is a key step in the implementation of sustainable agricultural systems. Realistic assessments of sustainability require: (1) the integration of diverse information concerning economic, social and environmental objectives; and (2) the handling of conflicting aspects of these objectives as a function of the views and opinions of the individuals involved in the assessment process (Sadok et al, 2009 p. 753).

Agriculture in particular has been challenged to quantify and diminish negative impacts while improving economic returns and supporting society’s health and well-being (FAO, 2017a). Often, we consider sustainability to be a choice, either meet today’s needs at the possible expense of tomorrow’s or suffer today in order to protect future generations. A goal of sustainable agriculture is to accomplish both, rather than facing a choice or a tradeoff. In 1991, FAO (Food and Agriculture Organization of the UN) defined sustainable agriculture as “a system that preserves land and water resources, that preserves genetic resources of plants and animals, and that is both economically viable and socially acceptable” (Parent et al., 2013 p. 240). Lewandowski et al. (1999)
expanded this thinking and offered the following definition that represents the all-encompassing complexity of sustainable agriculture by stating it is the, “management and utilization of the agricultural ecosystem in a way that maintains its biological diversity, productivity, regeneration capacity, vitality, and ability to function, so that it can fulfill – today and in the future – significant ecological, economic and social functions at the local, national and global levels and does not harm other ecosystems” (Van Cauwenbergh et al., 2007 p. 229). Altieri (1995) simplified the parameters to production that is energy-efficient, self-sustaining, conserves resources, and is both economically feasible and socially agreeable. Twenty-five years after FAO’s first attempt at defining sustainable agriculture not much has changed; currently FAO’s website lists five principles of sustainable agriculture (FAO, 2017b):

1. Improving efficiency in the use of resources is crucial to sustainable agriculture
2. Sustainability requires direct action to conserve, protect and enhance natural resources
3. Agriculture that fails to protect and improve rural livelihoods, equity and social well-being is unsustainable
4. Enhanced resilience of people, communities and ecosystems is key to sustainable agriculture
5. Sustainable food and agriculture requires responsible and effective governance mechanisms

Jules Pretty (1994) took a provocative approach by suggesting “The central concept in sustainable agriculture is that it must enshrine new ways of learning about the world” (p.46). He suggested that sustainable agriculture isn’t static; it isn’t something to be taught. Instead the dynamic nature requires a learning approach that focuses more on how and with whom we learn not on what we learn (Pretty, 1994). This added dimension allows the basic tenants of sustainable agriculture to prevail while reminding us that
researchers, farmers, and agriculture professionals are learning more each day. This learning isn’t only steeped in scientific research, but is occurring anecdotally in fields, barns and rangeland all around the globe. It is this learning that will continue to propel us forward. We can’t be so enshrined in our principles and proof that we miss opportunities for growth.

The term sustainable agriculture has many different meanings and likely depends on the country, organization, community and/or individual defining it (Binder et al, 2010; Zhen, 2003; Rigby, et al., 2001; von Wirén-Lehr, 2001). There have been countless attempts to define, quantify, categorize, summarize and simplify the principles of sustainable agriculture so that it can be evaluated, prescribed and even governed. Before a definition can be determined and tools developed one must first understand the relationships between agriculture and the environment, economy and society.

*Agriculture and the Environment*

Agriculture has an important role to play in the ecosystem services available to society (Dale and Polasky, 2007; Swinton et al, 2007; Zhang et al, 2007; MA, 2005; Heal and Small, 2002). Simply put, ecosystem services are the benefits people receive from ecosystems. In 2005, the World Resources Institute (WRI) published the Millennium Ecosystem Assessment (MA). The report organized ecosystem services into four categories: supporting, provisioning, regulating and cultural (Figure 1.1). Agriculture’s impacts are represented in all four categories. The supporting and provisioning categories are perhaps the most direct ways to connect agriculture with ecosystem services, however looking a bit deeper reveals that the management practices farmers employ also play a role in the regulation of ecological relationships, such as suppression
of pest outbreaks, and the cultural benefits of agricultural land use. Zhang et al (2007) went a step further than the MA and suggested that agriculture both supports and degrades ecosystem function compared with unmanaged ecosystems. Ecosystems and agriculture have a close relationship (Saunders et al, 2010; Pretty, 2008). Agriculture depends on many ecosystem services for its success but many ecosystem functions are detrimental to agriculture (Figure 1.2). For example, ecosystem services to agriculture include nutrient cycling and pollination but ecological functions also include pest pressure and diseases, which could be considered dis-services. Agriculture provides food and habitat within ecosystems and can even increase biodiversity (Tscharntke et al, 2005), but can also degrade elements such as water and soil quality. It is only when the complexity of these relationships are acknowledged that we can begin to advise management plans that maximize benefits while minimizing damage (Dale and Polasky, 2007).

Figure 1.1 Millennium Ecosystem Assessment categories (Adapted from MA, 2005)
Figure 1.2 Ecosystem services and dis-services to and from agriculture. Solid arrows indicate services, whereas dashed arrows indicate dis-services (Reprinted from Zhang et al, 2007)

Agriculture can lead to environmental degradation (Pretty, 2008; Robertson & Swinton, 2005; Tilman, 1998) in the form of deforestation (FAO, 2017a; IPCC, 2014), depletion of water quality and quantity (Scanlon et al, 2007), soil quality (Kennedy and Smith, 1995), loss of biodiversity (Scherr & McNeely, 2008; Pimentel et al, 1997), soil loss (Montgomery, 2007), and increased chemical production and exposure (McKinlay et al, 2008; Tilman, 1998). The effects of these impacts are being seen globally in the form of climate change, food insecurity, inequality, disparity of wealth, health problems,
collapses of native species/increased persistence of pests, the list is seemingly endless (FAO, 2017a; Goodland & Anhang, 2009; McMichael et al, 2007; Tilman et al, 2002; Tilman, 2001). Yet, the provision of food and fiber is essential to life. We are faced with our basic needs potentially leading to our demise (Altieri, 1999).

Many studies have been conducted on agriculture’s impacts on the environment. Researchers have measured the impacts of management practices on water quality and availability (Dabrowski et al, 2009; Hoorman et al, 2008), biodiversity (Scherr & McNeely, 2008; Pimentel et al, 1997), soil biota/structure/fertility (McLauchlan 2006; Doran and Zeiss, 2000), human health (McMichael et al, 2007), climate change (FAO, 2017a; Mearns et al 2001), emissions (Boadi et al, 2004; Mosier et al, 1998; Johnson and Johnson, 1995) and more. Although not always in agreement on the degrees to which certain practices impact the environment, the consensus is that modern high intensity agriculture is degrading natural habitats both from land use changes and exceeding nature’s ability to absorb perturbations (FAO, 2017a; IPCC 2014). Where there is disagreement is on the ability of technology to solve these challenges.

The Green Revolution brought with it an influx of technology designed to increase global food production and it was successful in this regard (Evenson and Gollin, 2003; Tilman, 1998; Randhawa, 1974). What it lacked was a holistic approach to food production (Shiva, 2016; Tilman, 1998).

The Green Revolution was based on the assumption that technology is a superior substitute for nature, and hence a means of producing growth, unconstrained by nature’s limits. Conceptually and empirically it is argued that the assumption of nature is a source of scarcity, and technology as a source of abundance, leads to the creation of technologies which create new scarcities in nature through ecological destruction. The reduction in
availability of fertile land and genetic diversity of crops as a result of the Green Revolution practices indicates that the ecological level, the Green Revolution produced scarcity, not abundance (Shiva, 2016 p. 15).

The high input management schemes promoted by Nobel Laureate Norman Borlaug resulted in not only increased yields, but increased environmental degradation. Dr. Borloug remained committed to celebrating the benefits of his management systems without acknowledging the short comings (Bailey, 2000). Negative environmental effects are often left out of the accounting when the Green Revolution achievements have been estimated.

It is not clear which is greater – the successes of modern high-intensity agriculture, or its shortcomings. The successes are immense. Because of the green revolution, agriculture has met the food needs of most of the world’s population even as the population doubled during the past four decades. But there has been a price to pay, and it includes contamination of ground-waters, release of greenhouse gases, loss of crop genetic diversity and eutrophication of rivers, streams, lakes and coastal marine ecosystems. …It is unclear whether high-intensity agriculture can be sustained, because of the loss of soil fertility, the erosion of soil, the increased incidence of crop and livestock diseases, and the high energy and chemical inputs associated with it (Tilman, 1998 p. 211).

Despite increased yields, farmers and others found that increased production was incurring an environmental price in both the loss of ecosystem services and personal health and well-being (McMichael et al, 2007). When high intensity agriculture has been assessed holistically, benefits in terms of yield have diminished (Shiva, 2016; Evenson and Gollin, 2003; Tilman, 2001, 2000, 1998). Green Revolution strategies continue to be employed, with biotechnology currently providing a new means of seeking higher yield in conventional western production systems (Panesar and Marwaha, 2014).
Agriculture is expected to minimize soil and air pollution, inequality, loss of biodiversity, climate change and many other environmental, social and economic factors (FAO, 2017a). A major paradigm shift is being called for globally. One focus of that shift is agricultural production. This shift requires a more holistic understanding and reporting of the impacts of modern agriculture. These impacts are not confined to the environment, agriculture is inextricably linked to the economy and society.

*Agriculture and the Economy*

Agriculture has long been regarded as a means for building GDP and for providing revenues that can be translated into development or industrialization (MA, 2005). The World Bank (WB) cites 4% of the global GDP (Gross Domestic Product) can be attributed to agriculture as of 2014. The WB further breaks down this global contribution into four income levels defined by GNI, Gross National Income: low income (GNI per capita is $1,025 or less), lower middle income (GNI per capita is between $1,026 and $4,035), upper middle income (GNI per capita is between $4,036 and $12,475) and high income (GNI per capita is $12,476 or more). In low income populations agriculture makes up 31% of GDP whereas in high income populations it is only 1% (WB, 2014). In the United States agriculture from farm output is 1% of GDP (ERS, 2015; WB 2014) which supports the analysis in the above categories. (When agriculture is defined in more encompassing terms such as including forestry, fishing, textiles, food service, etc., the most recent report from ERS in 2015 calculates the total as 5.5% of the US GDP).

The Word Bank analysis indicates that agriculture plays a more important role in developing countries in terms of revenue, however it does not indicate how that
money is dispersed. In the case of Green Revolution technologies, the increase in production resulted in increased inequality and worsened the distribution in wealth (Randhawa, 1974). Increase in production should result in increased trade which should further yield increased wealth for the producers, however this is often not the case.

Agricultural markets do not operate wholly within the capitalist scheme of supply and demand. Agriculture is heavily subsidized and thus the true cost of food is not realized. These political interventions have ramifications in both the economic sustainability of agriculture and the societal dimension with regards to access to technology, funding, resources etc. The claim by international aid groups and developing world governments is that subsidies allow commodities to enter the global market at artificially low prices. These below-cost commodity sales make it impossible for developing countries to enter agricultural markets as the unsubsidized price of their goods is higher (Wise, 2004). While subsidies, and perhaps more importantly tariffs, are documented to play a large role in agricultural economics (Anderson et al, 2006) many argue that neither are significantly responsible for limiting access to agricultural markets. Research documents that many developing world farmers (aka rural poor) are not in the position to export, instead they are subsistence farmers with what little surplus they have sold in local markets (Wise, 2004). For those farmers in developing countries who have the capacity to export, lowering subsidies and tariffs would likely be to their benefit; however, these are often not the target population addressed in sustainable agriculture principles. Producers in the developing world that have the capacity to export are often agribusinesses who are already better poised to enter global markets regardless of subsidies and tariffs (Wise, 2004). Although these agribusinesses do not directly
contribute to the success of the rural poor in terms of market access they can provide jobs that could ultimately improve the quality of life for local laborers.

Access to credit is another major factor linking agriculture and the economy (Griffin, 1979). Successfully managing a farm often requires reliable access to borrowed funds. Crops, livestock maintenance and land ownership/rental often require money up front. While the developed world has infrastructure in place to offer lines of credit to farmers, that is often not the case in the developing world. It is not only access to credit, but access to fair and equitable credit rates (Griffin, 1979) that can be the difference between keeping the farm or losing everything.

Revisiting Zhang et al (2007), agriculture has the potential to provide economic services while also creating dis-services. While agriculture is a means for increasing GDP, which can translate into development or modernization that improves the economic and societal health and well-being, it also has been shown to increase inequality and disparity in wealth distribution. There are no guarantees that the revenues gained from the sale of agricultural products will be directed at the populations that are most in need. Principle three of FAO’s principles of sustainable agriculture states that “agriculture that fails to protect and improve rural livelihoods, equality and social well-being is unsustainable” (FAO, 2017b). Equitable distribution of financial resources continues to be a hurdle in achieving sustainability in the global agricultural sector. The impact of agriculture on the economies cannot be separated from its social impacts.

Agriculture and Society

The Green Revolution brought promise for feeding a growing population, however it also brought with it inequality, environmental degradation and increased
absolute poverty (Setboonsarng, 2006; Randhawa, 1974). It promised not only increased production but economic growth in developing countries by creating material abundance. It was also promised that agrarian conflict would be reduced (Shiva, 2016). Sustainable agriculture is in part a response to the failures of “modern agriculture”. Like the Green Revolution, sustainable agriculture recognizes the need to feed a growing population with limited land and water resources, but aims to do so in a fashion that is protective of ecosystems, society and economies. Sustainable agriculture does not reject modernization or technological advancements outright. The key principle is that no one factor is more important than another. In other words, increased yield is not more important than economic viability or social well-being. One leg of the three-legged stool of sustainability is no stronger or more important that the other two.

Food security is gaining global attention as growth in both populations and wealth is being realized (Garnett et al, 2013, Tilman et al, 2011). These increases inevitably lead to elevated demand for food. Given the limited environmental resources noted earlier, this means agriculture is being asked to get more out of each acre in production, otherwise known as intensification. The central goal of agriculture is to provide feed and fiber to the global population. Yet many studies have shown that, as production has increased, abject poverty and food insecurity have also risen. The question that needs to be answered is, can intensification be sustainable. I have already discussed both the positive and negative impacts of the Green Revolution. The challenge facing agriculture today is to expand on the positive results while negating the negative impacts. Many believe sustainable intensification is a policy challenge (Garnett et al, 2013). Policies,
often in the form of regulation, must be developed and enforced for agriculture to sustainably meet population needs.

The Brundtland report calls for forward thinking to protect future generation’s access to natural resources so that they have opportunity for economic and social well-being. It goes on to note that there are limits to environmental resources, but not to our ingenuity. Brundtland offers society a challenge. She demonstrates a belief that humans have the power to control our destiny. We can do that in ways that are shortsighted, meaning protective of today’s society but with little to no regard for tomorrow’s generations; or we can harness our collective power of ingenuity to create new opportunities. It is this ingenuity that both propels us forward and at the same time creates greater hurdles.

Once again revisiting Zhang et al (2007) agriculture provides services and dis-services to society. The services are easy to decipher, agriculture provides essential food and fiber to society. However, agriculture can provide dis-services in the form of inequality, and increased poverty. Humans are responsible for the development of agriculture and agricultural services. Bruntland pointed out that although natural resources may be limited, ingenuity is boundless. Just as with agriculture and the economy, sustainable agriculture challenges society to balance personal gains with protection of resources, needs of future generations and economic viability.

Thus far I have explored agriculture’s larger role in global sustainability, provided several definitions of sustainable agriculture and explained how agriculture is linked to the environment, economies and society. What follows is an exploration of methods for measuring sustainability from the broad framework of social-ecological systems thinking.
to the more applied approaches of models that have been developed to provide farmers, researchers, industry and policy makers with information necessary to implement management practices, develop instructional materials, provide feedback and inform local, national and global policy development.

*Measuring Sustainability in Agriculture*

“A SES [Social-ecological system] is an ecological system intricately linked with and affected by one or more social systems” (Anderies et al, 2004 p. 3). Social-ecological systems thinking is a framework for exploring ecosystem services and for evaluating agriculture.

All humanly used resources are embedded in complex, social-ecological systems (SESs). SESs are composed of multiple subsystems and internal variables within these subsystems at multiple levels analogous to organisms composed of organs, organs of tissues, tissues of cells, cells of proteins, etc. In a complex SES, subsystems such as a resource system, (e.g., a coastal fishers), resource units (lobsters), users (fishers), and governance systems (organizations and rules that govern fishing on that coast) are relatively separable but interact to produce outcomes at the SES level, which in turn feed back to affect these subsystems and their components, as well other larger or smaller SESs (Ostrom, 2009 p. 419).

Social-Ecological Systems (SES) thinking is one way to calculate the benefits and challenges of agriculture as it addresses the complexities in the system and evaluates them holistically. A key to SES thinking is that it integrates equally the social and natural sciences. When systems are evaluated with an integrated and holistic approach a more complete understanding is possible (Liu et al., 2007). Agriculture is a marriage of human and natural systems. Farmers rely on natural cycles such as the water cycle and nutrient cycling for the success of their operations. The proliferation of the human race depends partially on agriculture; thus, humans and natural systems are inextricably
joined. Without this basis of understanding decisions will be made that have the potential to negatively affect one side or the other of this partnership. Social-Ecological Systems thinking recognizes the reciprocal effects that humans and natural systems have on one another (Ostrom, 2009). These effects form complex feedback loops (Liu et al, 2007) that help scientists evaluate the sustainability of interactions. Agriculture is an excellent sector in which SES thinking can be utilized, as it is comprised of a multitude of complex feedback loops.

Applying SES thinking to evaluating a farm means not only the farming practices, but the entire supply chain (e.g. transportation, production and externalities) as well. Evaluating ways to build soil fertility is a small-scale example of where SES thinking could be employed in agriculture. Agricultural petrochemicals can boost soil fertility and thus increase yields (Evenson and Gollin, 2003; Tilman, 1998; Randhawa, 1974). However, the production of these inputs is energy intensive and presents significant health hazards (McKinlay et al, 2008; McMichael et al, 2007) to the employees who make, package and transport these chemicals as well as to the end users and the downstream recipients of nutrient-rich run-off. Employing SES thinking would consider all elements. Although natural fertilizers are generally considered to be more sustainable than agro/petrochemicals, manures and composts are not without their footprints; therefore, these must also be evaluated. Ruminants such as dairy cattle are known to produce high levels of methane due to enteric fermentation (Gerber et al, 2011; Thorpe, 2009). Methane is a greenhouse gas (GHG) that is 23 times more destructive than carbon dioxide (Steinfeld et al, 2007). Livestock rearing in general, and the dairy industry in particular, have been targeted as a major contributor to climate change (Gerber et al,
In the 2006 FAO report, *Livestock’s Long Shadow*, livestock was estimated to contribute 18% of the global CO$_2$ eq GHG emissions (Steinfeld *et al*, 2007). Additionally, if manures are applied in heavy concentration and/or are applied during rain events, they can potentially leach nutrients into local waterways just as agro/petrochemicals do. All factors must be included to fully comprehend the sustainability of the operation with regards to soil fertility.

All environmental impacts, both positive and detrimental, need to be weighed against human wants/needs for an assessment to be complete. Trade-offs are a part of agriculture, regardless of the style of production. Gaining insight into the levels of impact and identifying feedback loops in endeavors like agriculture are part of SES thinking. Understanding the dynamics of how this information fits together requires extremely broad and non-linear thinking (Folke, 2006). Social-ecological systems thinking is a framework for building holistic assessment tools.

Researchers, policy-makers, economists and more have joined together to develop assessment tools at various levels to guide our journey of quantification, understanding and management change. Agriculture has been under pressure to lower its footprint, increase production while limiting land expansion, provide inexpensive food, treat animals humanely, protect natural resources such as water, soils, ecosystems etc. (FAO, 2017a). Indeed, farmers are being called on to provide society with numerous benefits while minimizing negative impacts. To help understand and guide this challenge, a wide variety of assessment tools have been developed. Each tool provides a targeted audience with desired information. A tool designed to assist a farmer with better management of his/her farm doesn’t necessarily help the policy maker design legislation that is protective
of ecosystems and society. The two audiences are disparate in the types of information they need. Choosing the right tool is paramount to generating a valuable assessment.

There are several factors that differentiate sustainability assessments: the target audience, the method for data collection and indicator selection/boundaries of measurement. For this research 27 sustainability assessment frameworks were identified through literature review. That review yielded four main target audiences for which agricultural sustainability tools have been developed: researchers, industry, policy makers and farmers. Each target audience potentially has different desired outcomes thus may require different parameters, indicators, boundaries and scales. Some assessments are built with flexibility of measurement, which allows for greater diversity in target audiences. Table 1.1 lists the assessments reviewed for this research and indicates the target audiences. Any of these tools could be used by researchers, however, a tool was categorized as having researchers as a target audience if research implications were discussed in the original paper.
<table>
<thead>
<tr>
<th>Tool</th>
<th>Source</th>
<th>Target Audience</th>
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<td>Farmers</td>
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<tr>
<td>Agroecosystem Health Index</td>
<td>Vadrevu et al, 2008</td>
<td>X</td>
</tr>
<tr>
<td>APOIA-NovoRural</td>
<td>Rodrigues et al, 2010</td>
<td>X</td>
</tr>
<tr>
<td>Caring Dairy</td>
<td>van Calker et al, 2005</td>
<td>X</td>
</tr>
<tr>
<td>CSI</td>
<td>Composite Sustainability Index</td>
<td>Frater and Franks, 2013</td>
</tr>
<tr>
<td>CSI</td>
<td>DairyWise</td>
<td>Schils et al, 2007</td>
</tr>
<tr>
<td>DEA</td>
<td>Data Envelopment Analysis</td>
<td>De Koeijer et al, 2002</td>
</tr>
<tr>
<td>DELTA</td>
<td></td>
<td>Parent et al, 2013</td>
</tr>
<tr>
<td>EMA</td>
<td>Environmental Management for Agriculture</td>
<td>Lewis and Bardon, 1998</td>
</tr>
<tr>
<td>ESI</td>
<td>Environmental Sustainability Index</td>
<td>Sands and Podmore, 2000</td>
</tr>
<tr>
<td>FARMIS</td>
<td>Farm Modelling and Information System</td>
<td>Ehrmann, 2010</td>
</tr>
<tr>
<td>FESLM</td>
<td>Framework for the Evaluation of Sustainable Land Management</td>
<td>Smyth and Dumanski, 1993</td>
</tr>
<tr>
<td>GAMEDE</td>
<td>Global Activity Model for Evaluating the Sustainability of Dairy Enterprises</td>
<td>Vayssières et al, 2009a, 2009b</td>
</tr>
<tr>
<td>IDEA</td>
<td>Indicateurs de Durabilité des Exploitations Agricoles</td>
<td>Zahm et al, 2008</td>
</tr>
<tr>
<td>ISAP</td>
<td>Indicator of Sustainable Agricultural Practice</td>
<td>Rigby et al, 2001</td>
</tr>
<tr>
<td>MOTIFS</td>
<td>Monitoring Tool for Integrated Farm Sustainability</td>
<td>Meul et al, 2008</td>
</tr>
<tr>
<td>PG</td>
<td>Public Goods Tool</td>
<td>Gerrard et al, 2012</td>
</tr>
<tr>
<td>RISE</td>
<td>Response Inducing Sustainability Assessment</td>
<td>Hāni, 2003; Grenz et al, 2009</td>
</tr>
<tr>
<td>SAFA</td>
<td>Sustainability Assessment of Food and Agriculture Systems</td>
<td>FAO, 2013</td>
</tr>
<tr>
<td>SAFE</td>
<td>Sustainability Assessment of Farming and the Environment</td>
<td>Van Cauwenbergh et al, 2006</td>
</tr>
<tr>
<td>SALSA</td>
<td>Systems Analysis for Sustainable Agriculture</td>
<td>Eriksson, 2005</td>
</tr>
<tr>
<td>SAM</td>
<td>Sustainable Agroecosystem model</td>
<td>Belcher et al, 2004</td>
</tr>
</tbody>
</table>
Table 1.1. Continued

<table>
<thead>
<tr>
<th>Tool</th>
<th>Source</th>
<th>Target Audience</th>
</tr>
</thead>
<tbody>
<tr>
<td>SDFI</td>
<td>Sustainable Dairy Farming Index</td>
<td>Chand et al, 2015</td>
</tr>
<tr>
<td>SEAMLESS-IF</td>
<td>Ewert et al, 2009</td>
<td></td>
</tr>
<tr>
<td>SIMS_Dairy</td>
<td>Sustainable and Integrated Management Systems for Dairy Production</td>
<td>del Prado and Scholefield, 2008</td>
</tr>
<tr>
<td>SVA</td>
<td>Sustainable Value Approach</td>
<td>Figge and Hahn, 2004</td>
</tr>
<tr>
<td>TIM</td>
<td>Threat Identification Model</td>
<td>Smith et al, 2000</td>
</tr>
</tbody>
</table>

The data collection mechanism for the tools differed as well. Most collected real farm data, while only a few (SAM, FESLM, APOIA-NovoRural, ESI, TIM, SEAMLESS-IF) populated their models primarily with database/supply chain or regional information. When data was collected at the farm level there were three types of collection, farmer input (interviews), self-reporting or measurement. The most common was interaction with the farmer coupled by measurement. The least common form was self-reporting which was only used by Agroecosystem Health Index and Caring Dairy.

All models defined sustainability on the environmental, social and economic dimensions, however many were tagged as sustainability assessments even if they only addressed environmental aspects (Schader et al, 2014). Furthermore, some models were categorized as sustainability assessments if they only addressed one aspect of farm operations such as biodiversity or nutrient flows. A true sustainability assessment cannot just examine isolated parts, it must address the system (e.g. the farm) as a whole (del Prado and Scholefield, 2007). Of the 27 tools, 13 addressed all three sustainability dimensions at least at some level. Every tool included the environmental dimension.
except for DELTA, which focused solely on social aspects. Eight of the 27 included both the environmental and economic dimensions while five only evaluated environmental aspects (Table 1.2).

**Table 1.2 Measurement dimensions**

<table>
<thead>
<tr>
<th>Tool</th>
<th>Source</th>
<th>Economic</th>
<th>Environmental</th>
<th>Social</th>
</tr>
</thead>
<tbody>
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<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>APOIA-Novorural</td>
<td>Rodrigues <em>et al.</em>, 2010</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Caring Dairy</td>
<td>van Calker <em>et al.</em>, 2005</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>CSI</td>
<td>Composite Sustainability Index</td>
<td>Frater and Franks, 2013</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>DairyWise</td>
<td>Schils <em>et al.</em>, 2007</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEA</td>
<td>Data Envelopment Analysis</td>
<td>De Koeijer <em>et al.</em>, 2002</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>CSI</td>
<td>Composite Sustainability Index</td>
<td>Parent <em>et al.</em>, 2010</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>CSI</td>
<td>Composite Sustainability Index</td>
<td>Lewis and Bardon, 1998</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ESI</td>
<td>Environmental Sustainability Index</td>
<td>Sands and Podmore, 2000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FARMIS</td>
<td>Farm Modelling and Information System</td>
<td>Ehrmann, 2010</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>FESLM</td>
<td>Framework for the Evaluation of Sustainable Land Management</td>
<td>Smyth and Dumanski, 1993</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GAMEDE</td>
<td>Global Activity Model for Evaluating the Sustainability of Dairy Enterprises</td>
<td>Vayssières <em>et al.</em>, 2009, 2009s</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>IDEA</td>
<td>Indicateurs de Durabilité des Exploitations Agricoles</td>
<td>Zahn <em>et al.</em>, 2008</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>ISAP</td>
<td>Indicator of Sustainable Agricultural Practice</td>
<td>Rigby <em>et al.</em>, 2001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MOTIFS</td>
<td>Monitoring Tool for Integrated Farm Sustainability</td>
<td>Meul <em>et al.</em>, 2008</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>PG</td>
<td>Public Goods Tool</td>
<td>Gerrard <em>et al.</em>, 2012</td>
<td>X</td>
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</tbody>
</table>

Continued
Table 1.2. Continued

<table>
<thead>
<tr>
<th>Tool</th>
<th>Source</th>
<th>Sustainability Dimensions</th>
</tr>
</thead>
<tbody>
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<td>RISE</td>
<td>Response Inducing Sustainability Assessment</td>
<td>X X X</td>
</tr>
<tr>
<td>SAFA</td>
<td>Sustainability Assessment of Food and Agriculture Systems</td>
<td>X X X</td>
</tr>
<tr>
<td>SAFE</td>
<td>Sustainability Assessment of Farming and the Environment</td>
<td>X X X</td>
</tr>
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<td>SALSA</td>
<td>Systems Analysis for Sustainable Agriculture</td>
<td>X</td>
</tr>
<tr>
<td>SAM</td>
<td>Sustainable Agroecosystem model</td>
<td>X X</td>
</tr>
<tr>
<td>SDFI</td>
<td>Sustainable Dairy Farming Index</td>
<td>X X X</td>
</tr>
<tr>
<td>SEAMLESS-IF</td>
<td></td>
<td>X X</td>
</tr>
<tr>
<td>SIMS\textsubscript{ Dairy}</td>
<td>Sustainable and Integrated Management Systems for Dairy Production</td>
<td>X X</td>
</tr>
<tr>
<td>SVA</td>
<td>Sustainable Value Approach</td>
<td>X X X</td>
</tr>
<tr>
<td>TIM</td>
<td>Threat Identification Model</td>
<td>X X</td>
</tr>
</tbody>
</table>

Much has been published on the use of indicators as a method for assessment (Whitman and Cooke, 2014; Binder and Feola, 2013; Belanger \textit{et al}, 2012; Binder \textit{et al}, 2010; Gómez-Limón and Sanchez-Fernandez, 2010; Hayati \textit{et al}, 2010; Saunders \textit{et al}, 2010; Russillo and Pinter, 2009; Sydorovych and Wossink, 2008; Rao and Rogers, 2006; Mann and Gazzarin, 2004; Bockstaller and Girardin, 2003; Carruthers and Tinning, 2003; Freebairn and King, 2003; Zhen and Routray, 2003; Rigby \textit{et al}, 2001; von Wirén-Lehr, 2001; King \textit{et al}, 2000; Pannell and Glenn, 2000). Rigby \textit{et al} (2001) noted “the design and use of such indicators can be extremely useful in that they force those involved in the discussion of sustainability to identify the key aspects of sustainable agriculture and to assign weights to them” (p. 463). The number of indicators varies greatly in each tool. It
is difficult to generalize as standard terminology is not used. One tool will use the term “indicator” to describe a measurement at a high level (to define the category being measured), while another will use it at the sublevel (a focused subset of the category) (de Olde et al., 2016).

In an attempt to standardize, FAO (2013) developed the Sustainability Assessment of Food and Agriculture systems, SAFA, as a comprehensive framework for sustainability indicators in agriculture. FAO extended the dimensions of sustainability to include not only the environment, economy and society but also governance (FAO, 2013). Most of the assessments reviewed for my research focused at the farm level. Governance indicators are designed more for companies than farms (Schader et al., 2014) and thus often do not apply to my work. SAFA includes 21 themes, high level categories, which are further defined by sub-themes and then finally indicators (Figure 1.3).

![Figure 1.3 SAFA terminology (Adapted from de Olde et al., 2016)]
Several papers have been published on comparative analysis of tools (Ran et al, 2015; de Olde et al, 2016; Schader et al, 2014; Frater and Franks, 2013; Van Passel and Meul, 2012; van der Werf and Petit, 2002). This work builds off the results of de Olde et al (2016), which compared four sustainability assessment tools focused on farm-level evaluation to understand the relevance/usefulness to farmers. Of the 48 indicator-based tools they examined only RISE, SAFA, PG and IDEA met their selection criteria. The criteria included the need to be an indicator-based tool, peer-reviewed, address all three dimensions of sustainability, should address livestock as well as arable operations, had to be available in English and/or Danish and had to be suitable for North-West European farm management (de Olde et al, 2016).

The farmers perceived RISE as the most relevant tool to gain insight in the sustainability performance of their farm. The findings emphasize the importance of context specificity, user-friendliness, complexity of the tool, language use, and a match between value judgments of tool developers and farmers. Even though RISE was considered as the most relevant tool, the farmers expressed a hesitation to apply the outcomes of the four tools in their decision making and management. Furthermore, they identified limitations in their options to improve their sustainability performance. Additional efforts are needed to support farmers in using the outcomes in their decision making. The outcomes of sustainability assessment tools should therefore be considered as a starting point for discussion, reflection and learning (de Olde et al, 2016 p. 391).

The RISE Model

Response Inducing Sustainability Evaluation, RISE, was developed at the School of Agricultural, Forest and Food Sciences (HAFL) in Zollikofen, Switzerland which is part of the Bern University of Applied Sciences. Dr. Fritz Häni lead the initial
development. It was first used in 1999 on a Brazilian cocoa farm (Grenz, 2015). Since then it has been administered on over 3,300 farms in nearly 60 countries on six continents (HAFL, 2017). It is an indicator-based tool that measures performance at the farm-level by integrating information on all three pillars of sustainability. Data is gathered by trained RISE interviewers through in-person interviews with farmers and brief farm tours (See Appendix A for the RISE questionnaire). The goal of an assessment is to provide farmers with the necessary tools for developing long-term management plans. The results from an assessment will not proclaim a farm to be sustainable, instead feedback is presented on a continuum between optimal and unacceptable (Grenz et al, 2016).

Sustainability in RISE is based on Brundtlands’ (1987) definition described above and based on two central realizations 1) ecosystems have limited carrying capacities; and 2) meeting people’s basic needs is a priority (Grenz et al, 2016). The definition of an ideal farm according to RISE is:

The farm produces food, feed and other agricultural products and services in line with public and trade demand and in keeping with its potential as determined by the local climate, soils and socio-economic conditions. It creates and maintains an environmental, economic and social buffering capacity and maintains or increases the productivity of its natural, financial and human capital.

Non-renewable resources are only used if a physically and functionally equivalent renewable replacement can be made available and demand for non-renewables can be reduced through higher efficiency and lower resource intensity. The indirect use of non-renewable resources is steadily reduced. Soil and water use does not exceed their regeneration rate or irreversibly compromise their quality as a resource and habitat. Nutrient cycles are kept tight. The farm management employs knowledge and technology to improve resource efficiency. Production inputs are used as extensively as possible and only as intensively as is necessary. The farm’s production system helps to protect and promote the diversity and functionality of its ecosystems. No harmful substances are released into the soil, water or atmosphere in quantities that exceed their carrying capacity and resilience or that could pose a threat to human health. Indirect pollutant emissions are steadily reduced.

Livestock are kept in conditions that promote their health, meet their physiological requirements and, as far as possible, allow them to behave in a breed- and species-appropriate manner.
The people working on the farm are provided with decent and healthy working conditions that respect their human rights. This includes fair pay and treatment regardless of gender, age, religion, nationality, skin complexion or personal convictions. As long as they comply with the relevant safety and sustainability requirements, all people working on the farm are free to choose how they live and work. The farm environment provides everyone who works there with access to resources, education and participation in economic and social life. The wages paid allow the people on the farm and their families to enjoy a standard of living that guarantees their mental and physical health and well-being, including food, water, clothing, healthcare and essential social services.

The farm yields a revenue that allows the owner to pay their debts on time and invest in replacement or new sustainable production and farm management systems. The farm is buffered against natural and socio-economic turbulence. Its survival does not depend on single suppliers, customers, products or government subsidies. The farm and its people are protected through a network of formal and informal mechanisms (Grenz et al, 2016 p. 8).

Four foundational beliefs guide the RISE method 1) transparency of information; 2) voluntary participation; 3) thorough assessments; and 4) information is confidential (HAFL, 2017). Agreement on all levels is required before an assessment begins. RISE can be administered on any type of agricultural production system from subsistence farmers in Kenya to conventional dairies in the US. RISE has been designed to accommodate regional reference data which allows the assessment to more accurately depict the realities of any given farm, region, or scale.

RISE evaluates farms based on 10 themes and 46 indicators (Table 1.3) (In the SAFA Guidelines described above instead of indicators these would be called sub-themes). Once the assessment is complete the data collected is compared against benchmark data and then normalized. Optimal performance is 100 and unacceptable equates to 0. A score will be calculated for each indicator. Indicator scores are averaged to generate the theme score. Indicator scores and theme scores are provided to the farmer via a sustainability polygon. The polygon allows for a pictorial representation of the farm’s performance, but is not meant to be the final word on how sustainable it is. To
make the polygon easier to interpret it is color coded: red are problematic areas and equates to scores between 0 and 33; Critical issues are assigned yellow and are between 34 and 66; Scores in green are positive and represent tallies between 67 and 100 (Figure 1.4).
Table 1.3 RISE themes and indicators

<table>
<thead>
<tr>
<th>Theme</th>
<th>Indicators</th>
</tr>
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<tbody>
<tr>
<td>Soil Use</td>
<td>• Soil Management</td>
</tr>
<tr>
<td></td>
<td>• Crop Productivity</td>
</tr>
<tr>
<td></td>
<td>• Soil Organic Matter</td>
</tr>
<tr>
<td></td>
<td>• Soil reaction</td>
</tr>
<tr>
<td></td>
<td>• Soil Erosion</td>
</tr>
<tr>
<td></td>
<td>• Soil Compaction</td>
</tr>
<tr>
<td>Animal Husbandry</td>
<td>• Herd Management</td>
</tr>
<tr>
<td></td>
<td>• Livestock Productivity</td>
</tr>
<tr>
<td></td>
<td>• Opportunity for Species-Appropriate Behavior</td>
</tr>
<tr>
<td></td>
<td>• Living Conditions</td>
</tr>
<tr>
<td></td>
<td>• Animal Health</td>
</tr>
<tr>
<td>Material Use &amp; Environmental Protection</td>
<td>• Material Flows</td>
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<tr>
<td></td>
<td>• Fertilization</td>
</tr>
<tr>
<td></td>
<td>• Plant Protection</td>
</tr>
<tr>
<td></td>
<td>• Air Pollution</td>
</tr>
<tr>
<td></td>
<td>• Soil and Water Pollution</td>
</tr>
<tr>
<td>Water Use</td>
<td>• Water Management</td>
</tr>
<tr>
<td></td>
<td>• Water Supply</td>
</tr>
<tr>
<td></td>
<td>• Water Use Intensity</td>
</tr>
<tr>
<td></td>
<td>• Irrigation</td>
</tr>
<tr>
<td>Energy &amp; Climate</td>
<td>• Energy Management</td>
</tr>
<tr>
<td></td>
<td>• Energy Intensity</td>
</tr>
<tr>
<td></td>
<td>• Greenhouse Gas Balance</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>• Biodiversity Management</td>
</tr>
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<td></td>
<td>• Ecological Infrastructures</td>
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<tr>
<td></td>
<td>• Intensity of Agricultural Production</td>
</tr>
<tr>
<td></td>
<td>• Distribution of Ecological Infrastructures</td>
</tr>
<tr>
<td></td>
<td>• Diversity of Agricultural Production</td>
</tr>
<tr>
<td>Working Conditions</td>
<td>• Personnel Management</td>
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<td>• Working Hours</td>
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<td></td>
<td>• Safety at Work</td>
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<td></td>
<td>• Wage and Income Level</td>
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<td>Quality of Life</td>
<td>• Occupation and Training</td>
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<td></td>
<td>• Financial Situation</td>
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<td></td>
<td>• Social Relations</td>
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<td></td>
<td>• Personal Freedom &amp; Values</td>
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<td></td>
<td>• Health</td>
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<td>Economic Viability</td>
<td>• Liquidity</td>
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<td>• Stability</td>
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<td></td>
<td>• Profitability</td>
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<td>• Indebtedness</td>
</tr>
<tr>
<td></td>
<td>• Livelihood Security</td>
</tr>
<tr>
<td>Farm Management</td>
<td>• Business Goals, Strategy &amp; Implementation</td>
</tr>
<tr>
<td></td>
<td>• Availability of Information</td>
</tr>
<tr>
<td></td>
<td>• Risk Management</td>
</tr>
<tr>
<td></td>
<td>• Sustainable Relationships</td>
</tr>
</tbody>
</table>
Figure 1.4 Example of a RISE sustainability polygon

The sustainability polygon is only one piece of information provided to the farmer during a feedback session. Once all the data has been entered into the RISE software a report will be generated. This report will provide detailed information to the farmer regarding the farm’s performance. The report is organized by themes and indicators. Each detailed results section starts with an overall explanation of the theme followed by detailed information on the indicators. The report provides five areas of explanation for each indicator: sustainability goal, content, scoring, explanatory notes and ideas and recommendations. The sustainability goal, content and scoring are automatically generated, while the RISE assessor provides the explanatory notes and ideas followed by recommendations. The theme scores are not summed or integrated, rather they are reported individually and considered separately in recommendations for improvement. (See Appendix B for a sample report).
RISE was chosen as the model for this research for several reasons 1) it is a comprehensive assessment that collects and reports data on all three pillars of sustainability; 2) it is designed to be used at the farm-level; 3) it has the flexibility to assess farms of any kind; and 4) it collects data based on interviews and farm tours. This research will explore how data engagement at the farm level will influence how farmers think about the management of their farms. Data engagement can be represented in agriculture in many ways. Imagine you are a farmer thinking about installing renewable energy on your farm. Perhaps this idea is present because you are thinking about lowering your energy bills, lowering your GHG footprint or being a more responsible business. You could read about renewable energy to see if it is possible on your farm or you could request someone come out to your farm and perform an assessment. Reading about renewable energy is very different to talking to someone about the reality of energy production on your farm. Now consider whether you might be more likely to feel confident in your choice to install a wind turbine if you had a wind assessment conducted or if your read about the requirements for wind generation. I hypothesize when farmers receive place-based information based on real farm data they will be more likely to act. Therefore, if a farmer spends time with an assessor collecting detailed information on the reliability of wind generation at the farm they are more likely to move to installation than the farmer who has greater distance to the information.

This study builds on a wealth of prior research that explores how farmers make decisions (Stuart et al, 2014; Artikov et al, 2006; Edwards-Jones, 2006; Pannell et al, 2006; Burton, 2004; Vanclay, 2004; Wallace and Moss, 2002; Duram, 2000; Beedell and Rehman, 1999; Willock et al, 1999; Feder and Umali, 1993; Byerlee and Anderson,
1982) and explores the effect place-based information and real farm data has on inciting an intent to change management practices. The literature on farmer decision making is vast, below is a brief introduction to some of the major approaches that have historically been used to predict how farmers receive and process information when considering management change.

Farmer Decision Making

Much research has been conducted on what drives decision making in any field or context. Historically the theory of planned behavior has been used by researchers to explain how decisions are made. The theory of planned behavior posits there is a relationship between intentions and actions and this relationship is guided by not only the amount of effort invested but also a person’s control over other factors “such as requisite information, skills, and abilities, including possession of a workable plan, will power, presence of mind, time, opportunity and so forth” (Ajzen, 1985 p. 36). In short the theory of planned behavior asserts that people will engage in actions that they perceive will have a greater chance of success than failure and that they believe are supported by their peers (Ajzen, 1985). A key to theory of planned behavior is the acknowledgement of the role that social pressure plays in decision making.

Researchers examining farmers’ decision making have based much of their work on theory of planned behavior and have found that decisions are highly affected by balancing multiple influences. “Lemon and Park (1993) concluded that farmers, when trying to achieve ‘good practice’ on their farms, balance environmental, physical and commercial factors in their decisions about farming practices” (Beedell and Rehman, 1999, p. 166). Farms are complex structures requiring consideration of numerous factors
when making decisions regarding changing management practices. Changing
management is often a slow process that may take years to complete. Information needs
to move from a new idea, to greater depth of understanding, to witnessing success from
afar (likely seeing the practice demonstrated on some other farm), to conversations with
other farmers, industry professionals, ag advisors etc., before the change is initiated. The
timeframe for this process varies greatly depending on the significance of the change, the
newness of the practice, the sense of urgency for a solution, etc., however significant
management changes rarely, if ever, are snap decisions. Farmers want to see evidence
that the changes they are considering will result in a benefit to their operations.

When addressing intent to change management practices, the focus is often on
technical assistance and the application of science administered from a top-down
approach (Vanclay, 2004). In general farmers consult with industry experts, peers,
extension agents etc. to gather the necessary data they need to evaluate a the impact a
proposed change will have. Although technical expertise is required when evaluating
new management approaches, farmers also must process change from a social
perspective. Vanclay (2004) offered 27 principles to consider when addressing
sustainable management change with farmers (Table 1.4). He argues that simply
providing technical information is not enough to drive farmers to adopt more sustainable
management practices. If real sustainability is to be achieved, then advisors (e.g.
extension agents) must provide feedback that includes the social structure of farming.
Table 1.4 Vanclay’s 27 social principles for addressing management change

1. Farming is a socio-cultural practice
2. Farmers are not all the same
3. Adoption is a socio-cultural process
4. Profit is not the main driving force of farmers
5. It is hard to be green when you are in the red
6. ‘Doing the right thing’ is a strong motivational factor
7. Farmers don’t distinguish environmental issues from other farm management issues
8. There is a strong desire to hand the farm on to one’s children
9. Sustainability means staying on the farm
10. Women are an integral part of the farm
11. Stage in the lifecycle of a farming family and family composition are significant factors
12. Non-adoption is not the cause of land degradation, rather practices actively promoted by extension in the past have significantly contributed to degradation
13. Marginal farmers are not marginal because of their management ability but rather because of their structural location
14. Farmers’ attitudes are not the problem
15. Farmers construct their own knowledge
16. Effective extension requires more than the transfer of technology, it requires an understanding of world views of farmers
17. Farmers have legitimate reasons for non-adoption
18. Top-down extension is inappropriate
19. The 80-20 rule is a self-serving delusion (20% of farmers produce 80% of the agricultural wealth)
20. Science and extension do not have automatic legitimacy and credibility
21. Representation is not participation
22. Promotion of awareness through the use of dramatic images is counterproductive
23. Put degradation into perspective
24. The best method of extension is multiple methods
25. Group extension is not a panacea
26. Extension is likely to have only a small impact
27. Farmers need to feel valued

Note Reprinted from Vanclay (2004)

My experience in discussing sustainable management change with farmers suggests that there is no one way to approach a topic, farmer or situation. Although similarities exist between farms, no two farms or farmers are exactly alike. Psychological and social science theories have contributed to understanding what drives farmers to adopt more sustainable management practices, however there is still more to discover.
Providing farmers with information does not increase the sustainability of operations, implementing changes based on this information does. For agriculture to become more sustainable, farmers need to employ the process of continual improvement in all aspects of their business. This research examines how well farmers know their strengths and weaknesses and explores how accessing information will affect their intent to change management practices.

In addition to all the data sources farmers manage, they are often constrained when making changes to their management practices. This constraint is experienced both within the farmgate by factors such as cash flow, resource limitations, motivation, and inexperience with new technology or concepts and from beyond the farmgate by factors such as a lack of technical assistance and social pressures. Research, and my own experience on farms, has shown that family farmers are generally trying to operate their farms in manners that balance environmental and economic impacts, protect longevity, and provide a hospitable atmosphere for both their livestock and their families.

Improving their management is often challenged by barriers beyond their control. This research asks farmers to identify these barriers so that tools can be developed to assist with the lowering or elimination of them so that greater sustainability can be achieved.

**Thesis Statement**

Numerous factors contribute to farmers’ perception of the sustainability of their management practices, this research examines one factor, the influence of their own data. Farmers can engage with data on multiple levels. Some information is personalized such as farm soil tests, billing records and farm assessments while some data is more general such as best management practices and newsletter articles. My thesis is that the level of
personalization and engagement of the data will improve the accuracy of measurement of their farms’ management strategies as determined by the subjective RISE assessment which will in turn shape how farmers perceive their overall sustainability and ultimately guide their decision making on intent to change management practices for improved sustainability. This research examined how well farmers know the strengths and weaknesses of their management practices in terms of sustainability and explored how accessing information affected their intent to change management practices. I support this thesis in subsequent chapters with research that compares farmers’ overall assessment of the sustainability of their practices with objective measures of the sustainability of their practices, through comparing results from the RISE evaluation and a mail survey that I developed based on both RISE and readily available NRCS data. The correspondence between the subjective and objective measures can differ depending on consultation and examination of the underlying data. I further show differences in the farmers’ intent to change their practices as a function of distance to information, how well their current practices contribute to their sustainability, either according to them or in an objective index, and the existence of barriers to change.
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Chapter 2: Comparing the Pretest to RISE: How well did the pretest represent the more time intensive RISE assessment?

To gain insight into how farmers are managing their operations two options are most common, self-reporting and third-party interview. Self-reporting, where the farmers complete a questionnaire to the best of their abilities and return it for feedback, is the approach used by the major diary assessment tools in the US such as the Innovation Center for US Dairy’s Stewardship and Sustainability Framework (ICUSD, 2017), and Unilever’s/Ben and Jerry’s Caring Dairy (van Calker, 2005). The challenge with self-reporting tools is there is no opportunity for clarification. If a farmer misunderstands what a question is asking then their response will lack accuracy. If they respond more out of how they think instead of what management practices indicate, or they respond based on how they know they should be managing versus how they actually are managing, then their scores or feedback will be inflated. An example of should versus are is fencing cows out of the stream. When asking farmers if they allow their cows access to surface water they may be tempted to say no or minimize the extent of the cows’ access because they are aware that cows in streams create water quality issues. This unrepresentative response would likely indicate better management for water quality than what is actually transpiring on the farm. Self-reporting does not include a farm tour that would confirm if cows were fenced out of the stream. The benefit however of a self-
assessment tool is they are designed to be quick and easy. If farmers are expected to complete a written survey studies show the survey needs to be brief and easy to understand (Pennings et al, 2002; Pennings et al, 1999; Buse, 1973). This brevity and ease of answer provides a challenge when a comprehensive assessment is the goal.

RISE, Response Inducing Sustainability Evaluation, was chosen as the assessment tool to explore intent to change management practices for increased sustainability on organic dairy farms in Ohio. This tool was chosen for several reasons: 1) it evaluates sustainability at the farm level; 2) it measures all three realms of sustainability – environmental, social and economic; 3) it has the flexibility to address organic dairy production in the United States; and 4) it collects data based on interviews and farm tours. RISE has been used on over 3,300 farms around the world (HAFL, 2017), and has been established as a preferred tool by farmers due in part to the agreement farmers have between what the tool measures and what is important to their operations (de Olde et al, 2016).

RISE is an indicator-based tool that comprehensively measures performance at the farm-level. The goal of a RISE assessment is to provide farmers with the necessary tools for developing long-term management plans that will increase their sustainability (Grenz, et al, 2016). Data is gathered in a RISE assessment by trained RISE interviewers through in-person interviews with farmers and brief farm tours. The one-on-one interview process allows for discussion and clarification of the data so that what is reported is accurate. Accuracy is paramount to the process, as the feedback provided to farmers is based entirely on their management data, not on how the farmers think they are doing.
In contrast to self-assessment tools, RISE is not quick or easy but the time spent gathering detailed information on all aspects of the farm’s operations provides a more comprehensive feedback report upon which farmers can make more informed decisions regarding management changes. To complete a RISE assessment farmers are asked to consult their records and not provide responses based on general thoughts or conjecture.

There are benefits to both types of information collection thus self-reporting and in-depth interviews were used in this research. The self-reporting mechanism was used to capture the farmers’ initial views of their sustainability and to collect information on the degree to which they were employing management practices recognized under NRCS EQIP (Natural Resources Conservation Service, Environmental Quality Incentives Program) for cost-sharing and the RISE assessment. This initial self-reporting survey will be referred to as the “pretest.” Once the pretest was completed some farmers were asked to participate in a full RISE assessment. The combination of the two assessments provides the basis for exploring the larger question of the relationship between farmers and farm data and/or best management practices recommendations to discover how this data guides their management decisions and ultimately their intent to change management practices for improved sustainability. To address this question in part the RISE assessment tool was compared with a simplified, mailed, self-reporting pretest survey which served to gauge how farmers self-reported their management practices before any interactions with information based on their assigned treatment. It is assumed that farmers did not consult data sources when completing the pretest, instead they provided their “best estimates.” This assumption is based on conversations with farmers.
during the RISE assessment where they shared there quick and easy approach to completing the pretest.

For the research reported in this chapter a comparison was made between the indices, which will be referred to as “pretest indices”, constructed from a series of responses on management practices on the self-reported pretest, and the indices calculated from indicators related to management practices gathered in the RISE assessment, which will be referred to as “RISE indices.” The series of management practices that comprise the indices on both the pretest and in RISE represent an overall theme. There are nine themes that are explored in this work. A goal of the pretest was to identify management practices that mirrored the type of information collected in the RISE assessment so that intent to change management practices could be evaluated based on the treatment in which farmers participated. The establishment of cohesion between what was measured on the pretest/posttest and what is measured in RISE provides the foundation for supporting further exploration into intent to change.

Methods

The model system – Why study organic dairy in Ohio?

In 2009 USDA’s Economic Research Service (ERS) published a report on organic dairy production in the US in which it noted that organic milk production has been one of the fastest growing sectors within the organic industry (McBride and Greene, 2009). To better categorize dairy production, this study divided the US into four main production regions: the Northeast (Maine, Vermont, New York and Pennsylvania), Corn Belt (Ohio, Indiana, Illinois, Iowa and Missouri), Upper Midwest (Michigan, Wisconsin and
Minnesota) and the West (Washington, Oregon, Idaho and California). The West region had the largest herds with over 80% of the farms having more than 100 cows. The Northeast was the opposite with 97% of farms having less than 100 cows. The Upper Midwest and the Corn Belt represent average herd sizes for the industry. The Northeast has 44% of the farms but houses only 29% of the total organic cows – this translates to many, but small farms with an average herd size of 52 cows. The West has 7% of the total organic dairies but has nearly one-third of all the cows – meaning few but large dairies with an average herd size of 381 cows. The Upper Midwest and the Corn Belt are more even in terms of number of farms and number of cows. The Corn Belt, although the smallest percentage of farms and cows, 7% of each, represents the average organic dairy farm in the country. Average herd size in the Corn Belt is 75 cows, which is slightly larger than the Upper Midwest’s 64. In addition to being average in size, farms in the Corn Belt are diversified in terms of production. Most farms produce both cereals and grasses (McBride and Green, 2009) which provided the opportunity to study a wider range of management practices. For this reason, studying farms in the Corn Belt provided an opportunity to collect data not from the largest or smallest contributors, but from the industry’s most average sized and relatively diversified farms (Figure 2.1).
Ohio presented the opportunity to gather information from both Amish and non-Amish operations. Ohio is home to the nation’s largest overall Amish population which was estimated at nearly 72,500 in 2016 (YCAPS, 2016). Ohio saw the second largest increase in Amish populations in the country, with only Pennsylvania growing at a slightly larger rate (YCAPS, 2016). Holmes County, OH is home to the largest Amish population in the US (Lowery and Nobel, 2000). Amish have a strong history of dairy production in Ohio (Cross, 2006) and make up more than 25% of all the dairies in the state (Brock and Barham, 2009). Organic Valley (CROPP Cooperative), the country’s largest farmer-owned organic cooperative, has 188 member dairies in Ohio. The cooperative is comprised of 45% Amish and Mennonite members (Brandl, 2016). Not all Amish farm organically, many adopted conventional practices such as chemical fertilizer and pesticide application in the mid-1900s (Mariola and McConnell, 2013; Blake et al 1997), so it is difficult to generalize among this diverse population. “The
Amish motivations to farm, and their management decisions, are deeply linked to their own cultural and spiritual identity, as well as their ecological and economic viability on the land.” (Brock and Barham, 2015 p. 236). How these values are defined greatly depends on the community. The Amish farmers who participated in this research shared their desire to operate their farms with minimal inputs, thus, they found organic requirements to be in line with their current practices. Taking the step to certify their operations helped to ensure a higher pay price without having to significantly alter their production methods (conversations with participating farmers in 2016). In summary, Ohio organic dairies were chosen as the focus for this study because they are average in size, are part of diversified production systems that allow for data capture on a wider variety of management strategies, and represent both Amish and non-Amish farmers which further broadens the diversity of management strategies.

Research participants

All certified organic operations in the United States (US) must submit their certification paperwork annually to the United States Department of Agriculture’s National Organic Program (USDA’s NOP). This information is public record; therefore, the database can be accessed to identify certified organic agriculture operations across the US and beyond. The data was published on USDA’s Agricultural Marketing Service’s (AMS) website (https://organic.ams.usda.gov/Integrity/). To narrow the field to my target audience I used the following search criteria: certified organic, Ohio, and dairy/cows/milk. The search yielded 235 certified organic dairies in Ohio. Each of these dairies received a written invitation to participate in the research and a pretest survey.
The goal was to have a 25% response rate, although the actual response rate, 11% or 26 farms, was much lower than the stated goal.

The pretest captured demographic data from all respondents. The following is a breakdown of the participants in this research. Of the seventeen farmers who completed the entire research project, fifteen rented acreage in addition to owning farmland. Twelve farms were larger than 100 acres in terms of owned acreage while only four farms rented more than 100 acres. The length of time that farmers had owned their acreage varied: five farmers owned their farms for over 50 years, two owned between 25 and 50 years, and of the remaining farms the majority had owned their land for between six and ten years. The majority of the farmers who rented land (6) had been renting for between six and ten years, followed by four farmers who had rented for between 16 and 25 years. No farmer indicated that they had rented land for longer than 25 years. Nine farmers were certified organic for between six and ten years followed by six who had been certified organic for less than five years. There was one long-term organic farmer who had been certified for more than 15 years. The herd size of the farms was varied. Five farms had a herd size of less than 30 milking cows, two were milking between 31 and 50, and there were four farmers in each of the next two categories milking between 51 and 75, and 76 and 100. One farm was milking between 101 and 125 cows and one farm milked more than 150 cows. The farms were diversified in terms of location as well, representing thirteen different counties.

**Overview of research tool**

As noted, RISE is an indicator-based tool that captures data on farm management through interviews and farm tours. Once the assessment is complete the data collected is
compared against benchmark data and then normalized. Optimal performance is 100 and extreme need for improvement equates to 0. A score is calculated for each indicator which is then averaged to generate a theme score. (For information on the indicators associated with each theme and further details on RISE, see Table 1.3 in the Introduction and pages 23 – 29 and Figure 2.3).

Study design and data collection

This research followed a pretest/posttest study design, with three phases: the initial survey (pretest); RISE sustainability assessments administered at the farm; and a final survey (posttest). Data from the first two phases are reported in this chapter. To gather data in the first phase (pretest) a survey was administered that captured demographic data, current view of the sustainability of operations and a baseline for the current practices farmers are employing on their farms (See Appendix C for the pretest). The introduction to the pretest survey defined sustainable agriculture as an agriculture that:

- meets the population’s demand for high-quality food and agriculture-based raw materials
- does not degrade resources
- respects high standards for animal welfare, biodiversity and ecosystem quality
- provides attractive working conditions and a high quality of life
- is economically viable (Grenz, 2015)

Section III, Current Management Practices, asked “To what degree do you currently employ these management practices on your farm?” The majority of the questions were on a scale of 0 – 100 scale (Figure 2.2); however, some questions simply required a binary response of yes or no. The mean of the responses to the scale questions was used to calculate pretest indices scores for each theme. The management practices
chosen for this section were based on RISE indicators as well as practices that are recognized under NRCS EQIP (Natural Resources Conservation Service, Environmental Quality Incentives Program) for cost-sharing.

![Figure 2.2 Example pretest indices question and rating scale](image)

The calculation of indicator scores in RISE is achieved through a complex consolidation of questions asked throughout the in-depth interview. It is nearly impossible to state the number of interview questions in RISE as the questionnaire changes depending on what management practices are being employed and what is being produced. Many responses are used in the calculation of more than one indicator. The pretest took a more simplistic approach with the selected management practices only targeting one theme. A goal of the pretest was to gather data on the level to which farmers have employed practices that are generally accepted as sustainable, otherwise known as BMPs (Best Management Practices). The pretest was not intended to be on par with the depth of a RISE evaluation; however, it was intended to provide similar measurement. In addition to the pretest indices mirroring RISE, it also mirrored practices that have been identified by the US federal government as practices that are
protective of natural resources and economic and social well-being (Figure 2.3).

Although RISE is the template for which measurement on the pretest and posttest is based, it was important to represent management practices that were supported by local and federal agencies as this allowed for not only sharing information regarding improved sustainability of operations but also provided an opportunity to share available cost sharing practices for which the farmers could apply. When discussing implementation of new practices with farmers who participated in the RISE treatment groups, providing information on the opportunities for cost savings was generally well received.

The EQIP program administered by NRCS is “a voluntary conservation program that helps agricultural producers protect the environment while promoting agricultural production. With EQIP, NRCS conservationist experts provide both technical and financial assistance to implement environmentally beneficial conservation practices on working agricultural land.” (NRCS, 2017). The EQIP program was established as part of the 1996 Farm Bill to promote agricultural production, forestry management and environmental quality while enhancing environmental benefits (Stubbs, 2010). EQIP is administered by NRCS who in turn are responsible for establishing the national priorities which the program aims to address. Currently these priorities are:

1. Reduction of nonpoint source pollution, such as nutrients, sediment, pesticides, or excess salinity in impaired watersheds consistent with total maximum daily loads (TMDL) were available; the reduction of surface and groundwater contamination; and the reduction of contamination from agricultural sources, such as animal feeding operations
2. Conservation of ground and surface water resources
3. Reduction of emissions that contribute to air quality impairment violations of National Ambient Air Quality Standards
4. Reduction in soil erosion and sedimentation from unacceptable levels on agricultural land
5. Promotion of at-risk species habitat conservation including development and improvement of wildlife habitat
6. Energy conservation to help save fuel, improve efficiency of water use, maintain production, and protect soil and water resources by more efficiently using fertilizers and pesticides and

In addition to the national priorities each state can also identify priorities. Ohio has identified the follow priorities that should also be addressed by EQIP funding:

1. Air Quality: Access control, farmstead energy improvement, pumping plants, and roof and covers
2. Degraded Plant Condition: brush management, fence, prescribed grazing, forage and biomass
3. Excess Water: Irrigation pipeline, micro-irrigation, irrigation water management, and subsurface drains
4. Inadequate Habitat for Fish and Wildlife: Tree/shrub establishment, upland wildlife habitat management, vegetative barrier, and windbreak shelterbelt renovation
5. Inefficient Energy Use: Building envelope improvement, farmstead energy improvement, grassed waterway, and underground outlet
6. Insufficient Water: Pond, reside management, no-till, seasonal high tunnel system from crops, and structures for water control
7. Livestock Production Limitation: Feed management, forage harvest management, water well, and watering facility
8. Soil Erosion: Conservation cover, conservation crop rotation, cover crop, and forest stand improvement
9. Soil Quality Degradation: Access road, animal mortality facility, heavy use area protection, and mulching
10. Water Quality Degradation: Constructed wetland, riparian forest buffer, riparian herbaceous buffer, windbreak shelterbelt (NRCS, 2017)

EQIP is a competitive cost-sharing program that requires farmers to submit applications to receive assistance. State Technical Committees compile the list of eligible practices and resource concerns, set payment rates and limits and develop the
state scoring criteria for applications. Once the framework is established the Local Work Group reviews the scoring criteria to ensure it meets with not only state priorities but also local, county level needs. This two-tiered framework, in theory, ensures that the projects selected will provide the greatest environmental benefit and thus the highest benefit to the public good (NRCS, 2017). An on-going challenge the program faces is the increasing number of unfunded applications due to budget constraints (Stubbs, 2010). While the application rate is encouraging, as it indicates farmers are eager to implement more sustainable management practices, the inability to respond to these requests may result in the loss of interest in improvement and thus farmers continuing their less than optimal management practices.

The national and state priorities identified in EQIP reflect many of the same priorities that are identified in RISE. RISE was developed in Switzerland and although it is designed to be used around the world, there are aspects that could be more representative of European agriculture than US agriculture. While the priorities appear to be in alignment, the actual management practices that are identified as a means of achieving these priorities need further investigation. The comparison between what is measured in RISE and what the US government values in terms of willingness to provide funding is an interesting exercise that, should the two align, will further support both RISE as an internationally flexible tool and confirmation from an international perspective that NRCS is supporting practices that should lead to improved sustainability. Figure 2.3 provides a breakdown of the themes and indicators used in RISE and how they compare with the management practices used as indicators of RISE themes on the pretest.
Figure 2.3 Overview of RISE indicators and pretest/posttest indices for each theme
Figure 2.3 Continued
Figure 2.3 Continued
Statistical Analysis

The responses from the pretest were used to calculate the mean of each farmer’s responses for each theme index. The same was done for the index scores generated by the RISE assessment so that means for the farmer’s pretest indices and RISE indices could be compared. The data were analyzed using a paired samples t-test where the farmer’s pretest index scores were paired with their RISE index scores for each theme with $\alpha = .05$ (IBM SPSS, 2016). Normality in the data was examined using the Shapiro-Wilk test ($\alpha = .05$) (Razali and Wah, 2011; Shapiro and Wilk, 1965) before the t-test was completed. All variables were not significantly different from normally distributed with the exceptions of the pretest index score for energy and climate ($p = .007$) and the RISE indices of soil use ($p = .036$) and animal husbandry ($p = .01$). In addition to running the Shapiro-Wilk test, the assumption of normality is considered satisfied if the estimated levels of skewness and kurtosis are between $\pm 2$ (Gravetter and Wallnau, 2016; Doane and Seward, 2011; Field, 2009, 2000; Trochim and Donnelly, 2006; Cramer and Howitt, 2004; Cramer, 1998). To check skewness and kurtosis, z-values were calculated and all variables met criteria for normality except the pretest index score for energy and climate (skewness: 2.13), and RISE evaluation indices for soil use (skewness: -2.13) and animal husbandry (skewness: -2.20). Historically, t-tests were assumed to require normality in the data (Field, 2000) however, many are challenging that requirement (Weaver, 2011). In Field’s third edition (2009) normality is not included as a requirement for t-tests. Furthermore, given the small sample size, tests for normality have relatively low power. Therefore, I proceeded with the t-tests without transforming the data. Histograms were generated to represent the results for each theme.
To further interpret the results, Cohen’s d was calculated. Cohen’s d, also known as effect size, indicates the magnitude of the difference in means between the sample before the treatment and after the treatment. Cohen (1988) suggested benchmarks for t-test effect sizes as small effects ($d = 0.2$), medium effects ($d = 0.5$) and large effects ($d = 0.8$). These values are not rigid but suggested benchmarks (Thompson, 2007), to be used when there are no comparable findings in literature (Cohen, 1988), which is true for this research. Post hoc power analysis was also calculated using G*Power (Erdfelder et al., 1996) based on the calculated Cohen’s d, sample size of 12 and $\alpha = .05$.

**Results**

The null hypothesis was no difference between the pretest indices and the RISE indices ($H_0$: pretest indices by theme = RISE indices by theme) (Table 2.1, Figure 2.4). Therefore, a paired samples t-test was conducted to compare pretest index and RISE index scores for each theme (Table 2.1). The null hypothesis of equal pretest and RISE indices could not be rejected for material use and environmental protection, water use, biodiversity and working conditions, however, it was rejected for soil use, animal husbandry, energy and climate and quality of life (Table 2.1). As expected, effect sizes were small when the themes were not significant, however for the themes where the null hypothesis was rejected, the effect size was large (Table 2.1). Power analysis results indicate a relatively high probability of a type II error as power is low for the themes where the null hypothesis was not rejected (Table 2.1). Animal husbandry was the one theme where the average difference between pretest and RISE indices was small, yet significant.
Table 2.1 Paired samples t-test results for pretest indices vs. RISE indices by theme

<table>
<thead>
<tr>
<th>Pretest Indices vs. RISE Indices</th>
<th>Paired Differences</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Std. Deviation</td>
</tr>
<tr>
<td>Soil Use</td>
<td>27.41</td>
<td>24.78</td>
</tr>
<tr>
<td>Animal Husbandry</td>
<td>5.64</td>
<td>4.87</td>
</tr>
<tr>
<td>Materials Use &amp; Environmental Protection</td>
<td>4.79</td>
<td>17.22</td>
</tr>
<tr>
<td>Water Use</td>
<td>-1.89</td>
<td>19.35</td>
</tr>
<tr>
<td>Energy &amp; Climate</td>
<td>39.06</td>
<td>24.92</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>8.58</td>
<td>30.26</td>
</tr>
<tr>
<td>Working Conditions</td>
<td>-4.04</td>
<td>17.71</td>
</tr>
<tr>
<td>Quality of Life</td>
<td>13.28</td>
<td>17.21</td>
</tr>
</tbody>
</table>

For the themes with a significant difference between pretest indices and RISE indices: soil use, animal husbandry, energy and climate and quality of life, the mean of the farmers’ RISE scores were always higher than their pretest index scores as evident from the histograms in Figure 2.4.
Figure 2.4 Pretest indices vs. RISE indices comparison
Discussion

A goal of this research is to understand if farmers are provided personalized, on-farm evaluation of their operations, are they more likely to express intent to change management practices in the areas where they lacked or did not engage with the information. For intent to change to relate to the information gained from either the reading materials or the RISE assessment all materials must adequately address the same topics. For this research, all information was based on the RISE framework; therefore, the measurement of intent to change had to parallel RISE. To calculate intent to change, the farmers’ pretest responses were compared to their posttest responses (described in chapter 4). If the pretest does not mirror RISE, then it may not provide an adequate basis for measuring the influence of RISE on intent to change.

Although the pretest and RISE indices were compared in t-tests, with a null hypothesis of no difference in the means, the criteria for equivalence between the two that emerged after reviewing the results was an average difference of less than ten points between the two indices. The average differences for most themes were less than ten points, including animal husbandry, material use and environmental protection, water use, biodiversity and working conditions. These were also the themes for which the differences between pretest and RISE indices were not statistically significant, except for animal husbandry (Table 2.1, Figure 2.4). Although statistically significant, the difference for animal husbandry was in the same range as the difference for other variables that were not statistically significant, thus I concluded that the measurements on the pretest were an adequate measure of RISE for this theme as well. Although the chosen criterion of less than 10 points difference was somewhat arbitrary and power, i.e.
avoiding a type II error, is of greater concern than size in this analysis, power analysis indicated that a much larger sample size would have been required to detect statistically significant differences in this range. Depending on the theme, the range of the sample size needed to detect statistically significant differences of the size observed was 71 to 620 farmer surveys (Erdfelder et al, 1996). These sample sizes are well beyond what could be achieved in this study. Furthermore an average difference of 10 points is small when the variation within each of the indices is considered. Statistically significant average differences between the two indices were found for soil use, energy and climate and quality of life, and in each of these cases the mean difference between indices was more than 10 points, therefore, the pretest was not a good representation of RISE for these themes.

The soil use index was more than twenty-five points lower than the RISE index (Figure 2.4). This indicates that the management practices in the pretest under-represented soil quality as it was measured according to the RISE evaluation. The lack of alignment could be due to the simplification of the data collected via the pretest compared with similar but more detailed data collected via RISE. An inspection of the RISE questionnaire (See Appendix A) indicates that the pretest measurement was narrower in its scope than RISE for soil use. In particular the pretest focused primarily on tillage and soil cover whereas the RISE assessment also included soil organic matter, soil pH, crop productivity and detailed information regarding soil erosion and compaction that would be related to tillage and soil cover.

The pretest index for energy and climate was nearly 35 points lower than the RISE mean index for this theme (Table 2.1, Figure 2.4). RISE has a strong focus on
reducing the dependence on non-renewable energy sources which is a cornerstone for the measurement of the energy and climate index. The cost-sharing program at NRCS does not focus on encouraging farmers to reduce fossil fuel use at an equivalent depth instead the focus is on energy efficiency measures. NRCS provides cost sharing on improved ventilation, refrigeration, and heating and cooling as well as installation of variable speed drives. The pretest was a combination of both what NRCS incentivizes as well as what RISE measures, however the combination of management practices does not appear to adequately capture the appropriate data for this theme.

The statistically significant differences between the pretest and RISE indices for the theme quality of life is perplexing. The questions on the pretest were nearly identical to the questions on RISE as NRCS EQIP does not address practices that would improve quality of life. The difference in indices in this case may have been inherent in the difference between self-reporting and interview. Questions regarding quality of life are highly personal and may have been difficult for farmers to answer honestly. Farmers reported higher quality of life scores when being interviewed for RISE than when self-reporting, a possible indication of embarrassment or reluctance to share hardships openly.

A challenge in capturing data for a complex system is that the data is often not represented in only one theme. For example, questions on adequate ventilation could reflect animal husbandry management, energy and climate and working conditions. During the development of the pretest I made judgement calls on where to align NRCS practices as the pretest was not designed to have responses represented in multiple themes. The lack of consistency between RISE and the pretest may be due in part to the organization of the management practices on the pretest. I chose to place questions on
ventilation and heating and cooling in energy and climate as they captured data on energy consumption, however, these practices could have also been placed in animal husbandry as they indicate the quality of living conditions for the animals or in working conditions as they indicate the quality of working conditions for the farmers.

Conclusion

The comparison between the pretest indices and the RISE indices indicated that the questions about extent of management practices used on the pretest generally were a good representation of what is measured in RISE for all themes except for soil use and energy and climate. Furthermore, the comparison between RISE measurements and EQIP cost-sharing incentives was similar for most themes. This analysis suggests good alignment between management practices that support sustainable agriculture in the US and Europe.

The differences between the pretest indices and RISE indices for soil use and energy and climate pose a challenge for measuring intent to change management practices, because the pretest indices were not equivalent to the RISE indices for these themes. My research explores intent to change management practices based on farmers’ engagement with both personalized farm data and more general farm management information. To adequately measure the impact of this engagement the pretest had be in alignment with the materials that were shared and discussed. If the pretest measurement was too narrow or didn’t align then the farmers didn’t have the opportunity to express their full intent to change based on engagement with data. Due to this, intent to change results should not be considered in the final analysis for these themes. However, for
quality of life, the perplexing results and the correlation with RISE indicates that intent to change results should be considered for this theme.
References


Chapter 3: How well does a Farmers’ Overall Evaluation of their Farms’ Sustainability Reflect their Management Practices?

Farmers are often considered to be stewards of the land. Organic farmers frequently describe their management as in harmony with nature. What leads farmers to think of themselves in terms of sustainable managers of natural resources? In 1991 and 1992 Rodale Institute hosted a series of workshops aimed at training farmers in sustainable agricultural practices. The participants were surveyed to gain an understanding of their attitudes and the practices they employ that lead them to self-identify as sustainable farmers. Five hundred and forty-three farmers completed the survey, 447 farmers (82%) self-identified as sustainable (Hanson et al., 1996). The survey highlighted practices such as reducing the amount of inorganic fertilizers and increasing the use of animal and green manure, reducing herbicide use and increasing soil tillage, cover crops and crop rotations and increased diversification (Hanson et al., 1996). On average 70% of the farmers indicated that they were employing these practices (Hanson et al., 1996). When asked what hinders farmers in your community from adopting sustainable agriculture practices the most noted were lack of information, perceived lower yields and increased management. The results of the limited Rodale survey indicate that farmers had a strong definition of what it means to farm sustainably
and further identified themselves as sustainable farmers based on the management practices they employed.

The question of how specific management practices influence farmers’ perceptions of their sustainability is examined in this chapter. Like the Rodale surveys in the 90’s, this research starts with asking farmers to identify how sustainable they believe their practices to be in general and then asks farmers to report on the management practices they are employing that are related to sustainability. To further build on previous research this study examines farmers’ perceptions of their sustainability by exploring how engaging with data at different levels, from personalized farm data to more general best management practice data, will shape their perceptions of their sustainability and ultimately guide their decision making on intent to change management practices for improved sustainability. An example of close data is information that is personalized to the farm such as soil tests, billing records and results from farm assessments, this data is derived directly from their farms and thus provides them with information that supports or refutes the perceptions of their sustainable management. An example of distant data is information that is not personalized, it is directed at a more general audience such as best management practices, technical bulletins and industry newsletters. Although this data provides valuable information to farmers, the greater level of abstraction may make it less effective in shaping their perception of their own sustainability.

For the research reported in this chapter, two comparisons have been conducted. The first is a comparison based on the information provided by farmers on the pretest which consisted of first asking for the farmers’ overall judgement of their sustainability
along ten social, economic or environmental themes and then asked about individual practices the farmers were employing to generate a more objective index for each theme. For this comparison, the initial overall judgement will be referred to as “pretest theme,” and the individual practices will be referred to as “pretest indices.” Comparing the farmers’ responses on the two sections of the pretest was conducted to determine how well farmers’ management practices support their overall view of their sustainability. This comparison will test the hypothesis that if farmers view their overall sustainability as high, for example in soil management, then they should be employing practices that are generally accepted as promoting healthy soils.

The second comparison is based on the information collected on both the pretest and the RISE evaluation. I used RISE to collect information from farmers through an interview to gain insight into their management practices (for more information on RISE see chapter 1 and Appendices A and B). The pretest themes mirror the RISE themes thus this comparison will test how well the farmers’ views of their overall sustainability are reflected in the indices calculate from the detailed data collected for RISE. For this comparison, the pretest responses will be referred to as “pretest theme,” and the RISE indices will be referred to as the “RISE index.” Farmers receive a tremendous amount of information throughout their work. For example, for a farmer to provide a pretest theme score for Energy and Climate one thing they must consider is their consumption rates for all energy sources. If they know their usage, they may provide an overall pretest theme score that is equal to the objectively calculated score based on data for multiple indicators provided by the RISE evaluation. However, if they are not familiar with their consumption rates they will need to estimate which could result in greater variation and
differences from objective data-based scores. They can increase the accuracy of their response by consulting their records. The difference in their pretest theme score and their RISE index score will depend on how well they estimated unknown information and on whether they consulted reliable data.

Methods

The model system – Why study organic dairy in Ohio?

In 2009 USDA’s Economic Research Service (ERS) published a report on organic dairy production in the US in which it evaluated dairy statistics on a regional basis (Table 3.1). The Corn Belt, although the smallest percentage of farms and cows, 7% of each, represents the average organic dairy farm in the country. In addition to being average in size, farms in the Corn Belt are diversified in terms of production. Most farms produce both cereals and grasses (McBride and Green, 2009) which provided the opportunity to study a wider range of management practices.

<table>
<thead>
<tr>
<th>Region</th>
<th>States</th>
<th>Organic Dairies</th>
<th>Organic Cows</th>
<th>Average Herd Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northeast</td>
<td>Maine, Vermont, New York and Pennsylvania</td>
<td>44%</td>
<td>29%</td>
<td>52 cows</td>
</tr>
<tr>
<td>Corn Belt</td>
<td>Ohio, Indiana, Illinois, Iowa and Missouri</td>
<td>7%</td>
<td>7%</td>
<td>75 cows</td>
</tr>
<tr>
<td>Upper Midwest</td>
<td>Michigan, Wisconsin and Minnesota</td>
<td>42%</td>
<td>33%</td>
<td>64 cows</td>
</tr>
<tr>
<td>West</td>
<td>Washington, Oregon, Idaho and California</td>
<td>7%</td>
<td>31%</td>
<td>381 cows</td>
</tr>
</tbody>
</table>
Ohio presented the opportunity to gather information from both Amish and non-Amish operations. Amish have a strong history of dairy production in Ohio (Cross, 2006) and make up more than 25% of all the dairies in the state (Brock and Barham, 2009). Organic Valley (CROPP Cooperative), the country’s largest farmer-owned organic cooperative, has 188 member dairies in Ohio. The cooperative is comprised of 45% Amish and Mennonite members (Brandl, 2016) (For more information on organic dairy and Amish in Ohio see chapter 2 pages 52 – 54).

Research participants

The United States Department of Agriculture’s National Organic Program publishes a database of all certified organic producers in the US. To identify the organic dairies in Ohio I searched this database and yielded 235 certified organic dairies in Ohio. Each of these dairies received a written invitation to participate in the research and a pretest survey. Twenty-six farms returned the pretest, however only seventeen completed the full project (See chapter 2 for more details on the research participants demographic data, page 54).

Overview of the research tool

As noted in previous chapters, RISE is an indicator-based tool that captures data on farm management through interviews and farm tours. Once the assessment is complete the data collected is compared against benchmark data and then normalized. Optimal performance is 100 and extreme need for improvement equates to 0. A score is calculated for each indicator which is then averaged to generate a theme score. (For
information on the indicators associated with each theme and further details on RISE, see Table 1.3 in the Introduction and pages 23 – 29 and Figure 2.3).

Study design and data collection

To gather data for this research a pretest survey was administered (See Appendix C for the pretest). The survey focused on two areas: 1) the farmers’ overall view of their sustainability and 2) the degree to which farmers have implemented certain management practices. The survey was designed to capture both the farmers’ high level, view of their sustainability and the management practices employed on their farms.

Section II, Farm’s Overall Sustainability, asked the respondents “How would you rate your farm’s overall sustainability in the following areas?”. The following areas corresponded to the ten themes in the RISE assessment. Each theme was defined to minimize confusion on what they were asked to rate (Figure 3.1). The definition provided was based on the indicators that comprise the theme in RISE. Responses were on a scale of 0 – 100 and provided a measure of the farmers’ overall assessment of the sustainability of their practices for each theme.

<table>
<thead>
<tr>
<th>Soil Use</th>
<th>0</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
<th>80</th>
<th>90</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>This is defined by soil management, crop productivity, soil organic matter supply, soil reaction, soil pollution, soil erosion and soil compaction</td>
<td>Weak/Needs Improvement</td>
<td>Strong/Highly Sustainable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 3.1 Example of pretest theme description and rating scale
Section III, Current Management Practices, asked “To what degree do you currently employ these management practices on your farm?” The majority of the questions were on the same 0 – 100 scale; however, some questions simply required a binary response of yes or no. The mean of the responses to the scale questions was used to calculate pretest indices scores for each theme. The management practices chosen for this section were based on RISE indicators as well as practices that are recognized under NRCS EQIP (Natural Resources Conservation Service, Environmental Quality Incentives Program) for cost-sharing (See chapter 2, Figure 2.4 on page 63 for more details on the RISE and NRCS comparisons).

Analysis

The responses from the pretest were used to calculate the mean of farmers’ responses for each theme and for each index. The same was done for the theme scores generated by the RISE assessment so that means for the farmer’s pretest theme score and RISE index score could be compared.

The data were analyzed by paired samples t-tests where the farmer’s pretest theme scores were paired with their pretest index scores for each theme and the farmer’s pretest theme scores were paired with their RISE index scores for each theme with $\alpha = .05$ (IBM SPSS, 2016). Normality in the data was examined using the Shapiro Wilk test ($\alpha = 0.05$) (Razali and Wah, 2011; Shapiro and Wilk, 1965) before the t-test was completed. All variables were not significantly different from normally distributed with the exceptions of pretest theme scores for water use ($p = 0.004$), quality of life ($p = 0.003$) and economic viability ($p = 0.006$), the pretest index score for energy and climate ($p = 0.007$) and the
RISE index scores for soil use ($p = 0.036$) and animal husbandry ($p = 0.010$). In addition to running the Shapiro Wilk test, the assumption of normality is considered satisfied if the estimated levels of skewness and kurtosis are between ±2 (Gravetter and Wallnau, 2016; Doane and Seward, 2011; Field, 2009, 2000; Trochim and Donnelly, 2006; Cramer and Howitt, 2004; Cramer, 1998). To check skewness and kurtosis, z-values were calculated and all variables met criteria for normality except quality of life pretest theme (skewness: -2.781), economic viability pretest theme (skewness: -2.047), energy and climate pretest index (skewness: 2.129), and RISE index evaluation for soil use (skewness: -2.127) and animal husbandry (skewness: -2.204). Historically, t-tests were assumed to require normality in the data (Field, 2000) however, many are challenging that requirement (Weaver, 2011). In Field’s third edition (2009) normality is not included as a requirement for t-tests. Furthermore, given the small sample size, tests for normality have relatively low power. Therefore, I proceeded with the t-tests without transforming the data. Histograms were generated to represent the results for each theme and indices.

To further interpret the results, Cohen’s $d$ was calculated. Cohen’s $d$, also known as effect size, indicates the magnitude of the difference in means between the sample before the treatment and after the treatment. Cohen (1988) suggested benchmarks for t-test effect sizes as small effects ($d = 0.2$), medium effects ($d = 0.5$) and large effects ($d = 0.8$). These values are not rigid but suggested benchmarks (Thompson, 2007), to be used when there are no comparable findings in literature (Cohen, 1988), which is true for this research.
Results

My first null hypothesis was no difference between how farmers score themselves in the overall pretest themes and the pretest indices, both of which were designed to measure sustainable management practices but based on data regarding these practices in the case of the indices (H₀: pretest theme scores = pretest index scores, Table 3.2 & 3.3, Figure 3.2). Paired samples t-test results are provided in Table 3.3. The null hypothesis could not be rejected for working conditions, however it was rejected for all of the other themes: soil use, animal husbandry, material use and environmental protection, water use, energy and climate, biodiversity, and quality of life. As expected, the difference between overall theme score and pretest index was small for working conditions, however, it was larger for all other themes and largest for energy and climate and biodiversity.

Table 3.2 Mean and standard deviation for pretest themes, pretest indices and RISE indices scores

<table>
<thead>
<tr>
<th>Theme</th>
<th>Pretest Theme Scores (N = 25)</th>
<th>Pretest Index Scores (N = 25)</th>
<th>RISE Index Scores (N = 12)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil Use</td>
<td>M = 71.00, SD = 15.51</td>
<td>M = 54.10, SD = 19.47</td>
<td>M = 78.92, SD = 8.98</td>
</tr>
<tr>
<td>Animal Husbandry</td>
<td>M = 75.12, SD = 11.38</td>
<td>M = 80.79, SD = 8.61</td>
<td>M = 89.25, SD = 4.52</td>
</tr>
<tr>
<td>Material Use and Environmental Protection</td>
<td>M = 70.96, SD = 13.72</td>
<td>M = 59.76, SD = 16.45</td>
<td>M = 64.17, SD = 12.26</td>
</tr>
<tr>
<td>Water Use</td>
<td>M = 78.79, SD = 14.68</td>
<td>M = 63.15, SD = 21.13</td>
<td>M = 66.08, SD = 6.13</td>
</tr>
<tr>
<td>Energy and Climate</td>
<td>M = 71.6, SD = 18.45</td>
<td>M = 18.90, SD = 19.09</td>
<td>M = 54.33, SD = 23.18</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>M = 78.00, SD = 12.45</td>
<td>M = 42.64, SD = 27.79</td>
<td>M = 56.75, SD = 13.86</td>
</tr>
<tr>
<td>Working Conditions</td>
<td>M = 72.84, SD = 18.44</td>
<td>M = 67.47, SD = 16.33</td>
<td>M = 59.25, SD = 6.20</td>
</tr>
<tr>
<td>Quality of Life</td>
<td>M = 77.23, SD = 19.92</td>
<td>M = 63.67, SD = 15.48</td>
<td>M = 80.58, SD = 7.66</td>
</tr>
<tr>
<td>Economic Viability</td>
<td>M = 71.50, SD = 18.84</td>
<td>M = 58.81, SD = 21.39</td>
<td>--</td>
</tr>
</tbody>
</table>
### Table 3.3 Paired samples t-test results for pretest theme vs. pretest indices scores

<table>
<thead>
<tr>
<th>Pretest Theme vs. Pretest Indices</th>
<th>Paired Differences</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Std. Deviation</td>
</tr>
<tr>
<td>Soil Use</td>
<td>16.76</td>
<td>25.86</td>
</tr>
<tr>
<td>Animal Husbandry</td>
<td>-5.52</td>
<td>10.34</td>
</tr>
<tr>
<td>Materials Use &amp; Environmental Protection</td>
<td>11.13</td>
<td>18.76</td>
</tr>
<tr>
<td>Water Use</td>
<td>12.57</td>
<td>25.34</td>
</tr>
<tr>
<td>Energy &amp; Climate</td>
<td>48.55</td>
<td>27.85</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>31.17</td>
<td>23.44</td>
</tr>
<tr>
<td>Working Conditions</td>
<td>5.28</td>
<td>18.18</td>
</tr>
<tr>
<td>Quality of Life</td>
<td>10.54</td>
<td>22.04</td>
</tr>
<tr>
<td>Economic Viability</td>
<td>12.69</td>
<td>17.34</td>
</tr>
</tbody>
</table>

For themes with a significant difference between pretest theme and pretest index: soil use, material use and environmental protection, water use, energy and climate, biodiversity, quality of life and economic viability, the farmers scored themselves significantly higher in their overall theme scores than their calculated index scores as evident from the histograms in Figure 3.2. The only theme in which farmers’ overall scores were lower on average than their index scores was animal husbandry.
Figure 3.2 Pretest theme vs. pretest index comparison
My second null hypothesis was no difference between farmers overall theme scores and RISE index scores for nine sustainability themes (H₀: Pretest theme scores = RISE index scores, Table 3.2 & 3.4, Figure 3.3), and paired samples t-test results to test this hypothesis for each theme are given in Table 3.4. The null hypothesis could not be rejected for soil use, material use and environmental protection, quality of life, and farm management, however it was rejected for animal husbandry, water use, energy and climate, biodiversity, and working conditions.

<table>
<thead>
<tr>
<th>Paired Differences</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
</tr>
<tr>
<td>Soil Use</td>
<td>-2.5</td>
</tr>
<tr>
<td>Animal Husbandry</td>
<td>-11.33</td>
</tr>
<tr>
<td>Material Use &amp; Environmental Protection</td>
<td>7.5</td>
</tr>
<tr>
<td>Water Use</td>
<td>15.46</td>
</tr>
<tr>
<td>Energy &amp; Climate</td>
<td>22.60</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>25.55</td>
</tr>
<tr>
<td>Working Condition</td>
<td>17.55</td>
</tr>
<tr>
<td>Quality of Life</td>
<td>1.83</td>
</tr>
<tr>
<td>Farm Management</td>
<td>-2.58</td>
</tr>
</tbody>
</table>

For themes with a significant difference between pretest theme and RISE index: water use, energy and climate, biodiversity, and working conditions, the farmers overall scores were significantly higher than their RISE indices as evident from the histograms in
Figure 3.2. This difference was very consistent among farms. The only theme where farmers scored themselves significantly lower than their RISE evaluation score is animal husbandry, although these differences varied more among farms with two farmers scoring themselves above the RISE score.
Figure 3.3 Pretest theme vs. RISE index
Discussion

The comparisons of pretest theme with RISE index and pretest theme with pretest index indicated that there are aspects of sustainability for which farmers’ pretest scores agree, and others for which the differences are statistically significant. During discussions with the farmers two main reasons for the differences surfaced: 1) there was confusion about the definition of the themes or a misunderstanding about what was being measured; and 2) farmers did not engage with available information that would have assisted them in providing more accurate responses. Although farmers were provided a definition for each theme, they still could have interpreted the definition differently and with less consideration of underlying data than RISE does. For example, the theme biodiversity was defined by plant protection management, ecological priority areas, intensity of agricultural production, landscape quality and diversity of agricultural production. Farmers may not have evaluated these concepts using the same criteria, scales and thresholds as RISE. They may have rated themselves high in biodiversity, for example, because they are farming organically and assume that biodiversity is high, without considering the concepts and multiple indicators used in the RISE evaluation. Even if all elements of the definition were understood, they could estimate, weight and combine them differently than RISE would when estimating their pretest theme score.

RISE assessments were conducted via in-person interviews. Although the questions were standardized, farmers’ responses weren’t. During the interview farmers were guided through the questionnaire by the RISE assessor. It is the assessor’s job to help explain the question to maximize accuracy in reporting. Even with explanation and discussion, responses were open to interpretation. The areas that captured farmers’
interests changed from farm to farm, resulting in greater discussion for some themes and indicators and less for others on any given farm. When more in-depth discussion ensued, greater opportunity for clarification ensued.

The second factor that contributed to discrepancy between pretest themes and RISE indices is a lack of engagement with information regarding aspects of the assessment. A RISE assessment is comprised of hundreds of questions, some easy to answer such as “Have you had to sink your well deeper due to water quality or quantity concerns?”; and some far more difficult such as “What portion of your farm has areas with high environmental quality?”. Some questions do not require access to data, while others are best answered when farmers consult their records. For example, a simple question of the farm’s water consumption is difficult to accurately answer without measuring water usage. Farmers may not have access to measurements because they obtain their water from a well that is not metered. When the pretest asked “How sustainable is your water use?” as defined by water management, water supply, water use intensity and risks to water quality, farmers without documentation must guess. If they don’t perceive issues they may score themselves high. However, when the RISE assessment is conducted, a more detailed discussion of water use occurs in which the farmers are asked to quantify their usage – identify an actual number of gallons used per year. When documentation wasn’t available, we calculated the number of gallons they used per year in a variety of ways. Often the approach was to start with an amount they did know for a specific period of time and then work from there, meaning that the final response to the question was an educated estimate not a measurement. This process of discovery highlighted the lack of engagement with the information they needed to more
completely and objectively assess their farms performance which could contribute to the
differences between the pretest and RISE evaluations and the within pretest comparisons.

The themes for which the pretest theme and RISE index evaluations were equal
were aspects of operations where farmers would likely either have a firm understanding
of their management or responded to the questions during the RISE assessment much the
same as they would during the pretest evaluation. Soil management, for example, is
central to productivity. When problems arise regarding yield, pests, disease or
environmental issues farmers often respond with exploration and problem solving, using
measurements such as soil tests. Collecting information may lead to greater
understanding and a more informed pretest assessment. Material use and environmental
protection was a theme that farmers had little difficulty discussing during the interviews.
They seemed to be engaged with the information, and their pretest theme assessments
were not significantly different from RISE index scores. Data captured in this part of the
assessment focused on off-farm inputs such as feed, minerals and organic fertilizer as
well as management practices associated with manure application to build soil fertility
and minimize run off, and pest and weed management practices. Farmers had access to
records regarding their input purchases, however few needed to consult their records
when providing answers during the RISE evaluation. Information was easily recalled
without the use of billing records or field journals. Quality of life and farm management
are two areas that are highly subjective but easily reflected upon and answered. Given
the subjectivity of the questions, and the fact that they represent the same person’s
subjective reflection on similar questions, the pretest theme scores and the RISE index
scores tended to be similar. Furthermore, these questions do not require records or detailed data.

The themes for which significant differences were detected required significant discussion during the interview. The areas of water use, energy and climate, biodiversity and working conditions, proved to be more difficult for farmers to assess than others. Most of the difficulty centered around access to information such as water and fuel consumption data, biodiversity assessments and landscape evaluation, and personnel records, the perceived importance of the topic was also an issue. Apparently, farmers assumed that their management practices were relatively sustainable when they did not access and engage with this more detailed information. This assumption of sustainable practice was apparent regardless of how long they had farmed, their age or their satisfaction with their education level. For water use, energy and climate, biodiversity and working conditions, all farmers overestimated their sustainability when compared to their RISE assessment (Fig. 3.3).

Some themes apparently were difficult for farmers to evaluate, and some did not provide a score for a particular theme. At least one farmer did not provide an overall score for each of the following pretest themes: water use, energy and climate, biodiversity and working conditions. When asked during the interview why they did not provide a theme score they indicated a lack of understanding or knowledge about how to score their operations. These are the themes for which the pretest theme score and the RISE index were not in agreement. The only theme for which all farmers provided a score but for which a lack of agreement resulted was animal husbandry. This is also the only theme where farmers scored themselves lower than the RISE index.
The interview revealed that most farmers did not know how to interpret some of the themes when completing their pretest evaluation. Rating their overall sustainability in the ten themes required an abstract thought process to transfer what they believe to be true to the 0-100 rating scale (Figure 3.1 and Appendix C). For example, if they believe their management practices are sustainable, they would have to decide whether to mark 80 on the scale or 90 or 100 or some number in between. The themes that farmers had less difficulty evaluating were the themes for which they understood the definition and had information upon which they could base a response either from direct memory or from accessing personalized information. During the interviews with the farmers, most disclosed that they were confident in evaluating soil use, animal husbandry, quality of life, working conditions and farm management. Their comfort levels grew out of an understanding of their operations and how the theme was defined. This confidence indicated a greater understanding of the concepts and thus in general led to equal pretest overall theme scores and RISE indices. Furthermore, lack of significant differences between pretest theme scores and RISE indices were observed for all themes for which farmers have strong access to information, except working conditions and animal husbandry.

Working conditions was an example of a difference between how the farmers apparently thought about sustainability and how RISE measured it. Although the farmers indicated that they understood the definition and were confident in their evaluation, their pretest theme scores were significantly higher than their RISE index scores. Working conditions are defined as personnel management, working hours, safety at work and wage and income level. When asked during the interview about their understanding of working
conditions most dismissed the importance of this measurement and expressed disagreement with the way the RISE score was calculated, saying that it included unrealistic targets. For example, every participant called the expectation that farmers work 40-hour weeks and take a minimum 2-week vacation “ridiculous.” Most also noted that farms are dangerous places to work, thus you do what you can to protect yourself and your family, but having a formal safety plan in place was unrealistic. Working conditions was an example of a difference caused not by a lack of information, but rather a disagreement with the measurement criteria and its importance.

Animal husbandry was the only theme for which farmers scored themselves lower than the RISE index. Most farmers expressed confidence in their pretest theme score, thus, I would expect scores that were equal to RISE. The management of livestock is a daily challenge and dairy farmers are intimately connected with the health and well-being of their herd as it is their main source of income. The dairies’ successes are inextricably tied to effective herd management, therefore, depth of understanding in all aspects of the animals’ care is essential. Animal husbandry is defined by the indicators, herd management, livestock productivity, opportunity for species-appropriate behavior, living conditions and animal health. Successful dairymen/women are actively monitoring each of these indicators daily. The discrepancy between the scores apparently had less to do with a lack of information than with their goals for this theme. Since management of the herd is crucial to success, farmers may highlight the little details where improvement could be made and thus be more critical of their performance than a RISE evaluation would suggest is necessary.
The themes water use, energy and climate, biodiversity, and working conditions provided a challenge for farmers during the pretest theme evaluation. The data and rating scale necessary for providing responses to these themes was not readily known or understood by most farmers. Although farms are dependent on water and energy for their survival, many farmers did not know their usage. Beyond not knowing usage data, some farmers simply didn’t know how to rate themselves. At least one farmer failed to rate themselves in each of these themes. When asked during the interviews, these farmers replied that they didn’t know how to evaluate themselves according to these themes. Examples of their comments included, “What is sustainable water use?” “I have no idea what my greenhouse gas balance is. I can’t even hazard a guess.” “How do you measure biodiversity. I don’t know how to score that one.” One Amish farmer replied that he did not feel energy and climate was something that he should consider on his farm. For these themes the difficulty in pretest evaluation centered on a lack of understanding of the scale of measurement, meaning they didn’t have a reference for their performance, as opposed to a lack of understanding of the definition. The result was higher pretest theme scores than RISE index scores, indicating the farmers felt their practices were more sustainable than the objective RISE evaluation suggested.

Material use and environmental protection was the one theme for which farmers did not indicate having much data yet the pretest theme scores were not significantly different from RISE. This theme is defined by material flows, fertilization, plant protection, air pollution and soil and water pollution. Eight farmers had pretest evaluation scores that were higher than RISE whereas four farmers scored themselves lower suggesting where data are not available and perhaps where the concepts are
difficult to define, the pretest evaluation can vary widely among farmers. The large variance in pretest theme and RISE index scores resulted in the lack of difference between the two assessments.

Access to information and reliable data were reasonably strong indicators of the agreement between pretest theme scores and RISE indices. Areas of management where farmers indicated that they had a firm understanding of both the definition of the theme and context for measurement were the themes for which the pretest theme and the RISE index were equal. When farmers had to stretch their understanding, or lacked context for which to base their measurement, they did not score themselves as RISE did. These results are expected as they indicate the more the farmers know the better they are at assessing their sustainability in an objective manner, similar to an index. The challenge these findings highlight is how to get farmers to engage with data they have but may not be using and/or where data is scarce or non-existent driving farmers to seek out measures that would increase data capture. Increasing engagement with farm data will increase the accuracy of an overall view of sustainability. Having a realistic perception of the sustainability of management practices is the first step to driving change. If farmers do not perceive a problem why would they be driven to change? The theory of planned behavior states that intention is the best predictor of behavior (Ajzen, 1985). Intention is created by attitude, subjective norms and perceived control. If a farmer has a positive attitude towards needing to change, the change is supported (subjective norm) and it is fairly easy to achieve (perceived control), then it is more likely that they will indicate an intent to change management practices (behavior) for increased sustainability. However if their attitude is negative because they do not perceive a need to change then intention is
reduced and change is less likely. Improving farmers’ realistic views of their sustainability by increasing their engagement with farm data could lead to more positive attitudes towards behavioral change, which may ultimately result in increased intent to change.

Results from the comparison of pretest theme scores and RISE index scores were examined to determine if demographics played a role in how farmers scored themselves and how they scored on RISE. Demographic data was collected on farm and herd size, rented and owned acreage as well as number of years owned or rented, years certified organic, and number of people living on the farm. The farmers’ theme scores and their RISE index scores were regressed on each of these demographic variables, however, no statistically significant patterns were observed.

The comparison between the pretest theme and pretest indices scores indicate that the farmers’ view their overall sustainability as significantly higher than their management practices indicate for all themes except working conditions and animal husbandry. Working conditions was the only theme where there was no statistically significant difference between the pretest theme score and the pretest index score. Animal husbandry was the only theme for which the farmers scored themselves higher on their management practices than they did for the overall theme. Although statistically significantly different, the mean variance for most themes was less than thirteen points on a 100-point scale indicating that statistical significance may not translate to a large difference on the points scale. Although statistically there was a difference in the scores for these themes: animal husbandry, material use and environmental protection, water use, quality of life and economic viability, realistically the scores were not that divergent.
Furthermore the means of the pretest indices for all themes except material use and environmental protection, and economic viability were within or right on the boundary of the green area marking sustainable on the sustainability polygon (Figure 3.2). There was greater disparity (more than sixteen points) in the pretest theme and pretest indices for soil use, energy and climate and biodiversity.

Soil use was a theme in which the pretest theme and index scores were not in agreement, in that the farmers provided a mean theme score that was higher than their mean index score. Of the twenty-six farmers that participated in the pretest, seven farmers had higher index scores than theme scores, while nineteen were the opposite. Of the farmers that had a pretest index score higher than their theme score the variance was between four and thirty-three points. The variance among the farmers who rated themselves higher on their theme score than their index score was between five and sixty-two points. Little consistency was observed for this theme. The results from the comparison between the pretest theme and RISE index for soil use indicated that the farmers provided a pretest assessment of their soil use that was no different than their RISE assessment (Figure 3.3). In chapter 2 it was reported that the pretest was not in alignment with RISE for this theme, therefore the significant difference between the pretest theme and pretest index is likely due to the limited management practices used on the pretest and not due to the farmers erring in reporting. Based on all three of the assessments on soil use: RISE indices vs. pretest indices (reported in chapter 2), pretest theme vs. pretest indices and pretest theme vs. RISE indices, there is no evidence to support the farmers had difficulty accurately addressing management practices for soil
use. Instead the evidence supports the inability of the pretest to adequately capture the depth of practices that represent sustainable soil management.

Energy and climate was another theme for which the pretest theme and pretest index were not in agreement. Energy and climate was a theme where the farmers consistently over-estimated their scores - all farmers except one rated themselves higher on their theme score than what their management practices indicated. Results from the comparison between the RISE index and the pretest theme demonstrated that farmers scored themselves significantly higher on the pretest than on RISE indices. The comparison between the RISE index and the pretest index (reported in chapter 2) indicated that the pretest was not in alignment with RISE for this theme. These results indicate that the farmers either did not access farm data or did not have the necessary farm data when providing an overall score for this theme. Some of the variance between the pretest theme and pretest index scores could be explained by the failure of the pretest to adequately measure the diversity of management practices captured in RISE, however even with this considered the farmers still overestimated their performance, which indicates a lack of comprehension of how their farms are performing.

Analysis of the pretest index and RISE index for biodiversity (reported in chapter 2) indicated the pretest adequately aligned with RISE, however there is significant variance between the pretest index and the pretest theme. Biodiversity was also a theme where the pretest theme was significantly higher than the RISE index score. Much research has been conducted on the effect organic production has on protecting and enhancing biodiversity (Tuck et al., 2014; Gabriel et al., 2010; Bengtsson et al., 2005; Fuller et al., 2005; Hole et al., 2005; Mäder et al., 2002). Beyond academia, many
popular culture publications and websites (The Organic Research Center, Om Organics, FAO, FiBL, Wild Farm Alliance, iFOAM) profess organic agriculture to protect and promote biodiversity. A google search of “does organic farming benefit biodiversity” yields results that cite university research, mainstream news coverage, international food and agriculture organizations etc. that support this connection. There are headlines such as “Organic farming really is wildlife friendly, new research from Oxford University has found, with far higher species diversity on organic farms than conventional ones” (Turnbull, 2014), “Organic farms act as a refuge for wild plants, offsetting the loss of biodiversity on conventional farms, a study suggests” (Briggs, 2015), “New research confirms more biodiversity on organic farms” (The Organic Research Center, 2010), there is even a Wikipedia page entitled “Organic farming and biodiversity” (Wikipedia, 2017) that primarily supports the link between increased biodiversity and organic production. The country’s largest organic dairy cooperative, Organic Valley, internally uses the slogan “our farmers protect biodiversity”. Those in the organic community apparently maintain a firm belief that organic agriculture protects and enhances biodiversity at all levels. Given the popular culture references, organic industry beliefs and academic studies, it is not surprising that farmers scored their overall sustainability in biodiversity high on the pretest. Biodiversity (78.00) and water use (78.79) were the two highest theme means on the pretest. Given the basic belief that organic agriculture protects and promotes biodiversity farmers may have rated themselves on that belief alone instead of considering the actual practices they are employing.

Conclusion
The evaluation of the pretest theme and the pretest indices suggested farmers’ management practices did not align with the overall view of their sustainability for any of the themes except working conditions. Furthermore, the farmers viewed their overall sustainability as higher than what their practices indicated for all other themes except animal husbandry. Although there were small differences detected in the scores for animal husbandry, material use and environmental protection, water use and quality of life, the farmers have a fairly strong sense of the overall sustainability of their operations based on their management practices, because their overall theme scores were similar to their more objectively calculated pretest indices. This was further supported by the pretest indices and RISE indices being equal for each of these themes (reported in chapter 2).

The second comparison, farmers’ pretest evaluation of their farm’s sustainability by theme to their RISE index evaluation, indicated that where information was not readily known or easily accessible, the pretest theme and the RISE index tended to disagree. Conversely where information about management was regularly consulted and used for management, the evaluations tended to agree. Animal husbandry was the only theme for which agreement was poor even though information was apparently plentiful. This theme was also the only one where the farmer’s mean score was lower than the RISE mean.

Based on these results, farmers could benefit from the development of tools aimed at providing greater depth of information in the areas of water use, energy and climate, biodiversity and working conditions. By raising awareness of the impacts of their management practices farmers can make more informed decisions regarding management
changes. The results of this study indicate that farmers either engage with information or have easily recalled knowledge of their performance on soil use, animal husbandry, material use and environmental protection, quality of life and economic viability which led them to assessing their sustainability as an objective assessment would. However, information on water use, energy and climate, biodiversity and working conditions either is not available or isn’t being used by farmers. Developing programs aimed at increasing farm-based information, such as providing reduced-cost water meters, or landscape assessments for biodiversity enhancement, could drive farmers to improve the understanding of their farms’ sustainability which may ultimately drive their intent to change.
References


Chapter 4: Intent to Change and Barriers to Change: What influences farmers’ commitments to changing their management practices?

Often the theory of planned behavior has been used by researchers to explain how decisions are made. In short, the theory of planned behavior asserts that people will engage in actions that they perceive will have a greater chance of success than failure and that they believe are supported by their peers (Ajzen, 1985). The theory of planned behavior links beliefs with behavior. When people have time to plan their behavior the best predictor is intention. Intention is created by attitude (positive or negative feelings about the behavior), subjective norms (societal approval or disapproval about the behavior) and perceived behavioral control (how hard or easy the behavior is believed to be). If intention is strong, meaning a person has positive feelings, society approves and the behavior is easy to carry out, then behavior likely follows, however, if intention is weak, such as a person has negative feelings, or society disapproves and/or it is difficult to complete then follow through is less likely. A key to this theory is “planned” behavior. The assumption is that a person has a sufficient degree of actual control over a behavior, which may not be the case even if intention is strong. The theory of planned behavior has been used in the field of environmental psychology to predict behavior (Koger and Winter, 2011; Stern, 2000). In general, environmentally friendly actions are associated with a positive normative belief, stated another way, sustainable behaviors are generally
accepted by society as positive behaviors. However, subjective norms, attitudes and perceived behavioral control may point in the direction of adopting sustainable practices, but constraints such as a belief that one’s behavior will not have a large enough impact may deter a person from implementing sustainable choices (Koger and Winter, 2011; De Groot and Steg, 2007; Oreg and Katz-Gerro, 2006; Kaiser et al, 2005; Stern, 2000).

Researchers examining farmers’ decision making have used the theory of planned behavior and have found that decisions are greatly affected by balancing multiple influences. “Lemon and Park (1993) concluded that farmers, when trying to achieve ‘good practice’ on their farms, balance environmental, physical and commercial factors in their decisions about farming practices” (Beedell and Rehman, 1999, p. 166).

Although farmers are often seen as stewards of the land, they face realities that may limit their adoption of sustainable management practices not because they do not have the intention of protecting their environment, but because they are limited by factors such as financial constraints. For example, dairy production has been cited as a strong contributor to climate change due to the high levels of greenhouse gas production from livestock rearing (Steinfeld et al, 2007). Some farmers may wish to lower their GHG footprint from manure storage for example by covering their manure lagoon to capture the emissions before they are released into the atmosphere. This gas capture can then be used to offset their energy consumption by providing a fuel source for heating water to clean the milking parlor. While the practice of emissions capture from a manure lagoon has known environmental benefits the cost of implementing a lagoon cover may not be feasible. The return on investment may not be too long due to the size of their operations, the cheap cost of energy or the expense of the technology. In order for
farmers to make sustainable business decisions about the adoption of a lagoon cover they need to engage with information at several levels. Diffusion of innovation theory can be used to describe how this happens.

Diffusion of innovations theory has been widely used to explain the spread of new ideas and new technology use. The main component of this theory is that communication channels, time, social systems and the innovation itself are the main factors that influence the spread of new ideas (Rogers, 1995). Diffusion of innovation centers on social capital and describes the success of the spread of an idea by the types of adopters that are often first to experiment with new ideas. There are five categories of adopters 1) innovators – they make up 2.5% of the population and are responsible for introducing new innovations; 2) early adopters – they make up 13.5% of the population and are highly respected opinion leaders; 3) early majority – this is 34% of the population and is comprised of those people that take time to make decisions. They wait for the new status quo to establish itself; 4) late majority – this is also 34% of the population but this group are risk adverse and wait for the innovation to be well tested; 5) laggards – the final 16% of the population which is highly resistant to change. Rogers identifies the strongest influences on the adoption of a new innovation, not surprisingly, as ability and motivation. Diffusion of innovation theory outlines five stages to the adoption process. The first stage is knowledge. This is the time in which people are exposed to a new innovation but do not have much information about it. In the knowledge stage people are not yet inspired to find out more. The second stage is persuasion. In this stage peoples’ interests grow and they begin to actively seek out more information. The third stage is decision. Decision is the time when people weigh the advantages and disadvantages of
an innovation and decide if they are going to adopt it or not. The next stage is implementation. During implementation the innovation is employed and people determine its usefulness and gain greater insight and understanding. The final stage is confirmation, when the decision to keep using or reject the innovation is finalized. Diffusion of innovation can be seen throughout the agricultural decision making process. Farmers are regularly exposed to new innovations and technologies designed to lessen their workload, improve their bottom line, increase productivity and lower their ecological footprints to name a few (knowledge). The adoption of these technologies often depends on the support of early adopters who are generally well-respected members of the ag community whose opinions are highly trusted (persuasion). When these key leaders promote new ideas it is easier to gain interest in the community. As interest grows farmers become more willing to test new equipment, management practices, genetics etc. (decision). Often farmers will conduct field tests on small portions of their farm to see how the new innovation performs (implementation). If the results are favorable it is more likely that they will expand the practice to a larger portion of their operations (confirmation). Throughout this process farmers are engaging with information. First the information is general as it explains the value of the new practice or technology but this information is not personalized to a particular farm. As farmers interact with trusted sources their desire to test the new idea likely grows. The point at which the innovation is tested on the farm transfers the information from the general to the personalized as farmers are now gaining an understanding of how it works within their management system, on their landscape and within their own goals.
A common theme throughout these theories is the component of accessing information at some level. The theory of planned behavior focuses on how intention drives behavior. Intention is created by assessment of information at various levels, from peoples’ personal feelings to their perception of societies acceptance and finally how they perceive the feasibility of implementation. Diffusion of innovation traces how new ideas work their way through a social system. In this journey, information moves from the more abstract to personalized before adoption is accepted or rejected. Although farming is widely seen as an individual occupation farmers operate within a strong social system. Societal pressures, communication channels and intensions are inextricably linked to behavioral change and innovation adoption and all are based on the flow of information from the general concepts to the personalization of management change on each farm.

A multitude of models are designed to predict the adoption of agricultural innovations (Rauniyar and Goode, 1992; Traxler and Byerlee, 1992; Leathers and Smale, 1991; Pitt and Sumodiningrat, 1991; Tsur et al, 1990; Casewell and Zilberman, 1986; Feder, 1982; Bartlett, 1980; Rosenberg, 1976), usually based on assessing components such as risk, expenditures/profit functions, uncertainty and market demands. Many of these models approach adoption from the economic perspective whereas the above theories are rooted in sociology and psychology. Although many decisions are guided by economic evaluation, the bottom line is not the only predictor of adoption of management change. Pannell et al (2006) acknowledged the siloing of adoption literature by disciples which causes fragmentation and dilutes the overall general lessons. To combat this pitfall they created a cross-disciplinary consensus by bringing together scholars from diverse disciplinary backgrounds including economics, rural sociology and psychology. They
began their assessment by identifying two aspects of the learning process: “the collection, integration and evaluation of new information” and improving skills in the application of the innovation (Pannell et al., 2006, p. 2). In this work information is described as distant until on-farm trials of the new technology are conducted at which time the information is personalized. Once information is personalized this becomes the main driver of adoption (Pannell et al., 2006). This cross-disciplinary study also noted the important role that the social environment plays in farmers’ adoption of new technology. When addressing intent to change management practices, the focus is often on technical assistance and the application of science administered from a top-down approach (Vanclay, 2004). Although technical expertise is required when evaluating new management approaches, farmers also must process change from a social perspective, simply providing technical information is not enough to drive farmers to adopt more sustainable management practices.

My experience with discussing sustainable management change with farmers is that there is no one way to approach a topic, farmer or situation. Although similarities exist between farms, no two farms or farmers are exactly alike. Psychological and social science theories have contributed to understanding what drives farmers to adopt more sustainable management practices, however there is still more to discover. For example, intent to change could depend upon the initial assessment of sustainability. If farmers believe their current management practices are sustainable, then intent to change may not be indicated. Furthermore, if farmers believe their management practices are sustainable but then discover during the RISE assessment or from reading the materials sent to the control group that they are not as highly rated as they thought, it could affect intent to
change. This research aims to contribute to the previous studies by assessing data engagement and distance to information as contributors to intent to change management practices. Furthermore, I endeavor to gain insights into the barriers farmers face to implementing these changes.

For the research reported in this chapter, comparisons of intent to change management practices were made between three treatment groups that varied in the level of engagement with farm data in sustainability evaluations. Intent to change was measured by the difference between their pretest and posttest responses on the current and projected use of management practices associated with sustainability. Intent to change management practices depends on many factors. To better understand the challenges farmers face to altering their management, I captured data on the barriers to changing management practices. The goal of this research was to identify factors that influence farmers’ intent to change management practices and to identify barriers farmers face to implementing these changes.

Methods

The model system – Why study organic dairy in Ohio?

In 2009 USDA’s Economic Research Service (ERS) published a report on organic dairy production in the US in which it evaluated dairy statistics on a regional basis (Table 4.1). The Corn Belt, although the smallest percentage of farms and cows, 7% of each, represents the average organic dairy farm in the country. In addition to being average in size, farms in the Corn Belt are diversified in terms of production. Most farms produce
both cereals and grasses (McBride and Green, 2009) which provided the opportunity to study a wider range of management practices.

### Table 4.1 Organic dairy in the US, data from McBride and Green, 2009

<table>
<thead>
<tr>
<th>Region</th>
<th>States</th>
<th>Organic Dairies</th>
<th>Organic Cows</th>
<th>Average Herd Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northeast</td>
<td>Maine, Vermont, New York and Pennsylvania</td>
<td>44%</td>
<td>29%</td>
<td>52 cows</td>
</tr>
<tr>
<td>Corn Belt</td>
<td>Ohio, Indiana, Illinois, Iowa and Missouri</td>
<td>7%</td>
<td>7%</td>
<td>75 cows</td>
</tr>
<tr>
<td>Upper Midwest</td>
<td>Michigan, Wisconsin and Minnesota</td>
<td>42%</td>
<td>33%</td>
<td>64 cows</td>
</tr>
<tr>
<td>West</td>
<td>Washington, Oregon, Idaho and California</td>
<td>7%</td>
<td>31%</td>
<td>381 cows</td>
</tr>
</tbody>
</table>

Ohio presented the opportunity to gather information from both Amish and non-Amish operations. Amish have a strong history of dairy production in Ohio (Cross, 2006) and make up more than 25% of all the dairies in the state (Brock and Barham, 2009). Organic Valley (CROPP Cooperative), the country’s largest farmer-owned organic cooperative, has 188 member dairies in Ohio. The cooperative is comprised of 45% Amish and Mennonite members (Brandl, 2016) (For more information on organic dairy and Amish in Ohio see chapter 2 pages 52 – 54).

Research participants

The United States Department of Agriculture’s National Organic Program publishes a database of all certified organic producers in the US. To identify the organic dairies in Ohio I searched this database and yielded 235 certified organic dairies in Ohio.
Each of these dairies received a written invitation to participate in the research and a pretest survey. Twenty-six farms returned the pretest, however only seventeen completed the full project (See chapter 2 for more details on the research participants demographic page 54).

*Overview of the research tool*

As noted in previous chapters, RISE is an indicator-based tool that captures data on farm management through interviews and farm tours. Once the assessment is complete the data collected is compared against benchmark data and then normalized. Optimal performance is 100 and extreme need for improvement equates to 0. A score is calculated for each indicator which is then averaged to generate a theme score. (For information on the indicators associated with each theme and further details on RISE, see Table 1.3 in the Introduction and pages 23 – 29 and Figure 2.3).

*Study design and data collection*

This research followed a pretest/posttest study design, with three phases: the initial survey (pretest); sustainability assessments administered at the farm; and a final survey (posttest). To gather data in the first phase (pretest) a survey was administered that captured demographic data, current view of the sustainability of their operations and a baseline for the current practices farmers are employing on their farms. (for more information on the pretest see chapter 2 and Appendix C). Following the pretest, farmers were randomly assigned to one of three treatment groups that varied in the extent of personal contact and facilitated connection with detailed information about the farms: the control group, RISE assessment with written, mailed feedback, and RISE assessment
with in-person feedback (for more information on the RISE evaluations see Appendix A and B).

The control group did not receive any in-person contact or personalize information regarding how their farm performs. This group was mailed written information on best management practices aimed at improving the sustainability of their farms. The materials chosen were NRCS (Natural Resources Conservation Service) documents that, where applicable, focused on organic practices (some practices are not divisible by conventional or organic management such as fencing livestock out of waterways).

The second treatment group, RISE assessment with written, mailed feedback (RISE Mailed), received a farm visit and in-person RISE interview. The in-person interview allowed the farmers to ask questions, increased the accuracy of their responses and personalized the data upon which their feedback was based. For this group, the feedback was provided in written form only. This meant that the farmers received feedback based on their actual management, however they were unable to ask questions regarding the outcome, or gain clarity in recommendations.

The third treatment group received a RISE assessment with in-person feedback (RISE Full). As in the second treatment group, this group participated in a farm visit and in-person RISE interview. The difference between RISE Mailed and RISE Full was in the way feedback was provided. RISE Full received an in-person feedback session in which the results of the assessment were presented in written form and were discussed in detail. The feedback session provided the farmers the opportunity to ask questions
regarding their scores, how indicators were measured and calculated, and discuss possible recommendations for improvement.

The final phase of the research was a posttest designed to measure intent to change management practices and barriers to change. The posttest mirrored the pretest however the posttest asked farmers “To what degree do you plan to employ these management practices on your farm in the next 3 years” instead of how they are currently managing. For example, the pretest asked farmers “What percentage of your tillable acreage is planted with cover crops?”, whereas the posttest asked in the next 3 years, “What percentage of your tillable acreage will be planted with cover crops?”. To gauge intent to change, the farmers’ responses from their pretest were subtracted from their posttest response. To assist farmers with accurately reporting their intent to change, the responses they provided on the pretest where indicated on the posttest. If farmers did not expect to plant additional acreage in cover crops they would indicate the same response as they did on the posttest. If they felt cover crops were not beneficial to their management they may indicate a reduced amount of acreage in cover crops. If this occurred intent to change to be more sustainable was reported as a negative number. In addition to capturing information on intent to change management practices the posttest also asked the farmers to identify barriers to change (See Appendix D for the posttest).

Analysis

The differences in responses between the pretest and posttest for each of the RISE themes were the dependent variables used as the measure of intent to change management practices. The data were analyzed by analysis of variance and the means of the intent to change scores were compared among treatment groups for each theme by
planned contrasts between the control and RISE groups and between the two RISE groups – RISE Mailed and RISE Full (IBM SPSS, 2016). Each analysis of variance tested the hypothesis that the intent to change for a given theme differed among the treatment groups, where the hypothesized difference was greater intent in RISE than control groups, and greater intent in the RISE Full group than the RISE Mailed group. Therefore, contrasts were estimated for the control compared with the average of the two RISE groups, and between the two RISE groups. To explore potential bias in the data, linear regression analysis was conducted with the demographic data collected on the pretest as potential covariates for intent to change. Regressions of intent to change on pretest overall theme scores and pretest index scores for each theme were estimated to test the hypothesis that the intent to change depends upon the initial assessment of sustainability. Intent to change management practices was further examined by conducting analysis of variance for each management practice as well as frequency counts for intent to change by management practice. These frequencies were then ranked to provide insight into the management practices farmers indicated the strongest intent to change. The frequency of respondents who identified barriers to change was compared among groups using a $\chi^2$ contingency table (Microsoft Excel, version 15.32). I did not expect differences among the groups but if present they could help explain the presence or absence of differences in intent to change. The barriers identified were captured on the posttest. To calculate barriers to change frequency counts were conducted.

Results

Although intent to change could be either positive or negative, indicating a change to more sustainable or less sustainable practice according to RISE, the average
intent to change for all management practices was positive. Pretest and posttest responses were on a scale of 0 – 100. The results are reported in points where one point is equivalent to one unit of increase or decrease on the scale. The largest intent to change was in the energy and climate theme followed closely by water use (Figure 4.3). The themes that elicited the least intent to change were quality of life, biodiversity, material use and environmental protection.

My null hypothesis was no difference between the means of the treatment groups (H₀: Control group intent to change = RISE Full and RISE Mailed intent to change; H₀: RISE Full intent to change = RISE Mailed intent to change). Analysis of variances in intent to change scores for each theme among the three treatment groups are provided in Tables 4.2 & 4.3. The null hypothesis of the difference in mean intent to change being zero was rejected for animal husbandry (Table 4.3), with α = .1, but not for any other themes (Table 4.3). Power was generally low in each of these comparisons, and analysis of sample sizes needed to establish statistically significant effect sizes the same as those observed ranged from 66 to 2145, clearly considerably larger than the sample size achieved among Ohio organic dairies. Planned contrast tests indicated that there were statistically significant differences between the control and the RISE Full and the RISE Mailed treatment for animal husbandry (p = .027) and material use and environmental protection (p = .066). In each of these cases, the control group indicated a greater intent to change management practice than the RISE treatments (Table 4.4), contrary to my initial hypothesis.

The relationship between demographics and intent to change was explored by theme and no statistically significant results were found. This suggests that the size of
the farm, number of rented versus owned acres, years certified organic, herd size or number of people living on the farm did not significantly impact the intent to change management practices.
Table 4.2 Mean, standard deviation and lower bound and upper bound confidence intervals for analysis of variance of intent to change between the three treatment groups

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean (SD)</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil Use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>1.9 (6.32)</td>
<td>-3.80, 7.60</td>
</tr>
<tr>
<td>RISE In-person Feedback</td>
<td>2.49 (3.22)</td>
<td>-2.71, 7.69</td>
</tr>
<tr>
<td>RISE Mailed Feedback</td>
<td>6.03 (7.75)</td>
<td>0.34, 11.73</td>
</tr>
<tr>
<td>Animal Husbandry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>11.92 (9.51)</td>
<td>4.21, 19.64</td>
</tr>
<tr>
<td>RISE In-person Feedback</td>
<td>3.37 (3.07)</td>
<td>-3.68, 10.41</td>
</tr>
<tr>
<td>RISE Mailed Feedback</td>
<td>-1.09 (10.24)</td>
<td>-8.81, 6.63</td>
</tr>
<tr>
<td>Material Use &amp; Environmental Protection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>7.10 (8.09)</td>
<td>0.97, 13.23</td>
</tr>
<tr>
<td>RISE In-person Feedback</td>
<td>1.83 (3.70)</td>
<td>-3.77, 7.43</td>
</tr>
<tr>
<td>RISE Mailed Feedback</td>
<td>-1.39 (6.97)</td>
<td>-7.52, 4.74</td>
</tr>
<tr>
<td>Water Use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>9.33 (11.83)</td>
<td>1.37, 17.30</td>
</tr>
<tr>
<td>RISE In-person Feedback</td>
<td>5.90 (5.82)</td>
<td>-1.37, 13.17</td>
</tr>
<tr>
<td>RISE Mailed Feedback</td>
<td>3.60 (6.20)</td>
<td>-4.36, 11.56</td>
</tr>
<tr>
<td>Energy &amp; Climate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>5.52 (8.22)</td>
<td>-3.26, 14.30</td>
</tr>
<tr>
<td>RISE In-person Feedback</td>
<td>9.85 (11.43)</td>
<td>1.83, 17.86</td>
</tr>
<tr>
<td>RISE Mailed Feedback</td>
<td>4.97 (6.12)</td>
<td>-3.81, 13.75</td>
</tr>
<tr>
<td>Biodiversity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>5.50 (6.71)</td>
<td>0.05, 10.95</td>
</tr>
<tr>
<td>RISE In-person Feedback</td>
<td>1.75 (2.53)</td>
<td>-3.23, 6.73</td>
</tr>
<tr>
<td>RISE Mailed Feedback</td>
<td>0.30 (7.10)</td>
<td>-5.15, 5.75</td>
</tr>
<tr>
<td>Working Conditions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>1.73 (2.04)</td>
<td>-2.61, 6.08</td>
</tr>
<tr>
<td>RISE In-person Feedback</td>
<td>4.04 (4.56)</td>
<td>0.08, 8.01</td>
</tr>
<tr>
<td>RISE Mailed Feedback</td>
<td>3.60 (5.96)</td>
<td>-0.74, 7.94</td>
</tr>
<tr>
<td>Quality of Life</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>-1.90 (7.62)</td>
<td>-6.72, 2.92</td>
</tr>
<tr>
<td>RISE In-person Feedback</td>
<td>-0.90 (1.25)</td>
<td>-5.72, 3.92</td>
</tr>
<tr>
<td>RISE Mailed Feedback</td>
<td>3.10 (3.72)</td>
<td>-1.72, 7.92</td>
</tr>
<tr>
<td>Economic Viability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>7.80 (15.87)</td>
<td>-2.09, 17.69</td>
</tr>
<tr>
<td>RISE In-person Feedback</td>
<td>2.53 (5.11)</td>
<td>-7.36, 12.43</td>
</tr>
<tr>
<td>RISE Mailed Feedback</td>
<td>-0.33 (5.61)</td>
<td>-10.23, 9.56</td>
</tr>
</tbody>
</table>
Table 4.3 ANOVA results for intent to change management practices by theme

<table>
<thead>
<tr>
<th>Theme</th>
<th>( F(df) )</th>
<th>( p )</th>
<th>Effect size ( (\eta^2) )</th>
<th>Observed power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil use</td>
<td>( F(2, 13) = 0.73 )</td>
<td>0.499</td>
<td>0.1**</td>
<td>0.15</td>
</tr>
<tr>
<td>Animal husbandry</td>
<td>( F(2, 13) = 3.44 )</td>
<td>0.063</td>
<td>0.35***</td>
<td>0.54</td>
</tr>
<tr>
<td>Material use &amp; environmental protection</td>
<td>( F(2, 13) = 2.28 )</td>
<td>0.141</td>
<td>0.26***</td>
<td>0.38</td>
</tr>
<tr>
<td>Water use</td>
<td>( F(2, 13) = 0.61 )</td>
<td>0.556</td>
<td>0.09**</td>
<td>0.13</td>
</tr>
<tr>
<td>Energy &amp; climate</td>
<td>( F(2, 13) = 0.49 )</td>
<td>0.626</td>
<td>0.07**</td>
<td>0.11</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>( F(2, 13) = 1.14 )</td>
<td>0.35</td>
<td>0.15***</td>
<td>0.21</td>
</tr>
<tr>
<td>Working conditions</td>
<td>( F(2, 13) = 0.39 )</td>
<td>0.684</td>
<td>0.06**</td>
<td>0.10</td>
</tr>
<tr>
<td>Quality of life</td>
<td>( F(2, 12) = 1.43 )</td>
<td>0.277</td>
<td>0.19***</td>
<td>0.25</td>
</tr>
<tr>
<td>Economic viability</td>
<td>( F(2, 12) = 0.83 )</td>
<td>0.461</td>
<td>0.12**</td>
<td>0.16</td>
</tr>
</tbody>
</table>

*Note* ** = moderate effect, *** = strong effect
Linear regressions were conducted to determine the effect of the farmers’ initial view of their sustainability on intent to change management practices, with both the overall pretest themes (Table 4.5 and Figure 4.1) and the pretest indices (Table 4.6 and Figure 4.2) used as measures of their initial levels of self-reported sustainability. The slopes of intent to change predicted by pretest themes were significantly different from 0 ($\alpha = .1$) for soil use, energy and climate and working conditions. As the farmers’ pretest theme scores increased their intent to change decreased for soil use and working conditions, however, as pretest theme scores increased the farmers’ intent to change increased for energy and climate. Regression analysis on the pretest indices found that intent to change soil use ($M = 54.18$, $SD = 21.25$), animal husbandry ($M = 79.94$, $SD = 6.6$), water use ($M = 69.35$, $SD = 19.95$) and energy and climate ($M = 21.88$, $SD = 21.12$)
were significantly related with the associated pretest index ($\alpha = 0.1$). For these themes as the pretest indices score increased the intent to change decreased.

**Table 4.5** Regression analysis of intent to change on pretest overall theme scores

<table>
<thead>
<tr>
<th>Theme</th>
<th>$F(df)$</th>
<th>$p$</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil use</td>
<td>$F(1, 15) = 3.24$</td>
<td>0.092</td>
<td>0.18</td>
</tr>
<tr>
<td>Animal husbandry</td>
<td>$F(1, 15) = 0.08$</td>
<td>0.782</td>
<td>0.005</td>
</tr>
<tr>
<td>Material use &amp; environmental protection</td>
<td>$F(1, 14) = 0.001$</td>
<td>0.98</td>
<td>0.000</td>
</tr>
<tr>
<td>Water use</td>
<td>$F(1, 13) = 0.12$</td>
<td>0.74</td>
<td>0.01</td>
</tr>
<tr>
<td>Energy &amp; climate</td>
<td>$F(1, 12) = 4.30$</td>
<td>0.06</td>
<td>0.26</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>$F(1, 12) = 0.21$</td>
<td>0.656</td>
<td>0.02</td>
</tr>
<tr>
<td>Working conditions</td>
<td>$F(1, 14) = 4.48$</td>
<td>0.053</td>
<td>0.24</td>
</tr>
<tr>
<td>Quality of life</td>
<td>$F(1, 14) = 2.73$</td>
<td>0.121</td>
<td>0.16</td>
</tr>
<tr>
<td>Economic viability</td>
<td>$F(1, 14) = 0.96$</td>
<td>0.344</td>
<td>0.06</td>
</tr>
</tbody>
</table>

**Table 4.6** Regression analysis of intent to change on pretest indices

<table>
<thead>
<tr>
<th>Indices by Theme</th>
<th>$F(df)$</th>
<th>$p$</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil use</td>
<td>$F(1, 15) = 6.19$</td>
<td>0.025</td>
<td>0.29</td>
</tr>
<tr>
<td>Animal husbandry</td>
<td>$F(1, 15) = 22$</td>
<td>&lt; .001</td>
<td>0.59</td>
</tr>
<tr>
<td>Material use &amp; environmental protection</td>
<td>$F(1, 15) = 0.92$</td>
<td>0.352</td>
<td>0.06</td>
</tr>
<tr>
<td>Water use</td>
<td>$F(1, 15) = 6.77$</td>
<td>0.02</td>
<td>0.31</td>
</tr>
<tr>
<td>Energy &amp; climate</td>
<td>$F(1, 15) = 9.21$</td>
<td>0.008</td>
<td>0.38</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>$F(1, 14) = 1.67$</td>
<td>0.217</td>
<td>0.11</td>
</tr>
<tr>
<td>Working conditions</td>
<td>$F(1, 15) = 1.19$</td>
<td>0.292</td>
<td>0.07</td>
</tr>
<tr>
<td>Quality of life</td>
<td>$F(1, 14) = 1.16$</td>
<td>0.299</td>
<td>0.08</td>
</tr>
<tr>
<td>Economic viability</td>
<td>$F(1, 14) = 2.08$</td>
<td>0.171</td>
<td>0.13</td>
</tr>
</tbody>
</table>
Figure 4.1 Regression of intent to change on pretest theme scores. Standard errors for the slope of the line and the y intercept are represented in the parentheses below the corresponding variable in the equation.
No statistically significant differences among treatment groups were found when analysis of variance was conducted for each management practice. To further explore the management practices used in this analysis I conducted frequency counts for each practice and ranked how much intent to change farmers indicated. The five management practices for which farmers indicated the highest intent to change were 1) upgrading to energy efficient lighting; 2) improving forage quality; 3) installing variable speed drives; 4) securely containing manure and wastewater to protect water supplies from contamination; and 5) planting field boarders with native grasses. These top responses represented a single practice from the themes animal husbandry, water use and biodiversity and two practices representing energy and climate. The five practices for
which farmers expressed the least intent to change were 1) managing tillable acreage with reduced tillage/no-till/conservation tillage; 2) improving livestock productivity; 3) improving job security; 4) improving freedom of expression; and 5) reducing inputs from off-farm sources. For all but the off-farm inputs, the intent to change was a negative number suggesting that farmers have either tried these practices and they are not working and thus they are going to reverse their implementation or in the case of the quality of life practices they do not foresee their situation improving. No mean intent to change was found for reducing off-farm inputs. Out of the eleven management practices for which farmers expressed the least intent to change, six of the practices were from the quality of life theme.

Total intent to change was calculated for each farm by adding up their intent to change for each management practice. Farmers in the control group indicated the highest intent to change followed by the farmers in the RISE full group and finally the farmers in the RISE mailed group indicated the least intent to change. The groups were unbalanced, because the RISE full group had one more farmer than the RISE mailed and control groups. The total intent to change for the control group was 990 points, the RISE full totaled 729 points and RISE mailed totaled 453 points. Even though the control group had one less farmer it still scored 261 points higher than the RISE Full group. Adjusting for the disparity in group size did not change the ranking of intent to change by treatment group. These results are counter to my hypothesis with regards to the control group, however the RISE full group did indicate a higher intent to change than the RISE mailed group, as predicted.
Figure 4.3 Average and variation in intent to change management practices measured by the difference between posttest and pretest surveys.
Frequency counts were tabulated for each identified barrier to change (Figure 4.4). Fifty-nine percent of the respondents indicated “too expensive” and “won’t make a large enough impact” as the most significant barriers to change followed closely by “don’t have the proper equipment” (53%) and “takes too much time to manage” (47%). The farmers had the opportunity to write in additional barriers and noted “don’t see a need to change” (18%), “lack of time” (6%) and “doesn’t fit our operation” (6%).

![Barriers to Change](image)

**Figure 4.4** Barriers to changing management practices
Discussion

Intent to change

The model design and data collection and feedback mechanisms in RISE was assumed to be a useful way of testing how general or personalized information affects farmers’ intent to change management practices for increased sustainability. For this research, information was assumed to be differentiated on two levels: in-person assessment of farms versus general best management practices and in-person feedback on assessment results versus written, mailed feedback. I hypothesized that as farmers actively engaged with farm data to gain a more comprehensive view of the impacts of their management practices their intent to change management practices should increase.

The first test of the role farmer engagement with farm data plays in farmers’ intent to change management practices was to compare the farmers in the control group with farmers who participated in a RISE assessment. The farmers in the control group were considered to have less engagement with farm data than the RISE assessment farmers because the written information they received in the mail concerning management practices to improve their sustainability was not directly connected to their operations. The task fell on the farmers in the control group to read and interpret the information without the benefit of a personalized assessment. The only statistically significant result indicated that the control group expressed a greater intent to change animal husbandry practices than the groups that participated in a RISE evaluation. The data presented in chapter 3 revealed that farmers who participated in a RISE assessment scored themselves lower in this theme on the pretest than their RISE evaluation suggested they should. It was the only theme where that occurred. I posit that the lack of intent to
change in the RISE groups was due to their access to RISE evaluation results that indicated they were managing their herds better than they realized. The control group’s increased intent to change in animal husbandry may be a response to the search for continual improvement on their most significant source of income, their animals. On the pretest the control group had a mean overall theme score in animal husbandry of 79.4 ($SD = 9.45$) and a pretest mean index of 80.42 ($SD = 6.73$) in comparison to the RISE groups theme ($M = 75.12$, $SD = 11.38$) and pretest index ($M = 89.25$, $SD = 8.61$). On the pretest the control group scored their overall sustainability in animal husbandry higher than the RISE group, yet their indices based on management practices scored lower than those of the RISE group on average. The regression analysis for animal husbandry indicated that the lower the pretest index score the greater the intent to change. Intent to change management practices for animal husbandry appears to be influenced by a perception of greater need to change and perhaps their drive towards continual improvement.

Intent to change material use and environmental protection management practices was significantly different between control and the average of the two RISE groups according to planned contrasts at $\alpha = 0.1$. The control group indicated a greater intent to change than the RISE groups for this theme, similar to animal husbandry. However, no statistically significant relationship between intent to change and initial perception of this theme was observed.

The second test of the role data engagement plays in farmers’ intent to change management practices was to compare the effect of the feedback mechanism: in-person or mailed. The farmers who received the feedback from their RISE evaluation in mailed, written form were assumed to have less confidence in their interpretation of the results
than the farmers who received their feedback in-person. This lack of confidence was presumed to be greater for the mailed feedback because the farmers did not have the opportunity to discuss the results and recommendations. The feedback generated from a RISE assessment is lengthy and in-depth. Farmers may have had difficulty interpreting the information. During feedback sessions, the farmers often expressed confusion with the results and how scores were calculated. Although the results were then explained in more detail some confusion may still have remained. No statistically significant differences between the two RISE groups in intent to change were found.

The results of the regression analysis indicated that for two pretest themes, soil use and energy and climate and four pretest indices, soil use, animal husbandry, water use and energy and climate a farmer’s intent to change decreased as the view of their sustainability increased. These results suggest the farmers’ initial views of their sustainability were a better predictor of intent to change than engagement with farm data.

Regression analysis did not indicate a statistically significant intent to change management practices based on the RISE evaluation scores for any theme. However, farmers who participated in a RISE assessment had the lowest RISE scores for the theme energy and climate (54), and it was the theme where the farmers expressed the highest intent to change (6.53). Results reported in chapter 2 indicated that the pretest was not in alignment with RISE for energy and climate suggesting that the pretest/posttest comparison should not be used to compare intent to change between RISE and Control groups, however, the regression analysis results suggest that the RISE assessment did impact intent to change for this theme. Farmers also scored lower on their RISE evaluation for the theme water use (66) and it was the second highest theme for intent to change.
change (6.06) among the RISE evaluation groups, again suggesting that the data engagement during the RISE assessment may have played a role in the farmers’ intent to change. When farmers did not engage with the necessary data to adequately evaluate their sustainability they over-estimated their scores. If the farmers either had a better understanding of the overall theme and how it is measured, or engaged more with more detailed data from sources such as billing records, they may have had a pretest score more similar to the RISE index score, based on results described in Chapter 3.

Intent to change was regressed on demographic variables to determine if demographics played a role in influencing intent to change. Demographic data was collected on farm and herd size, rented and owned acreage as well as number of years owned or rented, years certified organic, and number of people living on the farm. In the regressions I examined, no patterns emerged that would explain intent to change based on these demographic factors.

*Barriers to change*
Table 4.7 Barriers to change as defined by theme

<table>
<thead>
<tr>
<th>Barrier to Change</th>
<th>Soil Use</th>
<th>Animal Husbandry</th>
<th>Material Use &amp; Environmental Protection</th>
<th>Water Use</th>
<th>Energy &amp; Climate</th>
<th>Biodiversity</th>
<th>Working Conditions</th>
<th>Quality of Life</th>
<th>Economic Viability</th>
<th>Farm Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Too Expensive</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Won’t make a large enough impact</td>
<td>5</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Don’t have enough information</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Don’t think will work on my farm</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>ROI is too long</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Take too much time to manage</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Don’t have the proper equipment</td>
<td>5</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Too labor intensive/ don’t have enough labor</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Don’t have the community support</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Don’t have enough land or sufficient capabilities</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Don’t see a need to change</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Lack of time</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Doesn’t fit our operation</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
As part of the posttest, farmers were asked to identify the barriers they face to changing management practices. A $\chi^2$ analysis of the posttest responses to barriers to change indicated a significant difference between the treatment groups ($\chi^2_{(2)} = 3.85, p = .05$) with the RISE groups identifying a greater number of barriers than the control group. The most common responses were “too expensive” and “won’t make a large enough impact” with ten out of seventeen respondents citing these barriers. Analyzing the data in greater depth, the most noted themes for the barrier of “too expensive” were water use, energy and climate and animal husbandry. With regards to “won’t make a large enough impact,” the farmers cited soil use followed by water use and biodiversity as the top themes where this barrier was identified.

Water use was the theme farmers reported being the most common barrier in terms of expense. During the RISE interactions, the discussions regarding sustainability in water use focused on water storage/capacity and irrigation, the control group’s printed materials also addressed these issues. Global predictions include more extreme weather events as a result of changing climate (FAO, 2017; Leiserowitz et al, 2013; Jones et al, 2007; Rosenzweig et al, 2001). Leiserowitz and his team (2013) discovered “Many Americans believe global warming made recent extreme weather and climatic events ‘more severe’… Most Americans (80%) have close friends or family member who experienced weather events in the past year, including… an extreme rainstorm (37%), or a drought (35%)” (p. 6). The farmers in this study did not necessarily agree that climate change is happening, but for the ones who participated in an interview, most conceded that they were experiencing more extreme weather. Once this was established conversations focused on how prepared they are for longer periods of drought and heavy,
prolonged rains. To address drought tolerance, we discussed water storage/capacity for which most conceded they were ill equipped. We discussed the possibility of adding water storage tanks and/or retention ponds that could bridge the gap between rains. Coupled with this we discussed the potential need for irrigation (of the twelve farms that participated in the RISE assessment only one currently irrigates). The high incidence of citing “too expensive” with regards to water use is likely linked to the perceived high cost of increasing water storage and implementing an irrigation strategy.

During both the RISE interview and feedback sessions farmers revealed their hesitancy with implementing management changes regarding energy and climate practices. They were not confident that they could afford practices such as renewable energy generation and GHG emission mitigation. Many cited the cheap cost of fuel as a key factor in not considering alternative energy implementation. Even the Amish that participated in this research were dependent on diesel-fueled generators instead of solar or wind power to provide energy for their off-the-grid farms. Discussions with the farmers revealed that none had ever had a renewable energy assessment upon which to base their assumption that solar and wind power were too expensive to be feasible. Regarding GHG emission mitigation, the management practices discussed most often were capturing emissions from manure storage lagoons (which are large usually open pits where all manure and often wastewater is stored) and lowering exhaust emissions by using more efficient machinery. Seven of the seventeen farmers participating in this research had a lagoon. None noted on the posttest that they plan on capturing greenhouse gases from it in the future. Conversations with six of the lagoon owners revealed they felt a cover would be too costly and could cite no incentives to justify the expense.
Farmers also saw little benefit in lowering emissions by updating machinery to more fuel-efficient engines. Although many agreed that newer equipment would be more fuel efficient, none were interested in retiring equipment that was in working order just for the sake of lowering emissions. Lack of incentives were cited along with cheap fuel and the high cost of new equipment as disincentives.

Changing animal husbandry management practice was inhibited by the expense of implementation. Improvements to animal husbandry management often focused on improvements to the barn and milking parlor. These capital costs were generally viewed as too expensive to be feasible. Many farmers agreed that they would like to make changes to their infrastructure, but that they did not have sufficient capital for such improvements.

Soil use was the theme that farmers most frequently identified with the barrier “won’t make a large enough impact.” Soil use was a theme where regression analysis indicated intent to change management practices decreased as both the pretest theme score and the pretest index scores increased. Farmers scored their sustainability in soil use low on the pretest in both the theme ($M = 71, SD = 15.51$) and the index ($M = 54.1, SD = 19.47$). The reading materials shared with the control group and the RISE interview and feedback materials addressed no-till/reduced tillage and conservation tillage to improve sustainability of soils. Although some of the farmers had implemented some degree of reduced tillage, there was consensus among the interviewed farmers that tillage is an integral part of organic management. Many did not feel their soil management practices were resulting in considerable erosion and expressed the belief that tillage was necessary to reduce weed pressure and compaction. The topic of carbon sequestration
was not one the farmers were interested in exploring. Tilling soils has been shown to have a negative impact on soil organic carbon sequestration (Lal, 2004; Halvorson et al., 2002; West and Post, 2002) however newer studies are challenging these results (Ogle et al., 2012; Christopher et al, 2009; Baker, et al, 2007). Discussions with farmers indicated that climate mitigation from soil management was not something they considered in their management plans.

Improvement in water use and biodiversity enhancement strategies were often identified as having insufficient impact to be of value. Perhaps the farmers are interpreting water issues as a global problem tied to climate, with their own practices having little impact on the global situation. Farmers frequently stressed their contention that organic management practices are protective of biodiversity. As noted in chapters 2 and 3, the farmers viewed their management practices as sustainable with regards to biodiversity. The evidence they provided during the interviews indicated that they did not feel the measurement of the sustainability of biodiversity was adequate in RISE. The selection of the barrier “won’t make a large enough impact” could be in response to the suggestions RISE puts forth to improve biodiversity sustainability such as having habitat and species diversity assessments conducted on farms and raising traditional or endangered breeds of livestock and plants.

Seven farmers cited not having enough information as a barrier to change. This barrier was most identified under the themes biodiversity and farm management by the farmers in the RISE treatment groups more frequently than the control group. The thesis that farmers participating in RISE will experience a higher level of confidence in the information as the information they receive will be personalized was not supported here.
One farmer in the control group identified a lack of information as a barrier compared to five farmers in the RISE treatments. Of the six farmers in the RISE treatments, three were in the RISE Full group and two were in the RISE mailed group and one did not participate in a treatment group. This result is contrary to my hypothesis. The RISE assessment was assumed to provide farmers with necessary information to implement management practices to improve sustainability. The examination of the barrier not enough information suggests that the farmers who participated in RISE received less useful information than those in the control. It is possible that the control group did not engage with the provided information at a level that would move them towards considering implementation. If their interest in a topic was not captured, they would likely not indicate a need for additional information; however, if farmers are actively considering making a management change their desire for more detailed information such as technical assistance is necessary. The difference between the treatment groups regarding this barrier may be due in part to a difference in intent to change and thus a difference in need for more detailed information.

Conclusion

The pretest/posttest design utilized in this research provided the opportunity to collect information from farmers regarding their current management practices and compare them to how they would like to manage their operations after being exposed to information designed to improve their sustainability. The hypothesis that providing a place-based comprehensive assessment will increase the farmers’ intent to change management practices was not supported. Instead farmers’ view of their sustainability on the pretest was a stronger indicator of intent to change. As the farmers’ pretest scores
increased their intent to change decreased in soil use, energy and climate, animal husbandry and water use.

For the themes soil use, material use and environmental protection, quality of life and economic viability the farmers’ overall view of their sustainability was supported by their farm data suggesting either the farmers consulted farm data prior to responding to the pretest or more likely data concerning these themes is more intrinsically known and easily recalled due to the overall importance of successful management in these areas. For the themes water use, energy and climate, biodiversity and working conditions the farmers initial overall view of their sustainability was higher than what their farm data suggested. Interviews with farmers indicated that these were the themes for which their knowledge of their farms’ performance was weakest. This weakness stemmed from either not taking the time to consult farm records or a lack of information available at the detailed level needed for assessment. The only theme where farmers consistently underestimated their performance was animal husbandry. The importance of proper animal husbandry techniques and the high attention to detail concerning their herds resulted in the farmers having higher expectations of performance. Animal husbandry is a theme where farmers interact with personalized, farm level data daily. Their knowledge of their farms’ performance was indicated by the more detailed index scores on the pretest equaling their RISE index score, however their lower overall theme score indicated their continual drive towards even more sustainable management.

Interviews with the farmers during both the RISE assessments and feedback sessions shed some light on their intentions towards sustainable management practices. The theory of planned behavior suggests that intension is the best predictor of behavior.
Participation in this research was voluntary thus the sample may have been biased to those predisposed to a commitment to sustainable management. While interviews with some indicated a lack of agreement in how some of the themes were measured such as biodiversity, farmers did not indicate a lack of agreement about the importance of any of the themes in terms of tenants of sustainable agriculture. Although statistical significance in intent to change management practices for the most part was not indicated, the farmers did convey their intentions to manage their farms in a sustainable manner. The theory of planned behavior notes that these intentions should translate into behavior, however constraints such as financial limitations, and beliefs that their efforts will not make a large enough impact likely contributed to the insignificant intent to change findings.

Some trends were identified regarding barriers to change. The two most cited barriers to change were expense and a belief that implementing changes would not result in significant impacts. Based on these results, the implementation of sustainable farming practices could be increased by providing farmers with financial assistance possibly in the form of cost-shares and low interest loans. The results indicate that the financial assistance is most needed in water management strategies, on-farm renewable energy production, equipment efficiency upgrades and capital improvement projects. In addition to financial barriers, farmers indicated their disbelief that their efforts to improve soil management, water use and biodiversity would significantly improve their operations. Beyond financial assistance, farmers would further benefit from educational materials and experiences such as field days aimed at improving soil management, water storage and capacity building, irrigation and biodiversity.
Individual practices for which farmers expressed the greatest and least intent to change provide some insight into the differences in intent to change among themes. Themes with the greatest average intent to change were energy and climate, animal husbandry, water use and biodiversity whereas the themes with the least average intent to change were soil use, animal husbandry, quality of life and material use and environmental protection. Farmers expressed the greatest intent to change some of the individual practices representing animal husbandry, whereas they expressed the least intent to change other practices representing this same theme. Working conditions and economic viability were the only two themes for which farmers expressed neither the greatest nor the least intent to change the individual practices representing these themes. The practices identified with the greatest intent to change generally resulted in a direct cost savings, with the exception of decreasing the potential for water contamination. The theme quality of life was comprised of two practices for which farmers expressed a desire to avoid change, job security and freedom of expression. Therefore, the response to individual practices explains at least some of the variation inherent in average intent to change for themes.

Water use was the theme that was associated with the most barriers to change, particularly in being seen as too expensive and unlikely to make a large enough impact. The practice of containing manure and wastewater to minimize water contamination, however, was among the practices that farmers expressed the greatest intent to change. Because water use practices are both a concern and a challenge for farmers, providing farmers with access to materials that may increase their knowledge of water consumption and management and providing them with opportunities to conduct on-farm trials of
management practices focused on water consumption and quality may remove the
barriers and further increase their intent to change. Diffusion of innovation suggests that
these changes can best be achieved by convincing trusted leaders in the community to test
these water use practices and share their experiences. Supporting farmers with the
resources needed to conduct on-farm trials to personalize the innovations to their farm
systems may also help with improving water use practices.

Diffusion of innovation theory provides a framework for examining how farmers
learn about and ultimately adopt of reject new management practices. In the context of
this research it appears farmers could benefit from trusted sources (early adopters)
spearheading management practices particularly in water use, biodiversity and energy
and climate. If farmers had the opportunity to learn from trusted sources and then pilot
management practices on their farms they may increase their intent to change
management practices. By first learning about practices from people within the farming
community that they trust and then having the opportunity to perform on-farm trials,
information moves from the general to the personalized within a supportive social
system. If the trials yield favorable results, the theory suggests farmers are more likely to
adopt the management change. As results from sustainable management practices are
communicated and piloted by early adopters there is an increased chance that the early
majority will begin to take interest and ultimately adopt these practices as well.
Diffusion of innovation suggests that as long as the practices are proving to be beneficial
to farmers this process will continue until these practices become the accepted norm.
References


Chapter 5: Conclusions

There are numerous factors that contribute to how farmers perceive the sustainability of their management practices, this research examines one factor, the influence of their own data. Farmers can engage with data on multiple levels. Some personalize information such as farm soil tests, billing records and farm assessments while some keeps data more general such as best management practices and newsletter articles. My thesis is that the level of personalization and engagement of the data will improve the accuracy of measurement of their farms’ management strategies as determined by the subjective RISE assessment which will in turn shape how farmers perceive their overall sustainability and ultimately guide their decision making on intent to change management practices for improved sustainability. This research examined how well farmers know the details of their management practices related to sustainability and explored how accessing information affected their intent to change management practices. I supported this thesis in subsequent chapters with research that compares farmers’ overall assessment of the sustainability of their practices with objective measures of the sustainability of their practices, through comparing results from the RISE evaluation and a mail survey that I developed based on both RISE and readily available NRCS data. The correspondence between the subjective and objective measures can differ depending on consultation and examination of the underlying data. I further
showed differences in the farmers’ intent to change their practices as a function of whether information is general or personalized, how well their current practices contribute to their sustainability, either according to them or in an objective index, and the existence of barriers to change. I found that when farmers engaged in personalized data such as billing and production records, they were more likely to assess the sustainability of their operations to be at about the same level as the more objective RISE assessment did. This was found for the themes soil use, material use and environmental protection, quality of life and economic viability. However, when they neglected or lacked data they were more likely to overestimate their sustainability, which occurred in the themes water use, energy and climate, biodiversity and working conditions. The one theme for which farmers consistently underestimated their sustainability was animal husbandry, a theme that is paramount for them.

The comparison between the pretest indices and the RISE indices indicated that the management practices used on the pretest generally were a good representation of what is measured in RISE for all themes except for soil use and energy and climate. Furthermore, the comparison between RISE measurements and NRCS cost-sharing incentives was similar for most themes. The differences between the pretest indices and RISE indices for soil use and energy and climate, however, pose a challenge for measuring intent to change management practices as these results indicate that the two are not measuring comparable practices. During the RISE sessions and in the printed materials sent to the control group, farmers learned about practices that were not represented in the narrow scope of the pretest/posttest therefore they did not have the

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opportunity to express their potential intent to change based on their treatment experience. Intent to change, therefore, may not be influenced by RISE for these themes.

The comparison between the pretest theme and the pretest indices suggested that farmers’ management practices did not support their overall view of their sustainability for any of the themes except working conditions. Furthermore, the farmers viewed their overall sustainability as higher than what their practices indicated for all themes except working conditions and animal husbandry. Although there were small differences detected between the pretest theme and pretest indices for animal husbandry, material use and environmental protection, water use and quality of life, the farmers have a fairly strong sense of the overall sustainability of their operations based on their management practices, which was supported by their overall theme scores being similar to their more objectively calculated RISE indices. This was further supported by the pretest indices and RISE indices being equal for each of these themes (reported in chapter 2).

The comparison of farmers’ pretest evaluation of their farm’s sustainability by theme to their RISE theme evaluation indicated that where information was not readily known or easily accessible, the pretest theme and the RISE theme tended to disagree. Conversely where information about management was regularly consulted and used for management, the evaluations tended to agree. Animal husbandry was the only theme for which agreement was poor even though information was apparently plentiful. This theme was also the only one where the farmer’s mean score was lower than the RISE mean score.

Based on these results, farmers could benefit from the development of tools aimed at providing greater depth of information in the themes of water use, energy and climate,
biodiversity and working conditions. By raising awareness of the impacts of their management practices farmers can make more informed decisions regarding management changes. The results of this study indicate that farmers engage with information on soil use, animal husbandry, material use and environmental protection, quality of life and economic viability, leading them to assess their sustainability at levels equivalent to a more objective assessment. However, information on water use, energy and climate, biodiversity and working conditions either is not available or isn’t being used by farmers. Developing programs aimed at increasing farm-based information, such as providing reduced-cost water meters, or landscape assessments for biodiversity enhancement, could drive farmers to improve the understanding of their farms’ sustainability which may ultimately drive their intent to change.

The pretest/posttest design utilized in this research provided the opportunity to collect information from farmers regarding their current management practices and compare them to how they would like to manage their operations after being exposed to information designed to improve their sustainability. The hypothesis that providing a place-based comprehensive assessment will increase the farmers’ intent to change management practices was not supported. The only cases where RISE as a tool to increase engagement with data influenced the intent to change practice, according to my measure of intent to change, were themes for which the increased engagement with data decreased the intent to change, possibly because the data suggested that the practices used were more sustainable than the farmers thought they were. The more frequent result was that farmers’ view of their sustainability on the pretest was a stronger indicator for intent to change. However, when personalized information was likely not consulted at the time
of the pretest, before any of the evaluation treatments were applied, I did produce evidence that the farmers scored themselves higher than the more object RISE evaluation did. This was the case for the themes water use, energy and climate, biodiversity, and working conditions. Interviews with farmers indicated that these were the themes for which their knowledge of their farms’ performance was weakest. This weakness stemmed from either not taking the time to consult farm records or a lack of information available at the detailed level needed for assessment.

Barriers to change may also affect the intent to change. The two most cited barriers to change were expense and a belief that implementing changes would not result in significant impacts. Based on these results, the implementation of sustainable farming practices could be increased by providing farmers with financial assistance possibly in the form of cost-shares and low interest loans. The results indicate that the financial assistance is most needed in water management strategies, on-farm renewable energy production, equipment efficiency upgrades and capital improvement projects. In addition to financial barriers, farmers indicated their disbelief that their efforts to improve soil management, water use and biodiversity would significantly improve their operations. Beyond financial assistance, farmers may benefit from educational materials and experiences such as field days aimed at improving soil management, water storage and capacity building, irrigation and biodiversity. Farmers need assistance with navigating the information and personalizing the application to their system. Conducting RISE assessments is one way to achieve this, however it is only one step in the continual improvement process. Demonstrations of sustainable agriculture so that farmers can
interact with the techniques, equipment and management philosophies are also needed if intent to change is to lead to actual implementation.

This research was the first exploration of the role general versus personalized information has on intent to change management practices. There are many aspects future research can explore to further develop what has been presented. This research collected information on intent using a survey, but it did not measure the relationship between stated intent to change and actual change in management practice by the farmers. Additional research is needed to relate measured intent to change with implementation. One direction this can take is to first establish the top management practices farmers are interested in exploring, as outlined in Chapter 4, and then determine the number of acres, cows, etc. need for an on-farm trial to be conducted. Approaching farmers with the question “would you be willing to implement this practice on your farm on a trial basis” may be a better predictor of intent to change than asking farmers to project their changes on a survey. Understanding farmers’ willingness to pilot management changes may also help to determine what level of intent to change is significant.

No follow up studies have ever been completed on the impact of RISE on actual implementation of more sustainable management practices (Grenz, personal communication). Plenty of farms have received assessments, over 3300, but little is known about the impact the assessments have had on farmers implementing more sustainable agricultural practices. Implementation studies in agriculture are often difficult because they require significant time for projects to be developed and completed, therefore, this research measured intent to change rather than the change itself. However,
measuring implementation seems necessary to determine if RISE assessments are increasing the use of practices associated with sustainable agriculture.

This project was limited by the small sample size, which resulted in low power for detecting statistically significant differences in the intent to change management practice. Post hoc power analysis (1 - β = .8 and α = .05) based on the intent to change data for all surveys resulted in an estimated required sample size of approximately 100 farms to detect statistically significant differences in the intent to change of the magnitude seen among treatment groups in my study. This exceeds my original goal of acquiring data from 60 farms or 25% of the organic dairies in Ohio. Voluntary participation with no additional incentives beyond the RISE assessment feedback makes the reality of getting a statistically significant sample size challenging. As important as statistical power, however, is the understanding described above of how a particular level of intent translates to actual change, and therefore, the level of intent needed for a change in practice to occur.

These results may be better explained through a more exhaustive collection and evaluation of demographic data. The demographic data collected during the pretest did not allow for more in depth examination of the results. For example, examination of education level or years of farming experience may help explain why farmers provided pretest scores that were not similar to their RISE scores. The demographic data collected in this study did not find any statistically significant relationships between these variables and the outcomes, however, as noted above, the limited sample size and demographic data collected may have prevented these differences from being detected.
This research journey started from a desire to better understand how to support farmers in improving the sustainability of their management practices. My history and passion for organic dairy lead me to focus on that population. What I discovered during my work was less about how to support farmers in improving sustainability and more about why farmers aren’t motivated to change. Most of the farmers in this study considered their management practices to be sustainable and for the most part, there was evidence to support their beliefs. The management of their soils, animals, quality of life and overall farm did average in the positive spectrum of sustainability. Material use and environmental protection and water use were within two points of being rated sustainable. Intent to change is seemingly lessened when farmers are already producing strong results.

In addition to their already positive management, I discovered that farmers don’t have much incentive to change. The current structure for incentives does not reward the early adopters or the farmers that strive for continual improvement. In many instances, improving management practices can be costly in financial, technical and labor resources. I am left asking the question why would farmers willingly strive to improve if they are not being rewarded. If there is no cap on emissions, why would farmers invest in technology that would lower their impacts yet not increase the value of their goods? If there is no recognition of the benefits to society that farmers provide by protecting biodiversity, why would farmers invest in greater diversification on their farms?

Throughout this project, I have had the opportunity to interact with farmers and gain a greater understanding of the complexities they face on a daily basis. They are constantly challenged with problem solving mechanical and technical issues, animal
husbandry challenges, soil health, and environmental protection all while providing for their families and society in a way that makes all of the stress and long hours worthwhile in the end. Farmers are undoubtedly unsung heroes in my eyes and yet instead of recognizing all that they provide to society they are often pointed to as the source of environmental and societal woes. If farmers are to be expected to continue to lower their impacts on the environment, protect societal well-being and contribute to the economy there must be more incentives to assist them. We as a nation must develop and enforce policies that support sustainable agriculture production instead of incentivizing unsustainable production. The expectation that farmers will voluntarily innovate is not a reasonable approach. Support is needed of their efforts.

This research focused on distance to information and how that distance affects intent to change management practices for improved sustainability. The results of these studies indicated that distance does play a role in how farmers view the sustainability of their operations. In general farmers tended to view their farms as more sustainable than their management practices suggested should be the case. Decreasing the distance to information could help farmers to have a more realistic view of their management practices. Farmers who viewed their sustainability as high were less likely to indicate an intent to change; however, when farmers were provided evidence that contradicted their beliefs of high sustainability it also resulted in increasing their intent to change.

Globally, agriculture is being called upon to diminish negative environmental impacts while improving economic returns and supporting society’s health and well-being. To meet this challenge, farmers need to continually improve their management practices. Reducing distance to information through personalized on farm assessments such as
RISE is one approach that will assist farmers with continuous improvement toward sustainability.


Foster, C., Green, K., & Bleda, M. (2007). Environmental impacts of food production and consumption: Final report to the department for environment food and rural affairs.


Goodland, R., & Anhang, J. (2009). Livestock and climate change: What if the key actors in climate change are... cows, pigs, and chickens? Livestock and Climate Change: What if the Key Actors in Climate Change are...Cows, Pigs, and Chickens?


Hayati, D., Ranjbar, Z., & Karami, E. (2010). Measuring agricultural sustainability. Biodiversity, biofuels, agroforestry and conservation agriculture (pp. 73-100) Springer.


Appendix A: RISE Questionnaire
This assessment will be based on your operations in 2015. If for some reason 2015 was an anomaly, please provide an average of the last few years.

☐ Do you use energy to run your farm? (electricity, solar, wind, propane, diesel etc.)
   □ Yes   □ No

☐ Do you irrigate?
   □ Yes   □ No

LIVESTOCK

1. How many livestock breeds are kept on your farm? (Total number of animal breeds for all animal types – i.e. Jerseys, Holsteins, draft horses, Boer goats = 4 breeds) ________

2. How many traditional or endangered breeds are kept on your farm? __________

3. Potential methane emissions resulting from husbandry system and slurry storage?
   □ Very High = animals kept in high density with no access to pastures, manure often stored as slurry in tanks
   □ High = animals kept in high density with no or only rare access to pasture, manure is largely stored as slurry in tanks
   □ Medium = animals kept in medium density and with limited access to pastures. Manure largely stored as solid waste
   □ Low = animals kept in low density with frequent access to pastures. If manure is stored at all, then largely in dried form
   □ Very Low = animals kept in low density with continuous access to pastures. Practically no manure storage with dung accumulating and drying on pastures

4. Is information concerning animal conditions and performance documented and used for herd management?
   □ Animals are regularly observed, information about performance, reproduction, animal transport and illness is collected and documented and used for livestock management
   □ Animals are occasionally monitored, information is incomplete and livestock management is mainly done by intuition
   □ The condition of the animals is only monitored when there are significant problems. There is no documentation or only performance data. Livestock management is done exclusively by intuition

5. Are animals purchased and bred according to sustainability criteria and animal welfare standards?
   □ Selection and breeding for robustness, adapted to climate and farm conditions, expected life performance etc.
   □ Conscious selection and breeding, but only or predominantly for short-term performance criteria
   □ No conscious choice ("take what you get"), no long-term perspective in livestock management
   □ Selection or breeding is not relevant for any animal category or not the decision of the farmer (i.e. boarding horses)

6. Are animal diseases and constraints to animal welfare actively prevented? (i.e. claws/hoofs are regularly trimmed, animals are clean, sufficient numbers of clean and dry rest areas are always available etc.)
   □ Barns are cleaned properly, frequently and thoroughly, hooves are maintained, animals with infectious diseases are separated etc.
   □ Preventative measures are implemented only partly and/or too seldom
   □ Animals and stables are neglected, hooves are too long and animals have poor posture, a significant number show signs of disease (discharge from eyes or nose, bald or sore areas etc.)
<table>
<thead>
<tr>
<th></th>
<th>Calves</th>
<th>1 - 2 yr Heifers</th>
<th>2 yr Heifers</th>
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<tbody>
<tr>
<td><strong>Number of units</strong> (Yearly average)</td>
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<td>Are animals permanently pastured?</td>
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<td>Yes</td>
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<td>No</td>
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<td>Grazing months/year</td>
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<td>Grazing hours /day</td>
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<tr>
<td>Yield per unit/day (DGR = Daily growth rate)</td>
<td>lbs/day</td>
<td>lbs/day</td>
<td># of offspring</td>
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<tr>
<td>How well does the farm meet the quality criteria for this product?</td>
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<tr>
<td>Clearly exceeded</td>
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<td>Partly exceeded</td>
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<tr>
<td>Fulfilled</td>
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<td>Partly not fulfilled</td>
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<tr>
<td>Not fulfilled</td>
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<tr>
<td>Quality of main product in comparison with regional average?</td>
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<tr>
<td>Significantly above average</td>
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<td>Slightly above average</td>
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<td>At the same level</td>
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<td>Slightly below average</td>
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<tr>
<td>Significantly below average</td>
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<tr>
<td>Development of yield and quality over the last 5 years?</td>
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<td>Significant improvement</td>
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<td>Slight improvement</td>
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<td>Stagnation</td>
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<td>Slight deterioration</td>
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<td>Significant deterioration</td>
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<td>The animals have sufficient space (enough rest places, drinking troughs and feeding stations of an adequate size etc.)</td>
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<td>Yes</td>
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<td>Partly</td>
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<td>No</td>
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<tr>
<td>Adequate numbers of clean, comfortable rest places are available?</td>
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<td>Yes</td>
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<td>No</td>
<td>Yes</td>
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<td>All walking surfaces are clean, non-slip and intact?</td>
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<td>Yes</td>
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<td>Partly</td>
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<td>No</td>
<td>Yes</td>
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<tr>
<td>Animals have at least eye contact with other animals of their species and live in stable social structures?</td>
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<td>Yes</td>
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<td>Partly</td>
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<td>No</td>
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<td>Are there enough clean and functional water devices?</td>
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<td>Yes</td>
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<td>Partly</td>
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<td>No</td>
<td>Yes</td>
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<td>Are the animals protected from heat and cold?</td>
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<td>Shade/wallow sufficient</td>
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<td>Shade/wallow too small</td>
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<tr>
<td>No shade/wallow</td>
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<td>Shade/wallow too small</td>
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<tr>
<td>No shade/wall</td>
<td>Yes</td>
<td>No</td>
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<tr>
<td>Milking Cows (including dry)</td>
<td>Bulls</td>
<td>Horses</td>
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| Shade/wallow sufficient     | Shade/wallow sufficient | Shade/wallow sufficient |
| Shade/wallow too small      | Shade/wallow too small  | Shade/wallow too small  |
| No shade/wallow             | No shade/wallow         | No shade/wallow         |

177
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<th>Question</th>
<th>Calves</th>
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<tr>
<td>Feed is at all times appropriate to needs and species?</td>
<td>Yes Partly No</td>
<td>Yes Partly No</td>
<td>Yes Partly No</td>
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<tr>
<td>All technical equipment is in working order, appropriate to the animals' needs and does not represent a danger of injury?</td>
<td>Yes Partly No</td>
<td>Yes Partly No</td>
<td>Yes Partly No</td>
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<td>Yes Partly No</td>
<td>Yes Partly No</td>
<td>Yes Partly No</td>
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<td>The animals have sufficient space to move in ways typical for their species?</td>
<td>Yes Partly No</td>
<td>Yes Partly No</td>
<td>Yes Partly No</td>
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<tr>
<td>Is the surrounding area for the animals well lit?</td>
<td>Pastured during the day</td>
<td>Pastured during the day</td>
<td>Pastured during the day</td>
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<tr>
<td>Is the air quality good?</td>
<td>Light ammonia smell</td>
<td>Light ammonia smell</td>
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<tr>
<td>Are the animals free of acoustic stress?</td>
<td>Yes Partly No</td>
<td>Yes Partly No</td>
<td>Yes Partly No</td>
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<tr>
<td>Are all animals healthy-looking and in good physical state?</td>
<td>Yes Partly No</td>
<td>Yes Partly No</td>
<td>Yes Partly No</td>
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<tr>
<td>Is veterinary treatment always based on observation and examination?</td>
<td>Yes Partly No</td>
<td>Yes Partly No</td>
<td>Yes Partly No</td>
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<tr>
<td>Do you perform modifications to your animals that would result in acute or chronic pain or impair their natural behavior? (i.e. dehorning or castration without anesthesia)</td>
<td>Yes Partly No</td>
<td>Yes Partly No</td>
<td>Yes Partly No</td>
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<tr>
<td>How many animals died of disease or from injury/accident last year?</td>
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<td>Milking Cows (including dry)</td>
<td>Bulls</td>
<td>Horses</td>
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<td>No</td>
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<td>Pastured during the day</td>
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<tr>
<td>Between 8 - 16 hours</td>
<td>Between 8 - 16 hours</td>
<td>Between 8 - 16 hours</td>
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<td>of artificial light/day</td>
<td>of artificial light/day</td>
<td>of artificial light/day</td>
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<td>In dark barns or more than</td>
<td>In dark barns or more</td>
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<td>Number of units (Yearly average)</td>
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<td>Broilers</td>
<td>Turkeys</td>
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<td>Are animals permanently pastured?</td>
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<td>Grazing months/year</td>
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<td>Yield per unit/day (DGR = Daily growth rate)</td>
<td>lbs/day</td>
<td>lbs/day</td>
<td># of offspring</td>
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<td>How well does the farm meet the quality criteria for this product?</td>
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<td>Quality of main product in comparison with regional average?</td>
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<tr>
<td>Development of yield and quality over the last 5 years?</td>
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<tr>
<td>The animals have sufficient space (enough rest places, drinking troughs and feeding stations of an adequate size etc.)</td>
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<td>Yes</td>
<td>Yes</td>
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<tr>
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<td>Partly</td>
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<tr>
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<td>Adequate numbers of clean, comfortable rest places are available?</td>
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<td>All walking surfaces are clean, non-slip and intact?</td>
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<tr>
<td>No</td>
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<td>Animals have at least eye contact with other animals of their species and live in stable social structures?</td>
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<td>Are there enough clean and functional water devices?</td>
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<td>Beef Cattle</td>
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<td>At the same level</td>
<td>At the same level</td>
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<td>Shade/wallow sufficient</td>
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<td>Shade/wallow too small</td>
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<td>Laying Hens</td>
<td>Broilers</td>
<td>Turkeys</td>
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<td>---------</td>
</tr>
<tr>
<td><strong>Feed is at all times appropriate to needs and species?</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td></td>
<td>Partly</td>
<td>Partly</td>
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<td></td>
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<td>No</td>
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</tr>
<tr>
<td><strong>All technical equipment is in working order, appropriate to the animals' needs and does not represent a danger of injury?</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
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<td>Partly</td>
<td>Partly</td>
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<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>Animals have regular and sufficiently long access to exercise? (at least 8 hours/day at least 90 days/yr)</strong></td>
<td>Pastured during the day</td>
<td>Pastured during the day</td>
<td>Pastured during the day</td>
</tr>
<tr>
<td></td>
<td>Between 8 - 16 hours of artificial light/day</td>
<td>Between 8 - 16 hours of artificial light/day</td>
<td>Between 8 - 16 hours of artificial light/day</td>
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<tr>
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<td>In dark barns or more than 16 hours artificial light/day</td>
<td>In dark barns or more than 16 hours artificial light/day</td>
<td>In dark barns or more than 16 hours artificial light/day</td>
</tr>
<tr>
<td><strong>The animals have sufficient space to move in ways typical for their species? (standing up, lying down, turning, grooming)</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Partly</td>
<td>Partly</td>
<td>Partly</td>
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<tr>
<td></td>
<td>No</td>
<td>No</td>
<td>No</td>
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<tr>
<td><strong>Is the surrounding area for the animals well lit?</strong></td>
<td>Pastured during the day</td>
<td>Pastured during the day</td>
<td>Pastured during the day</td>
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<td>Between 8 - 16 hours of artificial light/day</td>
<td>Between 8 - 16 hours of artificial light/day</td>
<td>Between 8 - 16 hours of artificial light/day</td>
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<td>In dark barns or more than 16 hours artificial light/day</td>
<td>In dark barns or more than 16 hours artificial light/day</td>
<td>In dark barns or more than 16 hours artificial light/day</td>
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<tr>
<td><strong>Is the air quality good?</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td></td>
<td>Partly</td>
<td>Partly</td>
<td>Partly</td>
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<td></td>
<td>No</td>
<td>No</td>
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<tr>
<td><strong>Are the animals free of acoustic stress? (constant loud noises from equipment)</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td></td>
<td>Partly</td>
<td>Partly</td>
<td>Partly</td>
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<tr>
<td></td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>Are all animals healthy-looking and in good physical state?</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Partly</td>
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<td></td>
<td>No</td>
<td>No</td>
<td>No</td>
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<tr>
<td><strong>Is veterinary treatment always based on observation and examination?</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td></td>
<td>Partly</td>
<td>Partly</td>
<td>Partly</td>
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<tr>
<td></td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>Do you perform modifications to your animals that would result in acute or chronic pain or impair their natural behavior? (i.e. dehorning or castration without anesthesia)</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td></td>
<td>Partly</td>
<td>Partly</td>
<td>Partly</td>
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<tr>
<td></td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>How many animals died of disease or from injury/accident last year?</strong></td>
<td>Pastured during the day</td>
<td>Pastured during the day</td>
<td>Pastured during the day</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

**Notes:**
- Yes
- Partly
- No
- Light ammonia smell
- Strong ammonia smell/draft
- Pastured during the day/no draft
<table>
<thead>
<tr>
<th>Beef Cattle</th>
<th>Swine</th>
<th>Goats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Partly</td>
<td>Partly</td>
<td>Partly</td>
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<tr>
<td>No</td>
<td>No</td>
<td>No</td>
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<tr>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td>Partly</td>
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<td>Yes</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Partly</td>
<td>Partly</td>
<td>Partly</td>
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<tr>
<td>No</td>
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<td>No</td>
</tr>
</tbody>
</table>

- **Pastured during the day**
- **Between 8 - 16 hours of artificial light/day**
- **In dark barns or more than 16 hours artificial light/day**
- **Pastured during the day/no draft**
- **Light ammonia smell**
- **Strong ammonia smell/draft**
- **Yes**
- **Partly**
- **No**
SOIL AND BIODIVERSITY

1. Composition of the overall farm – acreage should not appear in more than one category

<table>
<thead>
<tr>
<th>Category</th>
<th>Total Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmyard, buildings, house, roads (areas not usable for planting/grazing)</td>
<td></td>
</tr>
<tr>
<td>Open water, quarry, gravel pits, rocks, reserves (areas not usable for planting/grazing)</td>
<td></td>
</tr>
<tr>
<td>Wooded</td>
<td></td>
</tr>
<tr>
<td>Productive land – crops, grassland, permanent crops/pasture, greenhouses, buffer strips etc.</td>
<td></td>
</tr>
<tr>
<td>Total acres (including rented land)</td>
<td></td>
</tr>
</tbody>
</table>

2. How much wooded area belonging to the farm/rented was cleared or lost due to natural disasters over the last 20 years? __________ acres

Productive Land

3. How much farm land was lost during the past 10 years – soil that can no longer be used for agricultural purposes such as from salinization, erosion, sealing etc.? __________ acres

4. What is the average altitude of your productive acres? __________ feet above sea level

5. What is the predominante soil type? (please choose the answer that represents the highest percentage of your cultivated land)

   - Clay: pure/loamy/sandy
   - Clay: silty
   - Clay: slightly silty
   - Clay: very silty
   - Loam: sandy and very sandy/clayey
   - Loam: slightly sandy/silty
   - Sand: clayey
   - Sand: loamy
   - Sand: pure/loamy
   - Sand: loamy-silty
   - Sand: pure sand
   - Sand: slightly clayey
   - Sand: slightly silty
   - Sand: very loamy
   - Sand: slightly silty/slightly loamy
   - Sand: very loamy
   - Silt: pure/sandy/clayey/loamy

6. Check all cultivation practices that have been introduced throughout the last 20 years and the average number of acres/year (Only check practices that you are permanently implementing)

   - Application of compost _______ acres
   - Conversion of arable land to grassland _______ acres
   - Conversion of grassland in rotation to natural meadow/pasture _______ acres
   - Cultivation of crops for bioenergy _______ acres
   - Planting of deep rooted crops _______ acres
   - Increased time-of-use of grassland before following crop in rotation _______ acres
   - Nonuse of crop residues _______ acres
   - No-till cultivation _______ acres
   - Reduced tillage _______ acres
   - Planting perennial grasses or permanent crops _______ acres
   - Use of liquid manure _______ acres
   - Conversion of permanent crops to arable land _______ acres
   - Increased amount of fertilizer on poor soils _______ acres
Crops
Please complete the table below to identify the crops you produced last year (2015). If you planted more than one crop on the same field (double cropped) enter the information for each crop separately; thus total acres can exceed the amount reported earlier. Please report yield in tons of dry matter/year if possible. Use the next column to note if you used dry or wet tonnage. The “percent fed“ category is meant to capture if you produced feed that you did not feed to your animals by the end of 2015 – either it was sold or you had left over for the next year. Enter the percent that was fed. If you planted a crop that is not listed, please write it in the extra spaces below and fill out the information regarding that crop.

<table>
<thead>
<tr>
<th>Crop (If seasonal please circle what season)</th>
<th>Number of Acres</th>
<th>% Dry Matter</th>
<th>Month Planted</th>
<th>Duration of Cultivation (number of days to harvest)</th>
<th>Yield/Acre (Tons/acre)</th>
<th>Is yield measured in dry matter or wet tons?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barley (Spring or Winter)</td>
<td></td>
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<td></td>
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<tr>
<td>Corn Silage</td>
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<tr>
<td>Grain Corn</td>
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<tr>
<td>Ear Corn</td>
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<tr>
<td>Oats (Spring or Winter)</td>
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<tr>
<td>Winter Rye</td>
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<tr>
<td>Soybeans</td>
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<tr>
<td>Spelt</td>
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<tr>
<td>Triticale (Spring or Winter)</td>
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<tr>
<td>Wheat (Spring or Winter)</td>
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<tr>
<td>Alfalfa</td>
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<tr>
<td>Clover Grass in Rotation</td>
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<tr>
<td>Green Manure/Cover Crop (&gt; 60% legumes)</td>
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<tr>
<td>Green Manure/Cover Crop (&lt; 60% legumes)</td>
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<tr>
<td>Green Manure/Cover Crop (0% legumes)</td>
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<tr>
<td>Buffer Strips/hedgerows/fallow/brush</td>
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<tr>
<td>Pasture in Rotation - Cut</td>
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<tr>
<td>Pasture in Rotation - Grazed</td>
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<tr>
<td>Permanent Pasture - Cut</td>
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<tr>
<td>Crop</td>
<td>Number of cuts/year Or times grazed/year (if applicable)</td>
<td>% Fed (if all = 100%, if only half was fed in the year = 50% etc.)</td>
<td>Production Trend is the last 5 Years</td>
<td>Does the feed meet quality standards?</td>
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<tr>
<td>Barley (Spring or Winter)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>Clearly exceeded</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corn Silage</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>Clearly exceeded</td>
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<tr>
<td>Grain Corn</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>Clearly exceeded</td>
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<tr>
<td>Ear Corn</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>Clearly exceeded</td>
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<tr>
<td>Oats (Spring or Winter)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>Clearly exceeded</td>
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<tr>
<td>Winter Rye</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>Clearly exceeded</td>
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<tr>
<td>Soybeans</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>Clearly exceeded</td>
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<tr>
<td>Spelt</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>Clearly exceeded</td>
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<tr>
<td>Triticale (Spring or Winter)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>Clearly exceeded</td>
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<tr>
<td>Type of Manure Applied (i.e. liquid, bedding pack, chicken, compost etc.)</td>
<td>Number of acres applied</td>
<td>Amount/acre (either gallons/acre or tons/acre)</td>
<td>Are harvest residues removed? (i.e. straw)</td>
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<td>Acres</td>
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<td>Yes  No</td>
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<td>Acres</td>
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<td>Yes  No</td>
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<td>Acres</td>
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<td>Yes  No</td>
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<tr>
<td>Crop</td>
<td>Number of cuts/year Or times grazed/year (if applicable)</td>
<td>% Fed (if all = 100%, if only half was fed in the year = 50% etc.)</td>
<td>Production Trend is the last 5 Years</td>
<td>Does the feed meet quality standards?</td>
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<tr>
<td>Wheat (Spring or Winter)</td>
<td>N/A</td>
<td>%</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Alfalfa</td>
<td>%</td>
<td>Significant improvement</td>
<td>Stayed the same</td>
<td>Slight deterioration</td>
<td>Significant deterioration</td>
<td>Clearly exceeded</td>
</tr>
<tr>
<td>Clover Grass in Rotation</td>
<td>%</td>
<td>Significant improvement</td>
<td>Stayed the same</td>
<td>Slight deterioration</td>
<td>Significant deterioration</td>
<td>Clearly exceeded</td>
</tr>
<tr>
<td>Green Manure/Cover Crop (&gt; 60% legumes)</td>
<td>%</td>
<td>Significant improvement</td>
<td>Stayed the same</td>
<td>Slight deterioration</td>
<td>Significant deterioration</td>
<td>Clearly exceeded</td>
</tr>
<tr>
<td>Green Manure/Cover Crop (&lt; 60% legumes)</td>
<td>%</td>
<td>Significant improvement</td>
<td>Stayed the same</td>
<td>Slight deterioration</td>
<td>Significant deterioration</td>
<td>Clearly exceeded</td>
</tr>
<tr>
<td>Green Manure/Cover Crop (0% legumes)</td>
<td>%</td>
<td>Significant improvement</td>
<td>Stayed the same</td>
<td>Slight deterioration</td>
<td>Significant deterioration</td>
<td>Clearly exceeded</td>
</tr>
<tr>
<td>Buffer Strips/hedgerows/fallow/brush</td>
<td>%</td>
<td>Significant improvement</td>
<td>Stayed the same</td>
<td>Slight deterioration</td>
<td>Significant deterioration</td>
<td>Clearly exceeded</td>
</tr>
<tr>
<td>Pasture in Rotation - Cut</td>
<td>%</td>
<td>Significant improvement</td>
<td>Stayed the same</td>
<td>Slight deterioration</td>
<td>Significant deterioration</td>
<td>Clearly exceeded</td>
</tr>
<tr>
<td>Pasture in Rotation - Grazed</td>
<td>100%</td>
<td>Significant improvement</td>
<td>Stayed the same</td>
<td>Slight deterioration</td>
<td>Significant deterioration</td>
<td>Clearly exceeded</td>
</tr>
<tr>
<td>Type of Manure Applied</td>
<td>Number of acres applied</td>
<td>Amount/acre (either gallons/acre or tons/acre)</td>
<td>Are harvest residues removed? (i.e. straw)</td>
<td></td>
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<td></td>
<td>Acres</td>
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<td>Yes/No</td>
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<td>Acres</td>
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<td>Yes/No</td>
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<td>Acres</td>
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<tr>
<td>Permanent Pasture - Cut</td>
<td>100%</td>
<td>% Significant improvement</td>
<td>Clearly exceeded</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Slightly improvement</td>
<td>Partly exceeded</td>
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<tr>
<td></td>
<td></td>
<td>Stayed the same</td>
<td>Fulfilled</td>
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<tr>
<td></td>
<td></td>
<td>Slight deterioration</td>
<td>Partly not fulfilled</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Significant deterioration</td>
<td>Not fulfilled</td>
<td></td>
<td></td>
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<tr>
<td>Permanent Pasture - Grazed</td>
<td>100%</td>
<td>% Significant improvement</td>
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<td></td>
<td>Significant deterioration</td>
<td>Not fulfilled</td>
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</table>

Erosion
Water

7. How often has water erosion been observed on the farm over the last 5 years?
   - Never
   - Once
   - Several times

8. Are there areas on the farm where water erosion is possible because of a slope gradient of at least 5%?
   - Yes
   - No
Type of Manure Applied  
(i.e. liquid, bedding pack, chicken, compost etc.)  
If more than one type of fertilizer is used please note all and the # of acres each was applied

<table>
<thead>
<tr>
<th>Number of acres applied</th>
<th>Amount/acre (either gallons/acre or tons/acre)</th>
<th>Are harvest residues removed? (i.e. straw)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acres</td>
<td></td>
<td>No</td>
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<tr>
<td>Acres</td>
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<td>No</td>
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<tr>
<td>Acres</td>
<td></td>
<td>Yes/No</td>
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<td>Acres</td>
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<td>Yes/No</td>
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<tr>
<td>Acres</td>
<td></td>
<td>Yes/No</td>
</tr>
<tr>
<td>Acres</td>
<td></td>
<td>Yes/No</td>
</tr>
</tbody>
</table>

*Answer questions 9 – 12 if you answered “Yes” to question 17. If you answered “No” skip to question 13.*

9. If you have slopes of more than 5%, what is the soil type in the areas at risk?

- Clay: pure/loamy/sandy
- Clay: silty
- Clay: slightly silty
- Clay: very silty
- Loam: sandy and very sandy/clayey
- Loam: slightly sandy/silty
- Sand: clayey
- Sand: loamy
- Sand: loamy-silty
- Sand: pure sand
- Sand: silty to very silty
- Sand: slightly clayey
- Sand: slightly silty/slightly loamy
- Sand: very loamy
- Silt: pure/sandy/clayey/loamy
10. What is the maximum slope gradient on areas that are at risk of erosion?
- Very steep slope = > 30%
- Steep slope = 15% - 30%
- Moderate slope = 5% - 10%
- Low slope = < 5%

11. What percentage of the area has ground cover in periods of heavy rains?
- Completely covered = 100%
- Largely covered = 75%
- Partly covered = 50%
- Little coverage = 25%
- No soil cover = 0%

12. Are any additional measures taken to reduce the risk of erosion besides ground cover? (i.e. slope stabilizers such as stones, buffer strips etc.)
- Yes
- Partly
- No

13. How often has wind erosion been observed on the farm over the last 5 years?
- Never
- Once
- Several times

14. Are there particularly exposed areas of the farm where wind erosion is possible in periods of dry soil?
- Yes
- No

15. What is the soil matter content in areas of risk?
- Low = < 1%
- Medium = 1 – 14%
- High = > 15% (such as Peat soils)

16. What is the average wind speeds in areas of risk?
- Low = < 7 mph - calm wind felt on the face
- Medium = between 7 and 11 mph - leaves and small twigs move
- High = > 11 mph - dust and loose paper, leaves and branches move

17. What percentage of the area has ground cover in periods of strong winds?
- Completely covered = 100%
- Largely covered = 75%
- Partly covered = 50%
- Little coverage = 25%
- No soil cover = 0%
18. What is the maximum distance between windbreak hedges or similar elements that reduce wind speed to open areas?

- [ ] Very small distance (height of windbreak is < 5 times taller than the distance to open areas)
- [ ] Small distance (height of windbreak is < 10 times taller than the distance to open areas)
- [ ] Medium distance (height of windbreak is < 15 times taller than the distance to open areas)
- [ ] Large distance (height of windbreak is < 20 times taller than the distance to open areas)
- [ ] The distance is > 20 times taller than the distance to open areas

19. Are any additional measures taken to reduce the risk of erosion besides ground cover? (i.e. tall trees, hedgerows etc.)

- [ ] Yes
- [ ] Partly
- [ ] No

Soil Compaction

20. Has harmful soil compaction been observed on the farm in recent years? (This is compaction of the sub-soils resulting from heavy machinery use. Animals are generally not heavy enough to cause this type of compaction.)

- [ ] Yes
- [ ] No

21. Are machines with a wheel load of > 2.5 tons used? (On a 4 wheeled vehicle that would be a load greater than 10 tons: 2.5 x 4 = 10)

- [ ] Yes
- [ ] No

*Answer questions 22 – 26 if you answered “Yes” to question 21. If you answered “No” skip to question 27.*

22. Do such machines drive across soils that contain more than 25% clay?

- [ ] Yes
- [ ] No

23. Do such machines drive across soil that is in very moist condition? (i.e. wheel ruts are visible in crops)

- [ ] Yes
- [ ] No

24. Is soil that heavy machines have driven across intensively treated? (Such as by ploughing or planting of root crops?)

- [ ] Yes
- [ ] No

25. Are measures taken to protect the soil when heavy machines are used? (i.e. double tires, low tire pressure, lattice tires etc.)

- [ ] Yes
- [ ] No

26. Are measures taken to increase soil stability when heavy machines are used? (i.e. Liming, reduced tillage, cover crops etc.)

- [ ] Yes
- [ ] No

Soil Analysis and Nutrients

27. Are soil analyses carried out regularly AND the results taken into account in fertilization planning?

- [ ] Yes
- [ ] No
28. Are soil organic matter balances calculated for crop rotation AND taken into account in cultivation planning?
   □ Yes □ No

29. Are nutrient balances for nitrogen and phosphorus (N and P) calculated AND taken into account in the fertilization plan?
   □ Yes □ No

30. Can a deficient phosphorus supply be observed on at least 50% of arable land?
   □ Yes □ No

31. Are there areas with very high nitrogen input? (High N input would be over 290 lbs/acre or more than 2 animals/acre)
   □ Yes □ No

**Soil Reaction**

32. What portion of your land fits into each of the following pH levels?

<table>
<thead>
<tr>
<th>pH Level</th>
<th>% of Farm</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 5.0</td>
<td></td>
</tr>
<tr>
<td>5.0 – 5.5</td>
<td></td>
</tr>
<tr>
<td>5.6 – 7.0</td>
<td></td>
</tr>
<tr>
<td>7.1 – 8.0</td>
<td></td>
</tr>
<tr>
<td>&gt; 8.1</td>
<td></td>
</tr>
<tr>
<td>Total farm</td>
<td>100%</td>
</tr>
</tbody>
</table>

33. Are acidifying (acid producing/pH lowering) fertilizers used? (i.e. sulphate fertilizers, ammonia fertilizers, urea, superphosphate, triple-superphosphate, cattle slurry etc.)
   □ Yes □ No

34. If you have acidic soils are they sufficiently limed?
   □ Yes □ No

**Soil Pollution**

35. Are residues used for which no pollutant analysis results are available?
   □ Yes – Fresh manure, slurry, waste water or other residues
   □ No – No residues are used – if fully composted manure is used than the answer is “no”

36. Are fertilizers or Plant Protection Products (PPPs) used that contain heavy metals? (i.e. lime, phosphate, potassium sulfate with magnesium, cattle or pig slurry, poultry manure etc.)
   □ Yes □ No
Biodiversity

37. Has biodiversity advice been provided to the farm in order to promote rare species and habitats worthy of protection, with planning, implementation and monitoring of the measures’ success?

☐ Yes, the farm received advice in these areas
☐ Yes, but the advice was rather superficial or incomplete
☐ No, the farm did not seek any such advice

38. Has a check been carried out to see whether rare species worthy of protection are found on the farm?

☐ Yes, surveyed by someone with a good knowledge of different species
☐ Yes, but rather superficially surveyed
☐ No

39. If rare species worthy of protection are found on the farm, have specific measures to promote these species been implemented? (i.e. nesting boxes, trees with suitable nesting holes, tolerance of bats, linking of isolated habitats etc.)

☐ Yes, relevant, targeted measures have been implemented
☐ Yes, minor or rather unspecific measures have been implemented
☐ No

40. If measures have been implemented, was their success checked? (Are population trends monitored and surveys carried out?)

☐ Yes, their success was monitored fairly closely
☐ Yes, but their success was monitored rather superficially, randomly and unsystematically using rough estimates
☐ No

41. Has a check been carried out to see whether habitats worthy of protection are found on the farm? (i.e. wetlands, dry grasslands, virgin forests etc.)

☐ Yes, surveyed by someone with good ecological knowledge
☐ Yes, but rather superficially surveyed
☐ No

42. If habitats worthy of protection are found on the farm, have specific measures to promote these habitats been implemented?

☐ Yes, appropriate measures have been taken to ensure optimal maintenance and support of all protected habitats
☐ Yes, measures have been implemented but their impact is not yet optimal
☐ No

43. What portion of your farm has areas with high environmental quality? (Primarily undisturbed areas such as fallow areas, buffer strips, woods, waterways, rock piles, riparian zones etc.) ____________ %

44. What portion of your farm is in the vicinity of ecological elements? (Within 150 ft of natural areas such as waterways, woods, biological corridors, buffer strips, hedges etc.) ____________ %

45. How has the development of environmental elements on your farm changed from an ecological point of view? (Past 10 years trees, bush, hedges, stone piles etc. have increased)

☐ Changed in the desired direction (increased habitat for plants and animals)
☐ Stayed the same (nothing much has changed in the last 10 years)
☐ Changed in an undesirable direction (loss of habitat for plants and animals)
46. Is there any beekeeping on the farm?  
☐ Yes  ☐ No

---

**WATER**

1. How often do livestock enter open waters?  
☐ At least once a week  
☐ Less than once a week  
☐ Never

**Water Consumption**

2. How would you describe your situation concerning water availability and water quality?  
__________________________________________________________________________________________

3. Has the water supply deteriorated over the past 5 years?  
☐ Yes  ☐ No

4. Have wells had to be sunk deeper, has the pump had to be lowered or the type of pump changed?  
☐ Yes  ☐ No (If you don’t have a well answer “no”)

5. Has water quality deteriorated over the past 5 years?  
☐ Yes  ☐ No

6. Has there been or is there any conflict with neighbors over water quantity or quality?  
☐ Yes  ☐ No

7. Are you using water from deep aquifers? (water that recharges the aquifer very slowly or not at all)  
☐ Yes  ☐ No

8. Does the farm have access to information about water availability and quality **AND** is the information included in the farm management plan?  
☐ Yes  ☐ No

9. Is water consumption known and changes in use or supply being monitored?  
☐ Yes  ☐ No

10. How much water is used for livestock production each year? (Do not count drinking water for livestock, this is water that is used to wash down the cows, parlor, bulk tank, holding pen, for cooling etc.) ___________ gallons/year

11. How much water is used in crop production each year? (Do not include irrigation water, this is water that is used to clean field machinery, equipment etc.) ___________ gallons/year

12. Is water storage potential known and systematically documented?  
☐ Yes  ☐ Partly  ☐ No
13. Have any technical measures been taken over the last 5 years to increase the water storage capacity on the farm? (i.e. built a pond, added water tanks etc.)

- [ ] Yes
- [ ] Partly
- [ ] No

**Water saving measures**

14. Please note, by placing a check mark in the appropriate column, if you implement any of these water saving techniques.

<table>
<thead>
<tr>
<th>Technique</th>
<th>Yes</th>
<th>Partly</th>
<th>No</th>
<th>Not Applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical removal of manure before cleaning the stockyard with water</td>
<td></td>
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<tr>
<td>Reuse water in livestock production – in cleaning and/or chilling etc.</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reuse water in crop production – to clean machinery and or equipment etc.</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Water saving in the household – low-flush toilets, low-flow showerheads etc.</td>
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<tr>
<td>Rainwater capture and use</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Recycle/reuse cooling water</td>
<td></td>
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<tr>
<td>Training in efficient water use</td>
<td></td>
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<tr>
<td>Use of a pipeline milking system</td>
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</tbody>
</table>

**Water Storage**

15. Please note, by placing a check mark in the appropriate column, if you implement any of these water storage techniques.

<table>
<thead>
<tr>
<th>Technique</th>
<th>Yes</th>
<th>Partly</th>
<th>No</th>
<th>Not Applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced tillage</td>
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<td></td>
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<tr>
<td>Permanent soil cover</td>
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<tr>
<td>Measure for better water infiltration into the soil – dams, furrows etc.</td>
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</tr>
<tr>
<td>Constructed measures for saving water – ponds, dams, cisterns, rainwater catchment etc.</td>
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</tr>
</tbody>
</table>
# MATERIAL USE AND ENVIRONMENTAL PROTECTION

**Animal Feed and Fertilizers**

*Imports and Exports*

**1.** What mineral fertilizers did you import? (We are only concerned with N and P fertilizers)

<table>
<thead>
<tr>
<th>Minerals</th>
<th>Amount Imported in 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tons</td>
</tr>
<tr>
<td></td>
<td>Tons</td>
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<td>Tons</td>
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<td>Tons</td>
</tr>
</tbody>
</table>

**2.** What organic fertilizers did you import or export off of your farm? (Exporting would be hauling manure/compost off of the farm) - Please note if you are reporting in gallons, yd³, tons etc.

<table>
<thead>
<tr>
<th>Organic Fertilizer</th>
<th>Amount Imported in 2015</th>
<th>Amount Exported in 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

**3.** What feedstuff did you import? Please note the amount imported and the amount fed (this captures if you did not feed all that you purchased within the year).

<table>
<thead>
<tr>
<th>Type of Feed</th>
<th>Amount Imported in 2015</th>
<th>Amount Fed in 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Tons</td>
</tr>
<tr>
<td></td>
<td>Tons</td>
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<td>Tons</td>
<td>Tons</td>
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</tbody>
</table>
**Fertilization Management**

4. Are organic and/or mineral fertilizers used in crop production? (Only answer “no” if manure is spread in fields only by cows grazing – all other spreading of manure or organic fertilizers would be answered “yes”)  
   □ Yes  □ No

5. Do you take into account these factors when planning the application of manure/organic fertilizers?

<table>
<thead>
<tr>
<th>Fertilization Factors</th>
<th>Yes</th>
<th>Partly</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crop nutrient demand (target yield x quality)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Results of soil analyses (PK contents, texture, organic matter etc.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atmospheric nitrogen supply (nitrogen fixation by legumes etc.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Available quantity of manure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mineralization from harvest residues, mulch and green manure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time and dose (times of application are tailored to crop needs, according to development stage, weather conditions etc.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type/Formulation of Fertilizer (release rate, dosability)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Precise dosage and spread (application technology, wind speed etc.)</td>
<td></td>
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</tr>
</tbody>
</table>

**Storage and Spreading**

6. How is slurry (liquid manure) stored on the farm?
   □ Unsealed storage (on bare ground), risk of run-off/no fixed storage facility  
   □ Sealed storage, but run-off and overflow possible, or run-off not collected  
   □ Sealed storage, no run-off or overflow is possible and all run-off is collected  
   □ No slurry storage on farm and therefore no environmental risk from storage (run-off)

   *Answer questions 7 – 10 if you have slurry storage on your farm. If not skip to question 11.*

7. Do slurry pits have a solid cover?
   □ No, storage facilities are not covered  
   □ Yes, permeable cover or floating cover  
   □ Yes, fixed cover (roof)  
   □ No storage on farm/no environmental risk possible from storage (ammonia emissions)

8. Is slurry applied to fields? If so, how is it applied?
   □ Splash plate, spreader, other technique  
   □ Drag hose  
   □ Injection  
   □ Slurry is not spread

9. When is slurry incorporated into the soil?
   □ No incorporation in arable crops or later than the same day  
   □ Incorporated on the same day in arable crops  
   □ Immediate incorporation in arable crops (< 1 hour)/Only spread on grassland

10. Do you respect a buffer strip along surface waters when spreading slurry?
    □ Yes  □ No
11. How is farmyard manure stored on the farm?
   - Unsealed storage (on bare ground), risk of run-off/no fixed storage facility
   - Sealed storage, but run-off and overflow possible, or run-off not collected
   - Sealed storage, no run-off or overflow is possible and all run-off is collected
   - No storage on farm and therefore no environmental risk from storage (run-off)

12. How is silage stored on the farm?
   - Unsealed storage (on bare ground), risk of run-off/no fixed storage facility
   - Sealed storage, but run-off and overflow possible, or run-off not collected
   - Sealed storage, no run-off or overflow is possible and all run-off is collected
   - No storage on farm and therefore no environmental risk from storage (run-off)

Material Flows
In this section regional is defined by a distance of < 50 miles. This question is asking about the source of the feed not the seller. Where is the feed grown/produced? This does not include feed supplements such as vitamins, minerals etc.

13. If feed is bought from outside the farm, does it come from regional production?
   - Yes – All of feed comes from within 50 miles of the farm or no feed is bought at all
   - Mostly Yes – Most of the feed comes from within 50 miles of the farm
   - Partly – Half of the feed comes from within 50 miles of the farm
   - Mostly No – Less than half of the feed comes from within 50 miles of the farm
   - No – None of the feed comes from within 50 miles of the farm or the source is unknown

14. If organic fertilizer (slurry, manure, compost) is bought from outside the farm, does it come from regional production?
   - Yes – All of organic fertilizer comes from within 50 miles of the farm or no feed is bought at all
   - Mostly Yes – Most of the organic fertilizer comes from within 50 miles of the farm
   - Partly – Half of the organic fertilizer comes from within 50 miles of the farm
   - Mostly No – Less than half of the organic fertilizer comes from within 50 miles of the farm
   - No – None of the organic fertilizer comes from within 50 miles of the farm or the source is unknown

15. Please estimate the dry matter losses from crop production. (Losses can occur during harvest, storage and feeding from mineralization, spoilage, waste etc.)
   - Very Positive: Minor losses; < 5% of the total quantity
   - Positive: only 5 – 10% of the total quantity
   - Partly/Average: 10 – 20% of the total quantity
   - Negative: 20 – 40% of the total quantity
   - Very Negative: > 40% of the total quantity

16. Is the farm’s recycling potential fully tapped? (i.e. all recyclables materials are recycled – ag plastic is technically recyclable even if there is not an outlet for collection)
   - Yes: All recyclable materials are indeed recycled/reused
   - Partly: Half of the recyclable materials are recycled/reused
   - No: We do not recycle/reuse materials

Plant Protection
Plant protection refers to the control of harmful organisms (weeds, pests and diseases) on the farm.

17. What are the most important pests, diseases and/or weeds in your crops? Are the problems getting worse or better?
18. Are production systems designed such that damage from pests and diseases are minimized? (i.e. intercropping, crop rotation, break periods etc.)

☐ Yes
☐ Partly
☐ No

19. Are resistance and tolerance against pests and diseases taken into consideration when selecting cultivars?

☐ Yes
☐ Partly
☐ No

20. Are any products used for plant protection? (i.e. neem oil, copper etc.)

☐ Yes
☐ No

Waste Disposal and Emissions

21. What year were your most frequently used machines and tractors constructed? (only consider machines with combustion engines)

☐ Very Positive: All are 2011 or newer
☐ Positive: Most are 2011 or newer
☐ Partly/Average: Everything is 2000 - 2011
☐ Negative: Most are older than 2000
☐ Very Negative: All are older than 2000
☐ Not Applicable: I don't use combustion engines

22. Can air pollution due to burning waste or residues be ruled out? (burning anything will cause air pollution, especially ag plastic)

☐ Yes
☐ Partly
☐ No

23. Do neighbors complain about odor nuisance?

☐ Yes
☐ Partly
☐ No

24. Can environmental pollution from depositing and disposal of problematic materials be ruled out? (i.e. ag plastic, animal carcasses, batteries, used oil etc.)

☐ Yes
☐ Partly
☐ No

25. Can environmental pollution through wastewater from the household and farm be ruled out? (All wastewater must either be collected and filtered before entering open water or discharged into a treatment basin such as a septic tank)

☐ Yes
☐ Partly
☐ No

26. Are there any further emissions? (i.e. neighboring highways, factories or ashes?)

☐ Yes
☐ Partly
☐ No
ENGLISH USE

1. Is energy use monitored? (i.e. consumption, including fuel and propane use)
   - Yes
   - No

2. Do you produce renewable energy on the farm? (i.e. solar electricity/hot water, wind energy, geothermal etc.)
   - Yes
   - Partly
   - No

3. Have you had an energy audit conducted on the farm?
   - Yes
   - Partly
   - No

4. Please note any energy saving measures you have done on your farm or are planning on implementing soon.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Yes</th>
<th>Partly</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cogeneration of energy (heat and power)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Energy-efficient lighting (energy-saving bulbs and/or no permanent lighting)</td>
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<td></td>
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<tr>
<td>Energy-efficient management of barn climate (i.e. open-fronted barn)</td>
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<tr>
<td>Passive hay drying or using solar</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Heat recovery, heat exchanger, heat pump</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>No use of energy in livestock production (all work done manually)</td>
<td></td>
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<tr>
<td>Photovoltaics installed (i.e. Solar PV)</td>
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<tr>
<td>Water heating using solar power or wood (heating water with renewable resources)</td>
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<tr>
<td>Change to more energy-efficient production system</td>
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<tr>
<td>Use of drip irrigation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy-efficient management of irrigation pumps</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No till</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No use of energy in crop production (all work done manually or with animals)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduction of passages with combined machinery</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjustments to tractors and machinery (lower rpm, higher gear, tire pressure, clean air filters etc.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tractors and machinery suitable for farm size (not excessively mechanized)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5. Please list your energy mix on the farm as well as your usage. I have listed some typical energy sources, if you use something that is not listed, please add it in the blank spaces below and note the usage and units. If you use biodiesel please note if you produce it on farm or if you purchase it and what the source of the oil is i.e. soybean, sunflower, camelina etc.

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>Usage</th>
<th>Proportion from renewable energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>Kwh</td>
<td>%</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>Ft(^3)</td>
<td>%</td>
</tr>
<tr>
<td>Propane</td>
<td>Gallons</td>
<td>%</td>
</tr>
<tr>
<td>Diesel</td>
<td>Gallons</td>
<td>%</td>
</tr>
<tr>
<td>Gasoline</td>
<td>Gallons</td>
<td>%</td>
</tr>
<tr>
<td>Wood (slab, logs or pellets)</td>
<td></td>
<td>100 %</td>
</tr>
</tbody>
</table>

**Contract machine work**

6. Machine work conducted on the farm by a third party. Note the work and the number of acres or bales etc. If something is not listed, please write in the empty spaces

<table>
<thead>
<tr>
<th>Contacted work</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood chipper</td>
<td></td>
</tr>
<tr>
<td>Cultivator</td>
<td>Acres</td>
</tr>
<tr>
<td>Disk harrow</td>
<td>Acres</td>
</tr>
<tr>
<td>Seed drilling</td>
<td>Acres</td>
</tr>
<tr>
<td>High-pressure bale press</td>
<td>Bales</td>
</tr>
<tr>
<td>Large square bale</td>
<td>Bales</td>
</tr>
<tr>
<td>Spreading liquid manure</td>
<td>Acres</td>
</tr>
<tr>
<td>No-till drilling</td>
<td>Acres</td>
</tr>
<tr>
<td>Seed Broadcaster</td>
<td>Acres</td>
</tr>
<tr>
<td>Plowing</td>
<td>Acres</td>
</tr>
<tr>
<td>Production of grass silage</td>
<td>Acres</td>
</tr>
<tr>
<td>Round baler with wrap</td>
<td>Bales</td>
</tr>
<tr>
<td>Round baler without wrap</td>
<td>Bales</td>
</tr>
<tr>
<td>Corn silage chopping</td>
<td>Acres</td>
</tr>
<tr>
<td>Contracted Work</td>
<td>Amount</td>
</tr>
<tr>
<td>-------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>Tine weeder</td>
<td>Acres</td>
</tr>
<tr>
<td>Winter services (snow plowing)</td>
<td>Hours</td>
</tr>
</tbody>
</table>

---

**LABOR**

1. List the workers on your farm. Two categories have already been created. If these do not fit your needs, please add additional workers/employees in the spaces below. You can list each worker separately or you can group them together. For example, if you have 1 full-time employee and 1 part-time employee you could record the number of people as 1.5 or 1.25 or list each worker in the spaces provided. If children help with chores they do not need to be entered here.

If employees work year round the employment duration is 52 weeks/year. If you have seasonal employees, then note the number of weeks for which they are hired. For hired help vacation days = paid time off, including holidays. For self-employed labor note the number of days/year you take in vacation (as in being off the farm, not doing chores). If work hours/day or weeks/year fluctuate then provide an average.

This chart will continue across the page. Responses are only needed on the next page for hired workers. If you do not give cash bonuses, provide insurance or pay social security for your employees then leave those columns blank. The in-kind payments refer to the value of any additional non-cash bonuses you provide (i.e. boots, meat etc.)

<table>
<thead>
<tr>
<th>Workers</th>
<th>Number of people</th>
<th>Hours/day</th>
<th>Days/week</th>
<th>Weeks/year</th>
<th>Vacation days/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owners – Self Employed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hired Workers – Employed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
Personnel Management

2. Are short, medium and long-term operational personnel requirements known? (This is a question about knowing what it will take to keep the farm running, not about guaranteed labor.)
   - [ ] Yes
   - [ ] Partly
   - [ ] No

3. Is replacement of labor to cover age-related departures in the relevant areas guaranteed? (This can be viewed as a succession. When you are ready to retire is anyone guaranteed to take over the farm?)
   - [ ] Yes
   - [ ] Partly
   - [ ] No

4. Are apprentices trained on the farm?
   - [ ] Yes
   - [ ] No

5. Do all workers (hired and family) have the right to undergo continuous professional development in order to broaden their knowledge and increase their skills?
   - [ ] Yes
   - [ ] Partly
   - [ ] No

<table>
<thead>
<tr>
<th>Hourly/monthly wage</th>
<th>Housing value/month</th>
<th>Bonuses</th>
<th>Insurance</th>
<th>Social Security</th>
<th>In Kind Payments</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>$</td>
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<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
</tbody>
</table>

205
Answer questions 6 – 13 if you have hired employees. If you do not skip question 14.

6. Do all workers have a written contract?
   - Yes
   - Partly
   - No

7. Do workers receive payroll slips?
   - Yes
   - Partly
   - No

8. Do all workers have work permits and are they duly registered with the relevant authorities?
   - Yes
   - Partly
   - No

9. If housing is provided to workers, is all worker housing of an acceptable standard?
   - Yes
   - Partly
   - No
   - Not Applicable

10. Do all workers have the freedom to form, join and organize trade unions? (This is not a question if they have or will it is about whether or not they would lose their jobs if they joined a union.)
    - Yes
    - Partly
    - No

11. What protection do workers have in the event of an accident, illness or maternity?
    - Complies with legal requirements and minimum protection standards
    - Complies with the law but not the minimum protection standards
    - Not legally compliant or no protection at all

12. Is the worker’s income guaranteed in case of an accident, illness or maternity? (workers comp.)
    - Complies with legal requirements and minimum protection standards
    - Complies with the law but not the minimum protection standards
    - Not legally compliant or no protection at all

13. Are all farm workers compensated for overtime working? (Either with additional pay or time off)
    - Employees do not work overtime and have regulated and recorded working hours
    - Overtime is fully compensated: when financially compensated an additional payment is made. Overtime is voluntary
    - Overtime is only partly compensated
    - Overtime is not compensated and/or not done voluntarily. Working time is not regulated or recorded

SAFETY AT WORK

14. How many work-related accidents and/or illnesses have occurred on the farm over the past 5 years? ____________
15. Please complete the following questions regarding safely on the farm

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is a professional safety concept in place on the farm?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are safety risks known and systematically recorded?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does an action plan for safety measures exist?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is there a fixed date for implementation of this action plan?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is the process guided by a specialist?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are users of plant protection products (PPP) and animal treatment products (ATP) (including medications) trained in their use and storage?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are PPPs and ATPs protected to ensure there is no contact with skin/eyes or through vapor inhalation?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are PPPs and ATPs stored as recommended by the manufacturer and required by law? (i.e. in a safe and secure manner)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are the waiting times for PPPs and ATPs known and adhered to? (Are you applying as recommended by the manufacturer)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are there buffer zones of at least 18 feet to protect surface water, wells or cisterns from infiltration of PPPs and ATPs?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Child Welfare**

16. Do children < 16 years old help on the farm? (i.e. do chores)

- [ ] Yes  
- [ ] No

*Answer questions 17 – 19 if answered "yes" to question 16. If you answered "no" skip to question 20.*

17. Do children carry out work that could be problematic for their health or development? (i.e. carry heavy loads, work with chemicals/medications)

- [ ] Yes  
- [ ] No

18. Is their schooling adversely affected by working on the farm? (i.e. concentration problems resulting from tiredness, lack of time for homework, poor school attendance etc.)

- [ ] Yes  
- [ ] No

19. What type of chores do the children usually do on the farm? ________________________________

________________________________________________________________________________________
**Private spending of household**
The household’s private spending is only analyzed in the case of farms with self-employed workers who do not receive a wage and therefore by definition live from private spending. In order to assess the farm’s sustainability calculating the family’s ability to afford their way of life is critical to the long-term survival of the farm.

20. Number of adult family members? ________________

21. Number of children in the household? ____________

22. Total household spending according to accounts (without including housing or voluntary retirement contributions) $____________________

23. Do you pay rent for housing?  
   [ ] Yes  [ ] No

24. Do you pay additional costs for energy separate from the farm?  
   [ ] Yes  [ ] No

25. Does the household receive significant goods and services from the farm without having to pay for them? (i.e. private use of farm vehicles, food, milk etc.)  
   [ ] Yes  [ ] No

26. What voluntary retirement contributions did you make in 2015? $__________

---

**QUALITY OF LIFE**

1. How long have you worked on your farm? ________________________________

2. Have you ever been discriminated against because of your gender?  
   [ ] No  
   [ ] Selective gender discrimination  
   [ ] Significant and systematic gender discrimination

3. Have you ever suffered discrimination for non-gender related reasons? (i.e. race, religion, personal beliefs etc.)  
   [ ] No  
   [ ] Selective discrimination  
   [ ] Significant and systematic discrimination

4. Do any problematic working conditions exist on the farm such as forced labor?  
   [ ] Yes  [ ] No
How satisfied are you with the following areas of your life?

<table>
<thead>
<tr>
<th>Area</th>
<th>Very Satisfied</th>
<th>Satisfied</th>
<th>Partly Dissatisfied</th>
<th>Very Dissatisfied</th>
</tr>
</thead>
<tbody>
<tr>
<td>Occupation – Choosing to be a dairy farmer</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level of education you received</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Access to continuing professional development/acquiring new knowledge</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Income</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard of living</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Immediate social circle – family, children, partner, parents etc.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wider social circle – Friends, community, neighbors etc.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relevant political and economic framework – Agricultural policy, trends in product pricing, market stability etc.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leisure time – Do you have enough free time</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cultural and spiritual activities – Access to music, dance, church, culture etc.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health – Physical and mental health including stress level</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time management – Balancing work with private life/family time</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

FINANCIAL ANALYSIS

Stability

1. What proportion of total sales is attributable to the activity with the highest sales turnover? (This is a question about diversification of income sources. i.e. Does most of your income come from milk sales or do you have a second business or someone that works off of the farm?)

   - **Very Positive**: Not more than 20% of income comes from the main source (i.e. milk sales)
   - **Positive**: Not more than 40% of income comes from the main source
   - **Partly/Average**: About 60% of income comes from the main source
   - **Negative**: More than 80% of income comes from the main source
   - **Very Negative**: 100% of income comes from one source

2. Has the farm at least two (potential) customers from each significant income source? (Do you have other outlets to sell your milk if your current hauler shuts down or lowers your pay price below what you can afford?)

   - **Yes**: 3 or more customers
   - **Mostly Yes**: At least 2 customers
   - **Partly**: At least 1 customer for your main income source
   - **Not really**: More than one income source that each only has one customer
   - **No**: Only 1 income source and 1 customer outlet
3. What is the state of the infrastructure for the main source of income? (A good well-functioning infrastructure ensures that production capacity and the value of the goods concerned are maintained.)

- **Very Positive**: The entire infrastructure is in a very good state
- **Positive**: For the most part the entire infrastructure is in a good state
- **Partly/Average**: Some aspects are good while others are poor
- **Negative**: Mostly the infrastructure is in a poor state
- **Very Negative**: All of the infrastructure is in a poor state

4. Is the farm in a position to invest in maintenance and expansion?

- **Yes**: The farm has sufficient funds
- **Mostly Yes**: The farm has some means of its own and can also access external funding
- **Partly**: The farm only has limited means of its own but has sufficient access to external funding
- **Not really**: The farm only has limited means/no means of its own and has insufficient access to external funding
- **No**: The farm has no means of its own and no access to external funding

**Financial year 2015**

<table>
<thead>
<tr>
<th></th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner equity at the start of 2015</td>
<td>$</td>
</tr>
<tr>
<td>Owner equity at the end of 2015</td>
<td>$</td>
</tr>
<tr>
<td>Total farm income</td>
<td>$</td>
</tr>
<tr>
<td>Depreciation</td>
<td>$</td>
</tr>
</tbody>
</table>

**Farm Income Sources and revenues (2015)**

In order to assess the economic stability of the farm, all revenue streams should be looked at independently.

5. Please provide information on the different income streams on your farm. Several general categories have been listed, if you have additional income streams related to the farm please list them in the blank spots below.

<table>
<thead>
<tr>
<th>Income stream</th>
<th>Sales Unit</th>
<th># of Units Sold</th>
<th>Value per Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk Sales</td>
<td>Pounds of milk</td>
<td></td>
<td>$</td>
</tr>
<tr>
<td>Bull Calf Sales</td>
<td>Calves</td>
<td></td>
<td>$</td>
</tr>
<tr>
<td>Culled Cow Sales</td>
<td>Cows</td>
<td></td>
<td>$</td>
</tr>
<tr>
<td>Feed</td>
<td>Bales or Tons</td>
<td></td>
<td>$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$</td>
</tr>
<tr>
<td></td>
<td></td>
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<td>$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$</td>
</tr>
</tbody>
</table>
6. **Please provide information on other sources of income**

<table>
<thead>
<tr>
<th>Source of Income</th>
<th>Total Amount Earned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Cost for all Income Sources (i.e. all expenditures that can be directly attributed to the income source: seed, fertilizer, vet supplies, contract labor, machine rental etc.)</td>
<td>$</td>
</tr>
<tr>
<td>Revenue (income − expenses) from Direct Payments or Other State Support</td>
<td>$</td>
</tr>
<tr>
<td>If applicable, Income from Additional Farm-Related Activities (minus net direct costs)</td>
<td>$</td>
</tr>
</tbody>
</table>

7. **Please list any additional income from off-farm work. (i.e. side businesses, spouse working off the farm etc.)**

<table>
<thead>
<tr>
<th>Source of Income</th>
<th>Total Amount Earned</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$</td>
</tr>
<tr>
<td></td>
<td>$</td>
</tr>
<tr>
<td></td>
<td>$</td>
</tr>
</tbody>
</table>

8. **Please list additional financial information**

<table>
<thead>
<tr>
<th>Personnel Costs (2015)</th>
<th>Total Amount Earned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total personnel costs (including all payroll, benefits, taxes, bonuses, housing allotments, expenses, work gear etc.)</td>
<td>$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Structural Costs (2015)</th>
<th>Total Amount Earned</th>
</tr>
</thead>
<tbody>
<tr>
<td>excluding depreciation</td>
<td>$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Building Maintenance Expenses</th>
<th>Total Amount Earned</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$</td>
</tr>
<tr>
<td></td>
<td>$</td>
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<td>$</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Machinery Maintenance Expenses</th>
<th>Total Amount Earned</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$</td>
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<tr>
<td></td>
<td>$</td>
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<td>$</td>
</tr>
<tr>
<td>Other Material Expenses</td>
<td>$</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Leasing/Rental Expenses</th>
<th>$</th>
</tr>
</thead>
<tbody>
<tr>
<td>(not including accommodation - i.e. machinery, land rent etc.)</td>
<td>$</td>
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<tr>
<td></td>
<td>$</td>
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<tr>
<td></td>
<td>$</td>
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<tr>
<td></td>
<td>$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Liquidity (2015)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Liquid Assets (bank accounts and cash)</td>
<td>$</td>
</tr>
<tr>
<td>Financial Assets - Available on short notice (i.e. shares etc.)</td>
<td>$</td>
</tr>
<tr>
<td>Accounts Receivable - (any outstanding payments on which you are waiting)</td>
<td>$</td>
</tr>
<tr>
<td>Free Payment (i.e. interest-free credits from suppliers)</td>
<td>$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Third-Party Capital (As of year-end 2015)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Short-Term Debt (i.e. accounts payable or short-term loans – car, equipment)</td>
<td>$</td>
</tr>
<tr>
<td>Long-Term Debt (i.e. mortgage, farm payment etc.)</td>
<td>$</td>
</tr>
<tr>
<td>Interest paid on Long-Term Debt</td>
<td>$</td>
</tr>
<tr>
<td>Required Annual Payment on Long-Term Debt</td>
<td>$</td>
</tr>
<tr>
<td>Voluntary/Early Payment on Long-Term Debt</td>
<td>$</td>
</tr>
</tbody>
</table>
FARM MANAGEMENT

Business Goals, Strategy and Implementation

1. How satisfied are you with the following elements of your business strategy? (How you are choosing to manage your farm – i.e. number of times milking a day, number of employees, job delegation, feed choices etc.)

<table>
<thead>
<tr>
<th>Management of your farm</th>
<th>Very Satisfied</th>
<th>Satisfied</th>
<th>Partly Dissatisfied</th>
<th>Very Dissatisfied</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short-Term impact of your management strategy on the business</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(i.e. cash flow, indebtedness, liquidity etc.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short-Term impact of your management strategy on your social life</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(i.e. time with family, pay, working conditions etc.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short-Term impact of your management strategy on the environment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(i.e. impacts on soil, water, biodiversity etc.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Risk Management

2. Can you identify any substantial dangers on your farm?

- Yes
- No

3. If so, what are they and how likely are they to occur?

<table>
<thead>
<tr>
<th>Danger</th>
<th>Low Probability</th>
<th>Medium Probability</th>
<th>High Probability</th>
<th>Don’t Know</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. How satisfied are you with your protection against possible and relevant risks?

- Very satisfied
- Satisfied
- Partly Satisfied
- Dissatisfied
- Very Dissatisfied

Availability of Information

5. Do you have sufficient access to appropriate information?

- Yes
- Mostly Yes
- Partly
- Mostly No
- No

6. Do you have a good overview of the financial situation of your farm?

- Yes
- Mostly Yes
- Partly
- Mostly No
- No
**Stability of Relationships**

7. Are you satisfied with the current situation regarding cooperation? (i.e. Is there cooperation in those areas where it makes sense and does that cooperation take place on a fair and equitable basis?)

- [ ] Very satisfied
- [ ] Satisfied
- [ ] Partly Satisfied
- [ ] Dissatisfied
- [ ] Very Dissatisfied

8. Is there any significant conflict with people/groups/firms etc. outside of the farm?

- [ ] Yes
- [ ] No

9. Are there any significant levels of dependency? (i.e. suppliers, the bank etc.)

- [ ] Yes
- [ ] No

10. If so, please elaborate

<table>
<thead>
<tr>
<th>Brief Description of the Dependency</th>
<th>Impact on the farm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**THANK YOU!!**

I greatly appreciate your willingness to participate in this assessment. I know it is long and very involved, but hopefully your time spent pondering and answering these questions will lead to some learning opportunities in the future.

Please send your completed survey back to me in the self-addressed stamped envelope provided. Once I have received your reply I will be in contact with you regarding the findings. Thank you once again. I look forward to our next communication!
APPENDIX B: Sample of RISE Written Report
Farm details

<table>
<thead>
<tr>
<th>Name of farmer</th>
<th>Jennifer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm name</td>
<td>Sample Farm</td>
</tr>
<tr>
<td>Name of questionnaire/scenario</td>
<td>R_ddwRteRYI4lxgOJ</td>
</tr>
<tr>
<td>Project</td>
<td>Dissertation Research</td>
</tr>
<tr>
<td>Year</td>
<td>2015</td>
</tr>
<tr>
<td>Interviewer/extension agent</td>
<td>Jennifer Harrison</td>
</tr>
</tbody>
</table>

Introduction

This RISE report presents the results of the sustainability analysis. For the purposes of this research project I am providing the results of your RISE assessment to you only in written form. This document will explain the results, and suggest possible measures and next steps. Should you have any questions regarding the results or next steps please contact me at harrison.497@osu.edu or 831-345-9392.

Further RISE information

http://rise.hafl.bfh.ch
Bern University of Applied Sciences BFH
School of Agricultural, Forest and Food Sciences HAFL, RISE
Länggasse 85, CH-3052 Zollikofen, Switzerland
Sustainability polygon

Explanatory notes
The above polygon is a snapshot of the results from the assessment. Each of the ten indicators will be explained in greater detail later in this document. The polygon is used to provide a pictorial representation of your results but is in no way meant to be the final word. Please continue reading this document for greater explanation of how the results were calculated and suggestions for management practice changes that may improve your performance.

Ideas and recommendations
You may have noticed that you do not have results for Farm Management or Economic Viability. Although you provided information in these areas, information was missing that did not allow for those to be represented on this polygon. My calculations indicate that you would have scored 74 in Farm Management which would be in the green. There was too much information missing to generate a score for Economic Viability.
## Themes & Indicators

<table>
<thead>
<tr>
<th></th>
<th>Soil use</th>
<th>86</th>
</tr>
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<tbody>
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<td>Soil management</td>
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</tr>
<tr>
<td>1.1</td>
<td>Crop productivity</td>
<td>75</td>
</tr>
<tr>
<td>1.2</td>
<td>Soil organic matter</td>
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<tr>
<td>1.3</td>
<td>Soil reaction</td>
<td>100</td>
</tr>
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<td>1.4</td>
<td>Soil erosion</td>
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<td>1.5</td>
<td>Soil compaction</td>
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<table>
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<td>2.1</td>
<td>Livestock productivity</td>
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<td>2.2</td>
<td>Opportunity for species-appropriate behavior</td>
<td>100</td>
</tr>
<tr>
<td>2.3</td>
<td>Living conditions</td>
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<td>Animal health</td>
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<td>3.2</td>
<td>Plant protection</td>
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<td>3.3</td>
<td>Air pollution</td>
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<td>Irrigation</td>
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<table>
<thead>
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<td>Energy intensity of agricultural production</td>
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<td>5.2</td>
<td>Greenhouse gas balance</td>
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<table>
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<td>36</td>
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<td>6.1</td>
<td>Ecological infrastructures</td>
<td>100</td>
</tr>
<tr>
<td>6.2</td>
<td>Distribution of ecological infrastructures</td>
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<td>6.3</td>
<td>Intensity of agricultural production</td>
<td>76</td>
</tr>
<tr>
<td>6.4</td>
<td>Diversity of agricultural production</td>
<td>59</td>
</tr>
<tr>
<td>7</td>
<td>Working conditions</td>
<td>61</td>
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<tr>
<td>----</td>
<td>--------------------------</td>
<td>----</td>
</tr>
<tr>
<td>7.1</td>
<td>Personnel management</td>
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<td>7.2</td>
<td>Working hours</td>
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<td>Safety at work</td>
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<td>7.4</td>
<td>Wage and income level</td>
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<table>
<thead>
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<th>8</th>
<th>Quality of life</th>
<th>84</th>
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<tr>
<td>8.1</td>
<td>Occupation &amp; Training</td>
<td>83</td>
</tr>
<tr>
<td>8.2</td>
<td>Financial situation</td>
<td>88</td>
</tr>
<tr>
<td>8.3</td>
<td>Social relations</td>
<td>88</td>
</tr>
<tr>
<td>8.4</td>
<td>Personal freedom &amp; values</td>
<td>75</td>
</tr>
<tr>
<td>8.5</td>
<td>Health</td>
<td>88</td>
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<table>
<thead>
<tr>
<th>9</th>
<th>Economic viability</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>9.1</td>
<td>Liquidity</td>
<td>19</td>
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<tr>
<td>9.2</td>
<td>Profitability</td>
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<td>9.3</td>
<td>Stability</td>
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<td>9.4</td>
<td>Indebtedness</td>
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<td>9.5</td>
<td>Livelihood security</td>
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</table>

<table>
<thead>
<tr>
<th>10</th>
<th>Farm Management</th>
<th>74</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.1</td>
<td>Business goals, Strategy and Implementation</td>
<td></td>
</tr>
<tr>
<td>10.2</td>
<td>Availability of Information</td>
<td>63</td>
</tr>
<tr>
<td>10.3</td>
<td>Risk Management</td>
<td>66</td>
</tr>
<tr>
<td>10.4</td>
<td>Resilient Relationships</td>
<td>92</td>
</tr>
</tbody>
</table>

**Explanatory notes**

Each of the 10 indicators are represented on the polygon. (Your polygon only has 8 indicators due to the missing information noted above.) The themes are listed below the indicators. The scores for the themes are averaged together to provide the score for the overall indicator. The scores for the themes are represented on the polygon as black dots. The overall score for the indicator is depicted by the red line.

**Ideas and recommendations**

Details for each theme and indicator will be discussed later in this document. Continue reading for more explanation and information.
Detailed results

<table>
<thead>
<tr>
<th>Soil use</th>
<th>86</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculation variant: RISE 3.0</td>
<td></td>
</tr>
</tbody>
</table>

Fertile soils are a limited, easily degradable resource that is essential to both life and production. This topic reflects the state of the soil on the farm and how this state is affected by farming practices. The results for this topic answer the following questions for the farmer:
- How does the fertility of my soil rate?
- What impacts do my farming practices have on the fertility of my soil?

<table>
<thead>
<tr>
<th>Soil management</th>
<th>100</th>
</tr>
</thead>
</table>

**Sustainability goal**
Knowledge and technology are actively employed to facilitate productive, site-adapted and soil-conserving soil use.

**Content**
An assessment is made of whether soil analyses, nutrient and soil organic matter balances and changes in soil C content are calculated and taken into account and whether any agricultural area has been lost in the last ten years.

**Scoring**
100 points are awarded if all the relevant analyses are performed and no agricultural area has been lost.

**Explanatory notes**
Since soil forms the basis of almost all forms of agricultural production, good soil management is a key component of sustainable agriculture. This requires knowledge of and access to up-to-date information on soil fertility. Government and private sector monitoring systems such as those found in Switzerland, the EU and throughout the organic farming industry also adopt a knowledge-based, competent approach to soil management. This requires e.g. regular chemical soil analyses or the calculation of soil organic matter balances.

**Ideas and recommendations**
This looks great!

<table>
<thead>
<tr>
<th>Crop productivity</th>
<th>75</th>
</tr>
</thead>
</table>

**Sustainability goal**
Through appropriate yields per unit area, the farm contributes in terms of both quantity and quality to satisfying the demand for agricultural products and ensures its own economic competitiveness.

**Content**
Yields per unit area of all crops grown on the farm are compared to the regional benchmarks for very high, average and very low yields. In addition, product quality is evaluated based on regional or farm-specific criteria.
Scoring
The three benchmark yields are equivalent to 100 RISE points (= very high yield), 67 RISE points (average yield for the region) and 34 RISE points (low yield), with 0 RISE points awarded for no yield, +/- a 20-point correction for product quality. Linear interpolation is used to fill in the gaps between the three defined points.

Explanatory notes
The main purpose of agriculture is the production of food and raw materials. It produces 95% of the protein and 99% of the dietary energy consumed by humankind (WRI, 2000). The UN estimates that the global population will rise to somewhere between 7.8 and 11.9 billion by 2050 (UN, 2007). Changes in income levels and consumption habits mean that demand for agricultural products is set to grow even more rapidly than the global population. Chapter 14 of Agenda 21 calls for a sustainable increase of food production and for improved food security as the overarching goals of sustainable agriculture and rural development (UN, 1992). To calculate this indicator, all the crops on the farm and their main products are considered and weighted by the area on which they are grown. The scoring function takes account of regional yield variability, since yield can differ significantly between regions and crops, making a standard scoring system unsuitable. The way in which quality is defined also varies between different crops, regions and farm types. Consequently, a quality criterion (fat content, price, protein content, etc.) is defined for each crop at regional level, but can then be adapted at the level of the individual farm.

Ideas and recommendations
As a whole there aren’t any major problems here. I know that you are just coming out of transition so your yields may still be increasing. The model indicated that oats, rye and wheat scored the lowest in terms of your yield compared to regional averages.

| Soil organic matter | 100 |

Sustainability goal
The arable soil on the farm is well supplied with organic matter, ensuring that the soil organic matter content in the topsoil at least remains stable.

Content
Either the arable soil organic matter content is directly evaluated or a simple soil organic matter balance is calculated and evaluated based on rotation and farming practices.

Scoring
In the interests of simplicity, RISE assumes a high and stable soil organic matter content for permanent grassland, permanent crops and woodland (Kuntze et al., 1994). There are two options for evaluating the situation on arable land (mineral soil). If reliable analysis data is available, the topsoil organic matter content is evaluated based on altitude and soil type. The benchmark data was provided by a comprehensive analysis of Bavarian farms (Capriel, 2010), although it is not valid for peaty soils and chernozems. If robust data is not available, a simple soil organic matter balance is calculated and evaluated, with a distinction being drawn between organic and conventional farms. The coefficients for the soil organic matter balance are taken from the STAND “site-adapted method” (Kolbe, 2008). The goal is a stable soil organic matter content capable of ensuring an adequate nutrient supply whilst preventing nutrient inefficiency and high greenhouse gas emissions (Kolbe, 2012). The scoring functions of both the procedures used in RISE are only valid for the temperate climate zone. For areas outside of this zone, RISE uses coefficients that have not yet been scientifically validated.
Explanatory notes
The quantity and quality of soil organic carbon affects the soil’s biological and physical properties and in particular its filter and buffer properties (Kuntze et al., 1994; Candinas et al., 2002; Brock et al., 2008). Soil organic matter (SOM) content is influenced by the quantity and quality of any biomass that has been added to or left on the soil, site conditions (climate and soil) and tillage. A SOM balance can be calculated to provide a rough estimate of the organic matter supply based on location and management details (e.g. Kolbe 2012). Negative SOM balances should be avoided, since they result in a loss of soil organic matter. Excessively high SOM balances cause leaching and gaseous emissions that are harmful to the environment. However, the SOM balance does not in itself allow future soil organic matter content to be predicted. The heterogeneity of organic materials, plant productivity and soil and climate conditions means that significant errors can easily be made in the calculations for individual farms (Holenstein, 2010; Kolbe, 2012). Furthermore, SOM quality is very hard to estimate. Provided that reliable data is available, an evaluation of actual SOM content is clearly preferable to a SOM balance for farms in temperate regions. No proven calculation methods are available for areas with a tropical or subtropical climate (personal comment A. Gattinger/FibL, R. Oberholzer/ART). This also holds true also for carbon (C) accounting in the Clean Development Mechanism (www.v-c-s.org/afl.html).

If crop residues are removed or burned, the crop harvest index and the harvest residues’ SOM coefficient are used to calculate how much soil organic matter carbon has been lost. The use of soil carbon simulation models that take additional site factors into account is recommended for a more in-depth analysis. Examples of such models include Roth-C (Smith et al., 1997; Holenstein, 2010) and SIMEOS-AMG (Saffih-Hdadi and Mary, 2008).

Ideas and recommendations
Can’t argue with a perfect score

<table>
<thead>
<tr>
<th>Soil reaction</th>
<th>100</th>
</tr>
</thead>
</table>

Sustainability goal
Soil reaction is within the optimal range for crop growth; soil use causes neither salinization nor acidification beyond this range.

Content
Soil pH is evaluated in terms of crop requirements and the risk of salinization or acidification.

Scoring
Soil acidification and salinization are evaluated by a single indicator in RISE, since both are associated with soil pH. 100 points are awarded if all the soil on a farm has a pH of between 5.5 and 7.0. Points are deducted for higher or lower pH values. Further points are deducted if acidic fertilizers are used without the soil being properly limed. 25 points are deducted if more than 100 kg/ha per year (fertilizer quantity) of physiologically acidic fertilizers (e.g. urea, ammonium sulfate) are applied. In arid climates, adequate soil drainage is essential and soil pH should not exceed 7.0.

Explanatory notes
Most plants require a soil reaction of between pH 5.5 and pH 7.0 for optimal nutrient uptake. At pH values below 5.0, mineralization is inhibited, the availability of toxic metal ions such as Al3+ increases and the availability of alkaline nutrients declines. Once soil pH rises significantly above 7.0, soil biological activity falls and the availability of metallic nutrients and phosphates becomes problematic (Scheffer &
Schachtschabel, 1989). Very high pH values generally occur in connection with high ion contents in the soil solution which make it difficult for plants to absorb water through osmosis. Low pH values and soil acidification are typical

**Ideas and recommendations**
You reported 100% of your soils being within a pH of 5.5 – 7 which is ideal for most crops.

<table>
<thead>
<tr>
<th>Soil erosion</th>
<th>100</th>
</tr>
</thead>
</table>

**Sustainability goal**
The quantity of soil lost through water and wind erosion does not exceed tolerance levels even in the most threatened areas.

**Content**
Details are requested regarding the frequency and intensity of all erosion events to have occurred on the farm in the last 5 years. In addition, climate, slope gradients, soil type and cover and farming practices are used to calculate the risk of water and wind erosion for the highest-risk areas.

**Scoring**
100 points = no soil erosion observed; the risk of erosion does not exceed soil loss tolerance levels even in the highest-risk areas.

**Explanatory notes**
The “soil erosion” indicator score is whichever is the lower out of the two scores for water and wind erosion. 50% of both the water and wind erosion scores is accounted for by an evaluation of observed erosion, while the remaining 50% is based on an evaluation of the erosion risk for the highest-risk area. Details are requested of observations during the last 5 years, including information about the frequency and intensity of erosion events.

Water erosion risk is only calculated if the farm makes use of areas with a slope gradient of more than 5% over a slope length of at least 15 meters. The risk of erosion is calculated using the American RUSLE method (Renard et al., 1997), which is an upgraded version of the Universal Soil Loss Equation (USLE, www.iwr.msu.edu/rusle; Wischmeyer & Smith, 1961). Rainfall erosivity is defined at regional level and can be obtained from maps (e.g. http://soils.usda.gov/use/worldsoils/mapindex). The steepest slope gradient is ascertained for the land used by each of the farm’s different production systems. Soil cover during the period of maximum rainfall, the erodibility of each soil type (topsoil) and erosion prevention measures are also included in the evaluation. The evaluation system is based on RUSLE, while the soil loss tolerance level is derived from soil depth, as per the PC ABAG tool (www.lfl.bayern.de./appl/abag/web/). The standard value is 5 t per ha per year.

A similar approach is taken to calculating wind erosion. First of all, details are requested of erosion events during the last 5 years. If the farm has areas that are at risk from wind erosion due to exposure during periods when the soil is dry, the wind erosion risk is calculated for the highest-risk area. This is done using the method described in DIN 19706 (2002), where the input parameters are soil type, SOM content, average wind speed, soil cover (during the windiest period) and the presence, height and spacing of wind protection plants.

**Ideas and recommendations**
You did not express any trouble with soil erosion. Continue to monitor for soil loss through erosion. The best way to guard against soil erosion is to keep your soils covered. The fact that the majority of your crop
Land is in pasture plays a key role in minimizing soil loss. Planting cover crops on tilled acreage helps to prevent erosion and provides beneficial soil nutrients and soil stability. You are doing that as well. Keep up the great management.

### Soil compaction

<table>
<thead>
<tr>
<th>Sustainability goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crop growth and soil life are not impaired by over-compaction of the subsoil.</td>
</tr>
</tbody>
</table>

#### Content

The risk of excessive soil compaction is assessed based on risk factors (wheel load, soil moisture, soil type, tillage) and protection factors (pressure reduction, improvement of soil stability).

#### Scoring

100 points = no over-compaction observed. Soil is neither vulnerable to compaction nor tilled; maximum wheel load is 2.5 t or less.

#### Explanatory notes

Naturally formed soils are porous structures in which large pores (≥ 0.05 mm diameter) are important for aeration, drainage and root penetrability. If the pressure on the soil exceeds its inherent stability, this results in soil compaction and loss of large pore volume (van der Ploeg et al., 2006). Livestock usually only causes compaction of the topsoil (personal comment Matthias Stettler, SCA; Oberholzer et al., 2006). Soils containing more than 25 mass % of clay are particularly prone to compaction (AG Boden, 1994). Several methods have been developed to calculate soil compaction risk, including Terranimo (www.terranimo.ch), TASC (Diserens & Spiess, 2005) and SALCA-SQ (Oberholzer et al., 2006). In RISE 3.0, the risk of over-compaction is assessed by (i) directly requesting details of observed signs of compaction and (ii) by calculating a risk index that incorporates risk factors (machinery weight, clay content, soil moisture when driven on by machines, tillage) and protection factors.

#### Ideas and recommendations

You indicated that you drive heavy machines on clayey soils. To the extent possible avoidance of heavy machine traffic on these soils is optimal. If you must drive on these soils when conditions aren’t optimal, use of double tires to distribute weight or lattice tires and lowering the tire pressure helps to lesson compaction. To protect soil stability liming, reduced tillage and cover crops can be helpful. You indicated that you do employ some of these measures.

### Animal husbandry

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Animal husbandry is an integral part of many agricultural production systems. Livestock should be kept in a manner that ensures their welfare and does not harm the environment. Animal welfare-friendly practices encompass the “five freedoms”: freedom from hunger or thirst, freedom from discomfort, freedom from
pain, injury or disease, freedom to express normal behavior, and freedom from fear and distress (FAWC, 1979). At the same time, high performance and resource efficiency should also be pursued. This topic provides an indication of:

- whether livestock performance is at a high level
- whether the husbandry system allows for species-appropriate behavior
- whether the physiological needs of the animals are met
- whether the animals are healthy

**Sustainability goal**

Livestock populations on the farm are managed in a long-term and site-adapted manner in order to optimize animal health, animal welfare and sustainability.

**Content**

An assessment is made of whether livestock-related information is collected and employed in a targeted manner in breeding and husbandry in order to improve animal welfare.

**Scoring**

100 points = systematic monitoring and documentation of animal husbandry (health and performance), balanced criteria for selection and breeding.

**Explanatory notes**

Sustainable livestock production requires livestock farmers to be well informed about their animals’ health and performance. Customers and government authorities are increasingly demanding detailed documentation in order to prevent outbreaks of animal epidemics and zoonotic diseases and to ensure product traceability. Various effective aids such as cow and sow breeding planners are available to supplement the essential practice of observing animal behavior. Breeding and selection also afford the farmer considerable influence over both livestock performance and welfare and environmental impacts. Breeding for performance and product quality alone is acceptable but cannot in itself be considered sustainable. These criteria may be replaced by others that have been chosen by the farmer. If this is done, however, the criteria should at least make agronomic and economic sense, e.g. longevity, life-long performance, disease resistance, robustness and good body shape (Postler & Bapst, 2000).

**Ideas and recommendations**

There aren’t many concerns here.

**Livestock productivity**

**Sustainability goal**

Appropriate livestock performance is achieved on the farm.

**Content**

Annual performance of all livestock categories on the farm is compared against regional benchmarks for very high, average and very low performance. Product quality is also rated based on regional or farm-specific criteria.
Scoring
The three benchmark performance values are worth 100 RISE points (= very high yield), 50 RISE points (average yield for the region) and 0 RISE points (very low yield), +/- a 20-point correction for product quality. Linear interpolation is used to fill in the gaps between the three defined points.

Explanatory notes
All livestock categories with a quantifiable performance for which reliable information is available are assessed. Animal welfare, animal health and herd management are also assessed under this topic, meaning that a good topic score can only be achieved by farms with a high level of both productivity and animal welfare.

Ideas and recommendations
There aren’t any concerns here. Your cows looked happy and healthy during my visit. This model evaluates production on volume and not components. I understand that you are breeding and managing for components upon which you can be bonused as well as total volume. Regardless of the measurement, your farm is measuring highly sustainable. The only place where you lost points in this section was the layers and broilers. Their productivity was lower than the regional average.

Opportunity for species-appropriate behavior

| Opportunity for species-appropriate behavior | 100 |

Sustainability goal
The animal husbandry system provides the animals with the freedom to express their natural social, movement, resting and sleeping, feeding, excretion, reproductive, comfort and exploring behaviors.

Content
An assessment is made of whether the animals enjoy sufficient time out of doors and contact with other members of the same species and of whether their environment permits them to behave as naturally as possible.

Scoring
100 points = based on current knowledge, the conditions in which the animals are kept allow species-appropriate behavior for all of the behavior categories included in RISE.

Explanatory notes
The three-level qualitative assessment (optimal = 100 points, acceptable/room for improvement = 50 points, unacceptable = 0 points) follows the KTBL (2006) method for estimating the extent to which animal husbandry practices limit the animals’ natural behavior. The score is based on the 20% of the relevant animal category stock that is kept in the least favorable conditions, with no weighting by Large Animal Units. The three-level scoring system also draws on the animal welfare handbook of the German organic farming associations (2013). Six questions cover the three areas of freedom of movement (A), ground conditions (B) and social contact (C). These in turn influence the level of species-appropriateness in the behavioral areas of social behavior (C), movement (A, B), resting and sleeping (B), reproduction (A), comfort (A, B) and exploring (A, B). Table 5 provides an overview of the natural behaviors of cattle, pigs and poultry in the most important behavioral areas (KTBL, 2006).

Ideas and recommendations
I do not have any concerns with what I saw during my visit. The fact that you allow the cows to raise their calves is fantastic. No suggestions
Living conditions

Sustainability goal
The physiological needs of the animals are met; they live in a species-appropriate environment.

Content
An assessment is made of whether temperature, lighting, air quality, noise level and feeding arrangements meet the needs of the species in question.

Scoring
100 points = all animals live in species-appropriate conditions.

Explanatory notes
The requirements for animal health and welfare include clean water and air (sufficient oxygen content, few aerosols, low levels of dust and harmful gases such as ammonia), air temperatures within the species’ comfort zone, light and noise levels that do not disturb the animals’ senses and species-appropriate, welfare-friendly feeding arrangements (e.g. Algers et al., 2009). The housing system has a major influence on all of these indicators (Wechsler, 2005). Humans working with the animals also benefit from improved animal housing conditions: working in a species-appropriate structure is usually both more pleasant and healthier for humans, too. For this indicator, the scoring is once again based on the 20% of the relevant animal category that is kept in the worst conditions, with no weighting by Large Animal Units.

Ideas and recommendations
Again things looked well maintained, clean and the cows seemed to be healthy. No suggestions.

Animal health

Sustainability goal
The animals live free from pain and disease. The number of unintended losses is as small as possible.

Content
An assessment is made of the number of unintended losses, veterinary treatments, zootechnical interventions and the animals’ external condition.

Scoring
100 points = no veterinary treatments necessary, no mortality due to disease, injury or accidents, no mutilated animals.

Explanatory notes
The use of veterinary drugs may indicate failings in animal husbandry. Since current knowledge (2011) suggests that these substances do not cause major environmental damage, this issue is treated here rather than under any of the RISE topics connected with the environment. As with the previous two indicators, there is no weighting by Large Animal Unit factors. Homeopathic and natural substances (vitamins, minerals), vaccines and feed additives are regarded as non-toxic and are therefore not included in the RISE evaluation (Kools et al., 2008). Zootechnical interventions like tail docking or chicken beak trimming usually affect entire livestock categories and cause both pain and distress. The animals’ external condition can provide clues about their health, standard of care and social stress. An assessment was made of the appearance of the skin/coat, claws, joints, etc. of the 20% of the stock that is in the worst condition.
Although the brief farm visits did not allow for a detailed evaluation of the animals’ condition, the experience that we already have with RISE indicates that at least a rough assessment can be made in the short time available. If failings are uncovered during this assessment, the use of a more detailed system potentially also including animal behavior may be recommended.

**Ideas and recommendations**

You indicated losing 4 calves, 1 heifer, 1 cow, 3 steers and a layer and broiler during the year. Also the lack of use of a numbing agent while dehorning affected your score slightly. Use of local analgesics such as lidocaine or bupivacaine may aid in the animal’s comfort when dehorning.

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**Materials use & environmental protection**

**Calculation variant: RISE 3.0**

Sustainable agricultural production makes use of natural nutrient cycles. It preserves a good nutrient balance even at high productivity levels, while minimizing environmental pollution and materials use. This topic provides an indication of: whether tight cycles and sustainable origins are taken into account by materials sourcing (fertilizer, feed, etc.); whether damage to the environment is avoided in the storage, use and disposal of materials.

**Material flows**

72

**Sustainability goal**

The farm promotes sustainable production of consumables, machinery, infrastructure, feed and fertilizer through responsible sourcing. Targeted material selection and efficient resource utilization prevent waste.

**Content**

An assessment is made of:

- Whether priority is attached to the use of nutrient sources (chiefly feed and fertilizers) either produced on the farm itself or at least sourced locally (within a region-specific radius)
- Whether materials and equipment sourcing considers sustainability criteria and in particular the circular economy
- Whether unproductive losses are prevented

This indicator integrates information on the following components:

1) Self-sufficiency of feed supply (calculated): N-self-sufficiency, P-self-sufficiency
2) Self-sufficiency of fertilizer supply (calculated): N-self-sufficiency, P-self-sufficiency
3) Regionality of feed supply
4) Regionality of fertilizer supply
5) Losses from crop production - “food loss”
6) Degree of implementation of recycling potential

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Scoring
100 points = all materials are sourced locally, from sustainable sources. Unproductive losses are minimized.

Explanatory notes
This RISE indicator assesses whether the farmer makes an active effort to minimize materials use on the farm, prevent unproductive losses and produce as little waste as possible. It also assesses whether sourcing of materials such as feed and fertilizers prioritizes the use of the farm’s own resources, followed by locally sourced materials, with products only being sourced from further afield if there is no alternative.

Ideas and recommendations
You indicated that part of your feed and all of your organic fertilizer is sourced from within 50 miles of the farm. Finding a local source of feed would lower your footprint due to transportation which would improve your score. You indicated that you experience a 10 - 20% loss in crop production (during harvest, on-farm storage and feeding). It is possible to limit these losses through improved management during storage in particular. You indicated that you could do a better job of recycling. Improving recycling in both the farm operations and your household will lower your impacts on landfills and lower the use of fossil fuel in plastic production especially.

Fertilization  

Sustainability goal
A balanced crop nutrient supply facilitates good yields while preventing damage to the environment and soil nutrient deficiencies. Optimal use is made of the nutrients available on the farm and these are only supplemented by externally sourced nutrients where necessary.

Content
Nitrogen and phosphorus balances are calculated at farm level (supply-demand balance, the benchmark values for the scoring function can be adjusted in the regional data. Nutrient surpluses are evaluated more critically than deficits in surplus areas. The tolerance limit for surpluses is only increased in the event of a poor P supply, but not for poor N supply). An assessment is also made of whether fertilizers are used sparingly in accordance with best practice.

This indicator integrates information on the following components:

1) Fertilization management = Fertilization planning (factors taken into consideration):
   a. Crop nutrient demand (envisaged yield x quality)
   b. Results of soil analyses (P and K content, texture, soil organic matter content…)
   c. Atmospheric nitrogen immission, biological nitrogen fixation
   d. Available quantities of organic fertilizers (types, N and P contents, dilution factors)
   e. Nutrient mobilization from crop residues
   f. Mulch and green manure

2) Fertilizer application (factors taken into consideration):
   a. Time and quantities (demand-specific application and release)
   b. Type and formulation of fertilizer
   c. Disability
   d. Precise dosage
   e. Distribution (application technology, wind speed)
3) Farm nitrogen balance

4) Farm phosphorus balance

Scoring
100 points = fertilizers are only employed where necessary, based on the relevant analysis results. The farm has stable N and P balances, i.e. the difference between supply and demand does not exceed 10%. The exact details of the scoring function can be defined regionally for both N and P. As a rule, more points will be deducted for surpluses than for equivalently-sized deficits. Figure 14 contains some examples of scoring functions.

Figure 14. Standard scoring functions for farm nitrogen balance (left) and phosphorus balance (right). The functions’ key indicators can be defined at regional level.

Explanatory notes
Nitrogen and phosphorus can both contribute to eutrophication if they find their way into waterbodies. Since nitrogen compound emissions from agriculture are significantly more mobile than phosphorus compounds, nitrogen surpluses are likely to cause more rapid and extensive damage to the environment than phosphorus surpluses. In many countries, both of these nutrients are regulated by environmental and in particular water protection legislation.

Nutrient deficits, on the other hand, are a problem at farm and plot level. Although acute deficits of one or several elements can be detected through deficiency symptoms and reduced crop yields, in the case of structural undersupply of e.g. phosphorus it can be several years before the deficit becomes apparent, depending on the reserves present in the soil. In simple terms, it can be said that nutrient surpluses are a problem that affects society as a whole, while deficits are a private problem. The relative importance of surpluses and deficits varies significantly between countries and regions. In regions with high numbers of livestock and in industrialized nations in general, the bulk of the problems are caused by N and P surpluses. On the other hand, nutrient deficits are a problem in large parts of sub-Saharan Africa (with no access to fertilizer or low soil organic matter content) and some parts of South America (with phosphate-fixing soils
or low soil organic matter content). This is why we have allowed the scoring functions in RISE 3.0 to be adjusted at regional level.

In addition to calculating the N and P balances, the following aspects of fertilization practice are also analyzed and evaluated:
- need-based fertilization (time and quantity)
- use of biological nitrogen fixation potential and consideration of nitrogen input from the air
- ensuring full use of organic fertilizer potential

**Ideas and recommendations**
This looks great. You are taking into account all of the important factors when planning and spreading your fertilizer. You are highly self-sufficient in both N and P and your N and P balances are great for your crop demands.

| Plant protection | 100 |

**Sustainability goal**
Plant protection on the farm is based on the principles of integrated plant protection. Hazardous substances that are harmful to the environment are only used where strictly necessary and their impact on the environment is minimized through targeted selection and application.

**Content**
An assessment is made of:
- The extent to which plant protection problems are managed in accordance with the principles of integrated plant protection
- The toxicity and persistence of any plant protection products used
- Whether measures are in place to minimize any unintended side-effects caused by the use of genetically modified organisms (GMOs).

This indicator integrates information on the following components:
1) Management of plant protection challenges according to the principles of integrated plant protection: site-adapted production systems, variety selection based on resistance and tolerance to pests and diseases, reliable identification of species prior to chemical treatments, application of damage thresholds, use of biological and mechanical rather chemical means of plant protection, measures to keep the effectiveness of PPP (e.g. herbicide rotation).
2) Due diligence in GMO cultivation: compliance with relevant legislation, measures to prevent unwanted spread or outcrossing of genes, conservation of specific GM properties (e.g. herbicide tolerance, resistance to pests), development of PPP use since GMO adoption.

**Scoring**
100 points = plant protection practices are completely in line with integrated principles, or no plant protection products (PPP) or GMOs are used.

**Explanatory notes**
The first step is to compare plant protection management practices on the farm against the principles of integrated plant protection:
- cultivation system design
- selection of crop cultivars
- identification of harmful organism presence prior to PPP use
- use of the damage threshold approach
- biological and mechanical methods preferred to synthetic chemicals
- switching of active ingredient groups to prevent development of resistance
- correct application of PPPs

Points are not automatically deducted for the use of GMOs – this would not be justified by current evidence regarding the threat that they pose to humans and the environment. However, the unintended propagation or crossover of GMOs and/or the failure of the relevant preventive measures are scored negatively in RISE.

The third component of the indicator score assesses how PPPs are used on the farm. Persistence in the soil, acute and chronic toxicity to humans and ecotoxicity (risk-based, i.e. the toxicity for the most sensitive organism) are recorded for all PPPs used. Each of these criteria is captured using a three-level scale, e.g. “persistent” for a half-life of more than 3 months, “moderately persistent” for 1 to 3 months and “rapidly degradable” for less than 1 month. The scores are weighted by number of applications and treated area prior to being aggregated at the farm level.

Ideas and recommendations
You are non-GMO and as an organic farmer I did not witness any concerns regarding plant protection products (ppp). As a reminder, just because products and medicines are approved for organic use, they still need to be used and stored appropriately.

Air pollution

Sustainability goal
The storage, use and disposal of materials does not cause gaseous emissions that threaten or harm the health of humans, animals or the environment (air, soil, water and natural ecosystems).

Content
This indicator deals with gaseous emissions that can harm the health of humans or ecosystems. It integrates information on:

1) Ammonia: risk of ammonia emissions from animal production (number of livestock per area, rating of grazing practice, slurry storage, spreading and incorporation into the soil), risk of ammonia emissions from imported organic fertilizers (spreading and incorporation into the soil), risk of ammonia emissions from mineral fertilizers (type and quantity).

2) Exhaust gases, smoke and odor: Burning of problem wastes (e.g. plastics), complaints from neighbors due to unpleasant smell (e.g. from stables, slurry application, sewage sludge, biogas fermentation or composting).

This indicator addresses the storage, use and disposal of toxic substances (plant protection products, veterinary drugs, dyes and colors, etc.), as well as other substances that could be harmful to humans, animals or the environment (effluent, waste, spillages from feed or fertilizer stores, etc.). Interviewees are questioned about actual soil and water pollution incidents (in the last 5 years) and the risk of such pollution incidents occurring in the future is also assessed.
Scoring
100 points = no pollution incidents and no risk of pollution incidents occurring.

Explanatory notes
See the next indicator, “Soil and Water Pollution”.

Ideas and recommendations
You indicated that the majority of your most utilized machinery is fairly old which means the emissions are generally going to be higher. Additionally, your lagoon is not covered which can result in significant ammonia emissions as cannot incorporating liquid manure soon after it is spread.

Whenever possible upgrading machinery to more fuel-efficient engines and higher emissions control will be a benefit.

Covering your lagoon has many potential benefits – reducing emissions, could be a source of on-farm produced fuel, and would reduce odor.

When liquid manure is being spread on bare ground, incorporating it as soon as it is spread will reduce emissions.

| Soil and water pollution | 81 |

Sustainability goal
The storage, use and disposal of materials does not cause liquid or solid emissions that threaten or harm the health of humans, animals or the environment (air, soil, water and natural ecosystems).

Content
This indicator deals with liquid and solid emissions that can harm the health of humans or ecosystems. It integrates information on:

1) Nutrients (N and P): buffer strips for manure and slurry storage and spreading, silos, parcels with risks of nutrient leaching, temporary storage organic fertilizers on bare soil.

2) Pollutants in fertilizer: heavy metals, radioactive isotopes, organic substances (compost, sewage sludge) that were not analyzed for pollutants, slurry and manure containing antibiotic residues.

3) Plant protection products: buffer strips, water erosion (6 m wide vegetated buffer strip, permanent vegetation along field margins, prevention of siltation, maintenance of high water retention capacity = prevention of surface run-off), prevention of drift, eco-toxicological characteristics of PPP (toxicity and persistence).

4) Pollutants in wastes, residues and wastewater: storage and disposal of problematic materials, risks from household and farm wastewaters, share of adequately treated wastewaters, pollution caused by livestock entering into water, further risks of soil and water pollution.

This indicator addresses the storage, use and disposal of toxic substances (plant protection products, veterinary drugs, dyes and colors, etc.), as well as other substances that could be harmful to humans, animals or the environment (effluent, waste, spillages from feed or fertilizer stores, etc.). Interviewees are questioned about actual soil and water pollution incidents (in the last 5 years) and the risk of such pollution incidents occurring in the future is also assessed.
**Scoring**

100 points = no pollution incidents and no risk of pollution incidents occurring.

**Explanatory notes**

Many farms use a wide variety of substances that can cause soil, water and air pollution as well as harming living organisms. For instance, the health of humans, animals and ecosystems can be endangered if the surface water or groundwater become overloaded with nutrients (eutrophication) or contaminated with pollutants or pathogens. Spillages from manure stores and silos and soil erosion are among the key ways in which P can enter waterbodies and the groundwater.

RISE 3.0 assesses the following substances: slurry, manure, feedstuffs (especially silage), effluent, contaminants such as oil, antibiotics, heavy metals, etc., all types of waste and other toxic substances (acids, alkalis, dyes, colors, etc.). The natural resources to be protected include water, soil, air, near-natural ecosystems, humans and animals. As with the “soil erosion” indicator, 50% of the indicator score is based on observations (in this case, pollution incidents in the last 5 years) and the remaining 50% is based on a risk assessment. The risk assessment takes into account how the abovementioned substances are stored, used and disposed of on the farm. Observations during the farm visit play an important role in this qualitative assessment. The other component of this indicator comprises the answers to 8 questions about the likelihood of pollution events occurring on the farm. These include the burning and dumping of e.g. silage wrap, animal carcasses or batteries, spillages from manure trays, slurry pits or bunker silos, and soil pollution caused by waste oil, battery acid or spray mixtures.

**Ideas and recommendations**

Your manure and silage storage is not a problem. However, due to the use of manure, RISE recognizes the potential for heavy metals and harmful residues to be present when spread. That reduces the score in this section a bit.

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**Water use**

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Clean fresh water is indispensable both to human life, and to crop and livestock production. The production system employed by the farmer affects the amount and quality of the water available to other users. This topic addresses:

- How good the quality and quantity of the farm’s water supply is
- How intensively and efficiently water is used for production
- How sustainable are the farm’s irrigation practices

**Water management**

| 67                           |

**Sustainability goal**

Knowledge and technology are actively employed to ensure efficient, site-adapted and resource-conserving utilization of water resources.
Content
This indicator is only calculated if “blue” water (taken from aquifers or surface waterbodies) is used on the farm (as opposed to only “green” water, i.e. rainwater naturally absorbed by the plants). Interviewees are questioned about whether water consumption is monitored, whether opportunities to collect rainwater are used where doing so is feasible, whether they are aware of the potential water-saving measures that could be implemented on the farm and the extent to which such measures have actually been introduced.

Scoring
100 points = water consumption is monitored, potential water-saving measures are known and fully implemented.

Explanatory notes
Water-saving measures can accumulate the most points, since a wider range of (low-tech and high-tech) technologies and measures exists for this purpose. It is thus also easier for the farmer to take active measures to save water. A farm where nothing is done to save water in production can only achieve a maximum of 50 points and will thus be given a “room for improvement” rating. The question relating to the use of information is also intended to raise awareness about the fact that such information is available and can be used. The questions are intended as examples and may be modified or expanded.

Ideas and recommendations
You indicated that you do not have a strong knowledge of your consumption and that you have not exploited your water saving potential. Installing water meters and monitoring water quality could prove valuable in the long run. Short term knowledge indicates that water availability is not a problem. In an ever-changing climate drought is a reasonable risk. To ensure the sustainability of your farm, understanding your water consumption can help you to plan for a time when water availability is scarce. Scientists predict that we are going to experience greater extreme weather events – this means increased drought and storm events. In order to prepare for these extreme situations, you need to have a firm understanding of your demand. Additionally, when water is scarce, what little there is will need to be high quality. If you need water, but the only water available is contaminated, then it will be of no value.

| Water supply | 100 |

Sustainability goal
The quantity and quality of the farm’s water supply are secure in the short and long term.
Content

The current situation, trends and potential for conflicts concerning the quantity and quality of the water supply are recorded and assessed (Fig. 17).

Scoring

100 points = no problems on the farm (no need to increase depth of wells, no water-related conflicts, no deterioration in water quality, no decrease in water availability, no fall in the groundwater table), together with a low regional water stress level as defined by the WBCSD Global Water Tool.

Explanatory notes

Water scarcity becomes a problem when it leads to water stress, i.e. sufficient water is not (or no longer) available. Since in some cases it may be some time before water stress at regional level affects the water supply on-farm, and since the farm itself can directly affect the availability of water to other users in the region, the watershed level is also taken into account in RISE 3.0. The intention is to raise the farmer’s awareness of potential future water conflicts. The regional water stress index (“blue” water) is determined for the farm’s coordinates using the Global Water Tool of the World Business Council for Sustainable Development (WBCSD)10. Moderate stress is defined as beginning at a value of 0.2 and high water stress starts at 0.4 (mean annual relative water stress index). The Global Water Tool levels of “low”, “medium”, “scarce” and “stress” translate into 100, 66, 33 and 0 RISE points respectively. Other information sources may also be used, for example the WWF’s “Water Risk Filter”11 or the map included in Pfister et al. (2009)12.

Ideas and recommendations

Currently this isn’t an issue, but sustainability begs us to prepare for the future.

Water use intensity

| Water use intensity | 65 |

Sustainability goal

The quantity of water used in agricultural production is adapted to local conditions through the choice of crops and timing of cultivation. The farm is not dependent on externally supplied water and its irrigation requirements are minimized.

Content

The water demand of the farm’s crops and livestock is calculated based on standard regional coefficients and compared with the water supply as determined by climatic conditions over the course of the year in
question. Water requirements are estimated taking the timing and duration of crop cultivation into account.

Scoring
100 points = the farm’s total water requirements are less than the annual volume of rain that falls on its land. Crop selection and the time of year at which crops are grown ensure that irrigation requirements are minimized, thereby preventing a structural water deficit.

Explanatory notes
The water intensity of sustainable production systems must be adapted to local conditions in order to prevent the risk of overexploitation of “blue” water at regional level.

The calculation of water consumption in RISE 3.0 is based on the FAO’s CROPWAT model. Crop water demand is calculated using the CROPWAT coefficients (Et0 * Kc = potential evapotranspiration * crop-specific coefficient). Regional water availability (calculated from effective rainfall and potential evapotranspiration) is input and considered on a monthly basis. This allows structural water deficits to be identified.

Ideas and recommendations
Your water self-sufficiency percentage is 88%. You indicated that you do not currently irrigate, however this score indicates that your crops would benefit from increased water. Should weather patterns change, and we experience increased drought in Ohio, irrigation may become even more necessary. This is just something to think about when planning for the future. If potential future challenges are already on your radar screen you will be better prepared to address them when they become reality.

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Efficient irrigation methods enable high physical and financial yields.

Content
An assessment is made of whether (i) irrigation is carried out in a targeted and efficient manner, (ii) irrigation makes financial sense and (iii) there are any problems in connection with irrigation.

Scoring
100 points = irrigation is carried out in a targeted and efficient manner, as well as making financial sense and being problem-free.

Explanatory notes
This indicator is only used if the farm has crops that are irrigated. Artificial irrigation may be rated as good (color-coded green) if it is carried out in a knowledge-based and targeted manner, if unproductive water loss is avoided insofar as this is possible using current technology and in view of the farm’s financial situation (irrigation efficiency target of 85%) and if the use of irrigation makes financial sense. In addition, irrigation should not cause conflict with other water users or result in soil salinization (due to the use of excessively brackish water and/or inadequate drainage).

Ideas and recommendations
I didn’t see any problems here. What lowered you score a bit was have you exploited all of the water-savings potential during irrigation.
To be sustainable, agricultural production must be energy-efficient and not reliant on non-renewable, environmentally harmful energy carriers. This helps to protect the climate, which in turn has an impact on the health of plants, humans and animals. This topic addresses:
- The extent to which production on the farm is reliant on non-sustainable energy sources
- Which energy-saving measures have been implemented
- The net volume of greenhouse gases (minus sequestration) emitted by the farm

**Energy management**

**Sustainability goal**
Sustainable energy use is facilitated through the active deployment of knowledge and technology.

**Content**
This indicator is only calculated if energy is actually used on the farm (as opposed to only human and animal labor). Interviewees are questioned about whether energy consumption is monitored, whether the potential for producing renewable energy on the farm is being used, whether they are aware of the potential energy-saving measures that could be implemented on the farm and the extent to which such measures are actually being implemented.

**Scoring**
100 points = energy consumption is monitored, full use is made of the potential for producing renewable energy, there is an awareness of the potential energy-saving measures and these are fully implemented.

**Explanatory notes**
If a farmer is already taking steps to reduce energy use and become less dependent on fossil fuels, this should be recognized and made visible by RISE. Conversely, the absence of such measures can be taken to indicate a need for advice in this area. Targeted measures require an awareness of the (quantitative) situation, i.e. dependencies, bottlenecks and the overall importance of the energy supply to the farm. The measures that have been implemented on the farm are selected from a list of potential energy-saving measures. A fixed scoring system awards points to all measures based on their effectiveness and these are then added up to give a final score.

**Ideas and recommendations**
This calculation is based on you having knowledge of your energy consumption. Although you know your total consumption you have not explored energy saving measures. Have an energy audit conducted on your farm. This is an easy way to find cost effective measures that you can implement to save you money. Contact your local energy provider to schedule an audit. In many cases they will offer cost-share programs and often will provide materials free of cost. Energy efficiency is an easy way to save money, lower your greenhouse gas footprint and improve your sustainability.
Ideas and recommendations
Increasing the use of renewable energy and alternative fuels will help lower your GHG footprint, however the most important part of the energy conversation is efficiency. Production of renewable energy comes at a cost, before you install renewables the first step is to be as efficient as possible.

Greenhouse gas balance

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<th>Sustainability goal</th>
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<tr>
<td>The annual net GHG emissions of the area of the farm used for production do not exceed the amount that it would need to emit in order to prevent a rise in the average global temperature of more than 2°C compared to pre-industrial levels.</td>
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Content
A GHG balance is calculated using data on land and energy use, production methods, animal husbandry and land use changes, and is then rated against global and/or EU benchmarks.

Scoring
The scoring function awards points as follows: 100 points = 1.1 t CO2 eq./ha (average global emissions in 1990), 67 points = 2.0 t CO2 eq./ha (EU 15 average in 1990 minus 20%), 50 points = 2.5 t CO2 eq./ha (EU 15 average in 1990), 0 points = 5 t CO2 eq./ha (twice the EU 15 average in 1990). The benchmark values are based on data in Nabuurs et al. (2007), Smith et al. (2007), FAOSTAT (faostat.fao.org) and EEA (2013). Only a limited reduction of GHG emissions will be possible if demand for agricultural products remains unchanged. The estimated feasibility of reductions is based on data in Weiske et al. (2006).

Explanatory notes
RISE 3.0 calculates GHG emissions/sequestration for the following processes: land use change, burning of biomass, use of production inputs (fossil fuels) and livestock production.

Direct methane (CH4) emissions from ruminants are calculated using the method described by Mills et al. (2003), which calculates the quantity of CH4 based on the amount of dry matter fed to ruminants. The equation used provides a sufficient degree of accuracy for individual projections (Mills et al. 2003).

Calculation of indirect CH4 emissions resulting from slurry storage is based on the IPCC (Level II) approach (IPCC, 2006), which takes account of livestock species and number, ambient temperature and slurry management. Unlike the IPCC approach, however, RISE 3.0 uses linear interpolation to fill in the gaps between the extremes, resulting in some deviation from the original values. RISE 3.0 also differs from the IPCC (2006) tables in that interviewees are only asked for information about livestock farming intensity and slurry management and not about the region. The descriptions are based directly on the original IPCC criteria (1996). Nitrous oxide (N2O) emissions produced by slurry storage or spreading are not included. CH4 emissions resulting from slurry storage are rated as zero if the slurry is fermented in biogas plants.

The calculation of N2O emissions resulting from nitrogen application is based on IPCC (2006) Level I. The total quantity of N applied/input is used to produce an FIE (fertilizer-induced emissions) estimate for 1% of the N total (IPCC, 2006). The N sources taken into account are livestock excreta minus gaseous losses during livestock production and application, mineral fertilizers, atmospheric N deposition and N fixation by legumes. It is assumed that there is no difference between N from organic and inorganic compounds (Stehfest & Bouwman, 2006). Nitrogen resulting from N fixation by legumes is included owing to the lack of information on this aspect (Rochette & Janzen, 2005).
Ideas and recommendations
Increasing the use of renewable energy and alternative fuels will help lower your GHG footprint, however the most important part of the energy conversation is efficiency. Production of renewable energy comes at a cost, before you install renewables the first step is to be as efficient as possible.

| Greenhouse gas balance | 100 |

Sustainability goal
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The calculation of emissions from crop residue burning assumes that 80% of the dry matter is burned and that 0.07 kg N2O and 2.7 kg CH4 are produced per ton of dry matter. Fixed, region-specific (CO2 eq.) values are used for the burning of grassland and woodland. The quantity of CO2 fixed through afforestation is based on a region-specific time period and calculated in proportion to the time elapsed between the year of afforestation and the year of analysis. In accordance with the Kyoto Protocol rules, CO2 emissions purely from livestock respiration and the burning of crop residues and grassland are not taken into account. In both cases, the same quantity of CO2 was/continues to be fixed by plants.

RISE 3.0 permits the selection of certain individual land use measures that result in C fixation or release. Only those measures that do not go back more than 20 years and are implemented on a permanent basis are taken into account. The baseline figures are taken from Freibauer et al. (2004).

In RISE 3.0, the global warming potential of methane and nitrous oxide is set at 28 and 298 CO2 equivalent respectively (GWP100 in IPCC, 2013). As in the calculation of energy intensity, “gray” emissions from the production of inputs such as mineral fertilizers and pesticides are not taken into account.

In RISE, one global GHG scoring function is used for all farm types because, from an ecological point of view, there is no justification for using a different scoring method based on either the location or the source of the agricultural emissions.

**Ideas and recommendations**

Your total was calculated to be less than 0 tons CO2 eq./ha. This means that you are sequestering more carbon equivalent than you are emitting. Congratulations! You are the only farm that I have been on that has shown this. I believe it is because of the pasture-based nature of your operations.

RISE does not calculate GHGs based on energy and fat corrected milk. Many of the articles published on US dairy footprints calculate based on a fat and protein corrected milk. Although there is a solid argument for calculating in this manner, I argue that it is still helpful to understand the raw data. Once you have the raw data you can then make additional calculations as needed. FAO published a report in 2010 that found the average emissions on North American dairies is about 1.2 kg CO2 eq./kg of fat and protein corrected milk. ([http://www.fao.org/docrep/012/k7930e/k7930e00.pdf](http://www.fao.org/docrep/012/k7930e/k7930e00.pdf))

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<th>Biodiversity</th>
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**Calculation variant: RISE 3.0**

The diversity of living organisms and the health of ecosystems are closely connected. Indeed, agricultural production and human life itself are only possible at all thanks to the regulation of water, nutrient and gas balances, pollination, soil formation and other functions performed by ecosystems. This topic addresses:

- What is being done to promote the diversity of species, varieties and breeds on the farm
- How well natural ecosystems are preserved and connected within the agricultural landscape
- The quality of plant protection management
- Whether substances that are toxic to humans and nature are used for crop and livestock protection
Biodiversity management

**Sustainability goal**
The farm has a biodiversity management system that incorporates a strategic and systematic approach to planning, decision-making, implementation and monitoring of activities geared towards species protection and ecosystem conservation.

**Content**
The farm should either be receiving comprehensive advice on biodiversity or have a knowledge of the current situation. There should also be planning and implementation of species and habitat protection measures and monitoring of the success of any measures implemented. A variety of farming measures to promote biodiversity should be implemented in the agricultural area (and optionally also unproductive land, woodland).

**Scoring**
100 points for comprehensive advice on biodiversity or a knowledge of the current situation, planning and implementation of species and habitat protection measures and monitoring of the success of any measures implemented. In addition, a variety of farming measures to promote biodiversity should be implemented in the agricultural area.

**Explanatory notes**
“Conscious” management: Sustainable agricultural production requires conscious management of the different natural resources that a farm uses and influences. As one of these resources, biodiversity is strongly affected by the methods used in production (see sources for the “intensity of agricultural production” indicator). Farmers thus have a responsibility to protect and promote biodiversity and to make sure that they do not harm it.

In order to ensure that a given site’s biodiversity is maintained and is not damaged as a result of unintended impacts or changes in farming practices, the farmer must have a fundamental sensitivity to and knowledge of this subject and its context (Hungerfold & Volk, 1990). Active biodiversity management may then involve farmers obtaining external advice and support in order to develop decision-making guidelines and potentially also help with the implementation of measures, although this may also be done by the farmers themselves. In order to ensure a systematic approach to management, it is recommended that the “plan, do, check, act” management cycle should be adhered to – this approach is also used in the Eco-Management and Audit Scheme (EMAS) and ISO 14000. As far as rare species or protected habitats are concerned, the first step of this approach is for the farmer to be informed about the actual and potential presence of such species/habitats on the farm. The next step is to use this information to develop and implement specific individual measures. The third step is to monitor the success of the measures that have been implemented and the final step is to carry out any necessary amendments to the measures.

For reasons of efficiency, in this component of the indicator RISE concentrates on selected areas of biodiversity and selected steps in the management cycle. It therefore focuses on the management of protected and wild plant and animal species where the first three steps in the cycle are selected and on the management of protected habitats (e.g. dry grassland, reed beds, natural hedgerows, wetlands) where the first two steps are selected. Most of these habitats are affected by human activity and can include both cultivated land (e.g. species-rich grassland) and biotopes not used for agriculture (e.g. stands of trees/bushes, waterbodies). The management cycle should ideally incorporate all four steps and all aspects
of biodiversity for every area. This means that a comprehensive biodiversity management system would include the conservation and promotion of genetic diversity.

Measures to promote biodiversity: In addition to the planning aspects covered by the first component of the indicator, biodiversity management also includes concrete farming measures. It has been shown that different farming practices have different impacts on biodiversity. For instance, the extent to which insects and other small animals are harmed varies depending on which mowing technique is used. Scythes and sickle bar mowers are relatively low-impact techniques, whereas mortalities of up to 80% can be expected if rotary mowers with conditioners are used (Humbert et al., 2009; Fluri et al., 2011). RISE has one list with a selection of corresponding measures for each different type of land use. There is also always an open-ended category for measures not contained in the list.

Crop production measures:
- Undersown crops in crop production
- No use of insecticides, fungicides or growth regulators
- No use of herbicides
- No use of mechanical weed control (without seedbed preparation)
- Other measures (e.g. mixed cropping of cereals and vegetables, winter planting with intercrop or green manure during winter months, measures to promote soil organisms: use of manure compost, soil-friendly crop production: no plowing, no-till drilling and rotary band seeding, higher percentage of leys in rotation, diversity of botanical families in vegetable cultivation)

Measures for Grassland:
- Use of sickle bar mowers
- No use of mower conditioners
- Mowing at staggered intervals
- Delayed mowing (after main flowering season)
- No silage
- No use of PPPs on grassland
- Other grassland measures (e.g. strips of grassland left unmown as cover for small animals)

Permanent Crop Measures:
- Ecologically valuable margins, e.g. hedgerows, hedgerows and bushes in fruit cultivation, extensive grass and wild herb strips along orchard margins
- No clearing or burning (e.g. removal of standard fruit trees)
- Ground cover managed to promote biodiversity, e.g. greened driving lines, no herbicides, alternate mowing/mulching of driving lines
- Significant proportion of extensive/unused species (e.g. shade trees, dead wood, plants that are not fertilized or treated with PPPs)
- No PPP use
- Other measures (e.g. cultivation of resistant fruit varieties, reduced use and use of nature-friendly plant protection products in fruit cultivation, leaving brush piles, rock piles, wood piles, wild bee hotels and lacewing boxes)

Since the impact on biodiversity depends on the type of land that is being managed in one or other of the ways listed above, the percentage of each land type is estimated on a five-level scale, with the points totals being weighted by land type before being added together to give a final score.
Ideas and recommendations

This calculation is largely based on the series of questions I ask you regarding if you have ever had anyone come out to your property and conduct an assessment on species or habitat. Most farmers have never sought such advice. The premise here is you can’t manage what you don’t know. By having a study conducted you will have more information regarding protection of species and habitat. I realize it is unlikely that most will seek such advice so this just may be one of those areas that remains a challenge.

Additionally, this category is based on how you manage your cropland and grassland. See above measures that can be implemented to help protect and promote biodiversity.

<table>
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<tr>
<th>Ecological infrastructures</th>
<th>100</th>
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Sustainability goal
The farm hosts several areas with high biodiversity potential that provide a habitat for rare and specialized plants and animals.

Content
An assessment is made of the percentage of the agricultural area that has a high ecological value (planar, linear and dotted structures). The area being assessed can be optionally extended to the entire farm area.

Scoring
100 points are awarded if 17% of the farm has high biodiversity potential. This figure is based on the UN Convention on Biological Diversity (Nagoya, Aichi), which states that 17% of terrestrial areas should be managed for nature. This threshold may be adjusted at regional level.

Explanatory notes
Many plant and animal species require ecologically valuable habitats for their survival. The extreme changes in the cultivated landscape and the intensification of agriculture that have occurred over the past 50 years have led to a reduction in biodiversity. The experts agree that areas managed for nature are required if biodiversity is to be preserved. In addition to nature reserves, these may also include areas in forests and on cultivated land, since many species require extensively managed land. Research into the ecological effects of government agri-environment schemes in Switzerland reported positive impacts for most groups of organisms. However, the programs’ effectiveness was highly dependent on the ecological quality of the areas, e.g. their structural diversity (Knop et al., 2006).

This indicator reflects the percentage of the farm area that has a high ecological value. By default, only the area used for agriculture is assessed. The ecological value of the various areas is estimated by the farmer.

The targets proposed by the experts for the proportion of ecologically valuable land range between 15% and 20% (IOBC, 2004; UN, 2010). The UN’s Nagoya Protocol on the conservation of biodiversity calls for 17% of all terrestrial areas (not just agricultural areas) to be managed for nature. Accordingly, the standard optimal percentage of ecological priority areas (worth 100 points) has been set at 17%. In other words, this indicator measures the farm’s contribution to the achievement of the UN conservation target. Where sound reasons exist, this target may be altered at regional level by the RISE extension agent.

Ideas and recommendations
Looks great

| Distribution of ecological infrastructures | 73 |
Sustainability goal
The landscape is well connected, allowing mobile animal species to move from one ecological stepping stone to another. There is no “erosion” of ecological structures.

Content
An assessment is made of the interconnectedness of ecologically valuable structures in the landscape as well as of how the proportion of these structures has evolved over the last 10 years (Fig. 29).

Scoring
100 points awarded if 100% of the arable land contains or is in close proximity (< 50 m) to ecologically valuable structures and if these structures’ development has followed a positive trend (+/- 20 points). The optimal value for the ecological quality of the landscape may be adjusted at regional level.

Explanatory notes
In addition to the percentage of the total area containing ecologically valuable structures, one measure of a landscape’s ecological quality is how well these structures are interconnected. What matters is not just whether there is enough habitat to sustain healthy populations but also the spatial distribution of these habitats and whether exchanges can occur between the populations present in different locations. Sustaining stable populations can also serve the interests of agriculture, since highly fragmented landscapes have been shown by Kruess & Tscharntke (1994) to have less potential for natural pest control.

RISE establishes whether a habitat can be considered to be well connected through the use of remote sensing images (e.g. satellite images from Google Earth), maps, or visual inspection in the field. A 50 m buffer zone is mapped out around all the relevant landscape elements (hedgerows, trees, rock piles, etc.). The percentage of the farm’s agricultural area that falls within 50 m of a landscape element so that it is still accessible to many organisms is then calculated. In this RISE indicator, “well connected” is thus taken to mean that several landscape elements are distributed all over the farm. If this is the case, it is assumed to be highly likely that an exchange of populations between elements will be possible, meaning that they are interconnected in the classical sense. The percentage of interconnected habitats is directly translated into a RISE score.

Ideas and recommendations
Things look to be on track in this area. Improving bufferstrips, wildlife corridors, connecting wilderness areas all provide habitat and cover for wildlife. Allowing forested areas to exist on your property instead of maximizing cropland or grassland improves wildlife habitat.

Intensity of agricultural production

| Intensity of agricultural production | 76 |

Sustainability goal
Production intensity is low enough to provide habitat for a diverse flora and fauna.

Content
The intensity of fertilization, PPP use and livestock production (stocking density) is calculated on an area basis and the measures taken to foster biodiversity in the agricultural area are recorded. Both aspects are then scored.
Scoring

100 points = no nitrogen fertilization (0 kg N per ha), no PPP use, low stocking density (2 Large Animal Unit per ha). Any sprays used should have only a low level of toxicity for non-target organisms (including beneficial insects and aquatic organisms) and low persistence (half-life <1 month).

Explanatory notes

The intensity of agricultural production strongly affects species diversity (Donald et al., 2001; Marshall et al., 2003; Green et al., 2005; Kleijn et al., 2009) as well as ecosystem functions such as biological pest control (Tscharntke et al., 2005; Geiger et al., 2010), crop pollination (Biesmeijer et al., 2006) and the conservation of soil fertility (Brussaard et al., 1997). Excessive nitrogen application substantially alters the competitive balance in plant communities, favoring fast-growing species and impoverishing species diversity (Grime & Hunt, 1975, Hawes et al., 2010).

Potential measures of intensity include productive output (e.g. yields per unit area) and the intensity of agricultural input use and management interventions (Donald et al. 2001). This RISE indicator largely follows the approach proposed by Herzog et al. (2006) for assessing intensity, in which the intensity of fertilization, PPP use and livestock production is evaluated.

As far as fertilization intensity is concerned, high levels of nitrogen application cause soil eutrophication, alter and impoverish the composition of plant communities and lead to an increased risk of nitrate leaching into the groundwater and harming aquatic ecosystems.

As far as the intensity of PPP use is concerned, the number of PPP applications per unit area and the toxicity and persistence of the substances used are assessed. The latter are not included in the approach proposed by Herzog et al. (2006). However, toxicity and persistence are both important factors for evaluating environmental impacts (Kovach et al. 1992). In principle, the harm caused to biodiversity will increase with the number of PPP applications. The RISE scoring function can be adapted to local conditions using regional data. Split PPP treatments (splitting a single PPP application into several applications) have the advantage of enabling the quantity used to be reduced, meaning that a lower overall amount of the substance enters the environment. However, multiple PPP applications increase the amount of time that organisms are exposed to the substance, which in turn increases the amount of harm caused to them. It is therefore justified to treat individual split applications as “fully-fledged” PPP applications.

As far as livestock production intensity is concerned, high stocking densities result in high levels of nitrogen entering the environment, altering the composition of plant communities and potentially causing high ammonia emissions. Although stocking density is to some extent correlated with fertilization intensity, on many farms stocking density still provides a good measure of the intensity of use of pasturage land and land used for fodder crop production (Herzog et al., 2006).

For all three components of this indicator (fertilization, PPP use and stocking density), the first assessment basis considers intensity across the whole of the agricultural area. This provides a measure of the overall intensity of the farm in each of these three areas. Extensively used areas compensate for the substances used on the production-oriented areas. However, in order to obtain a measure of the intensity of production-oriented areas alone, the second assessment basis only assesses the intensity of these areas. The same scoring functions are used so that the degree of compensation can be ascertained.

Ideas and recommendations

RISE did not find your practices to be overly intense. As noted above the use of PPPs was not concerning. Your stocking density is within the recommended parameters. The only area the is contributing to a slightly
lower score is your use of manure for fertilization. It is common to spread manure because you need to empty your lagoon instead of because your soil tests and crops are indicating a need. I do not believe you indicated having a nutrient management plan in place. Developing a plan, and more importantly following the plan, will help you to manage fertilization in an optimal way.

| Diversity of agricultural production | 59 |

**Sustainability goal**
Through diverse agricultural production and on-farm use of genetically diverse crops and livestock, the farm contributes to the survival and development of plant and animal genetic resources. This helps to ensure that a wide diversity of primary genetic material will still be available to future generations for breeding purposes. By growing different types of crops, the farm helps to create a more diverse cultivated landscape.

**Content**
An assessment is made of various aspects of production diversity: the number of different land use types, the number of arable and permanent crops grown, the number of livestock breeds on the farm (with bonus points awarded for old or endangered varieties and breeds); for permanent grassland, frequency of use and yields are evaluated; beekeeping is rated positively.

**Scoring**
100 points = 5 different land use types (this figure may be adjusted at regional level), 6 different livestock breeds, 3 rare and/or old breeds or varieties and bees kept on the farm, high percentage of diverse permanent grassland (assessment based on frequency of use and yield), 10 different arable and permanent crops (for >10 ha of arable and permanent crops, max. 10 crops; for under 10 ha of arable and permanent crops, 1 crop per ha).

**Explanatory notes**
In modern agriculture, the diversity of ancient, locally adapted or resistant crop varieties and livestock breeds has been replaced by a handful of high-performance cultivars and breeds. While this has led to improved yields and performance, it has also eroded the genetic basis of resilient production systems in many parts of the world (ÖW, 2004). The concentration on a small number of high-performance breeds, species and cultivars entails a number of risks for yields resulting from e.g. reduced disease resistance and adaptability to changing environmental conditions, as well as the danger of inbreeding depression. Where genetic diversity declines, opportunities for future breeding programs are irretrievably lost, impairing adaptability to unforeseen disease threats or changing environmental conditions (BfN, 2010). Declines in genetic diversity also result in loss of cultural heritage, since many native breeds and varieties are of cultural and historical importance. Examples include the Hérens cattle used in cow fighting in the Swiss canton of Valais and the Rheinthaler Ribelmais ancient corn variety or Swabian lentils that are an important part of local recipes and customs.

The conservation of livestock breeds and crop varieties through their use on farms makes an important contribution to the protection of genetic resources and provides an opportunity to safeguard, maintain and develop valuable cultivated landscapes (BfN, 2010). This can in turn provide both agronomic (rotation, pest control, soil conservation) and economic (risk spreading) benefits. Diversification can also be advantageous in terms of workload and is often socially desirable, since it enriches the landscape.

Farms that grow ancient, local, endangered and/or disease-resistant fruit, vegetable or cereal varieties make an important contribution to crop genetic diversity conservation. This may involve arboreta
(orchards with several different local varieties) or the cultivation of ancient vegetable or cereal varieties. By allowing farmers to preserve their independence and combat monopolies, it can also have a positive impact on costs over the longer term.

Honey bees and other insects contribute to the value of farm harvests by pollinating crops and wild plants. In addition to the direct benefits of pollination, beekeeping can also be expected to provide indirect benefits, since bees require a continuous supply of flowering plants, something that is more commonly found in small-scale landscapes. The presence of honey bees also requires farmers to take particular care over which plant protection products they use, and this in turn benefits wild pollinators, other insects and the subsequent parts of the food chain.

**Ideas and recommendations**
This is another area where improvement can be a challenge. I understand that you are choosing the breeds you raise and the crops you plant to maximize milk production. If included in your goal was to preserve native or endangered plant and animal breeds I would encourage you to think about diversification in these areas.

You indicated you raise 6 different breeds on your farm which generates a perfect score as does beekeeping. What lowered your score was the fact that you do not raise any old/endangered plant varieties or animal breeds.

<table>
<thead>
<tr>
<th><strong>Working conditions</strong></th>
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<td><strong>Calculation variant:</strong> RISE 3.0</td>
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A committed and productive labor force is a basic requirement for a successful farm. Both of these traits are strongly influenced by on-farm working conditions. This indicator assesses the objective working conditions for farm employees and self-employed farm labor. The following aspects are addressed:
- Occupational health and safety/physical working conditions
- Work organization
- Respect of basic rights
- Remuneration
- Justice

| **Personnel management** | 79 |

**Sustainability goal**
Good personnel management ensures that the farm has a sufficient short-, medium- and long-term supply of satisfied, motivated and adequately trained personnel. There is little potential for conflict thanks to transparent and fair terms and conditions of employment.

**Content**
An assessment is made of whether the farm has a professional, forward-looking personnel management system in place and whether working conditions comply with the decent work standards established in the relevant human rights conventions and agreements.
Scoring
100 points = personnel requirements are known / arrangements are in place for replacing workers leaving the farm for age-related reasons / an apprenticeship program is in place / written employment contracts / pay stubs resp. payslips/ work permits for all personnel / measures are taken to motivate the workforce (e.g. incentive systems, praise) / protection against unfair dismissal / adequate income protection in the event of accidents, sickness, maternity, etc. / no discrimination / no forced labor of any kind / freedom to form labor unions.

Explanatory notes
Although personnel management is not often specified as a direct component of working conditions, it actually has a substantial influence on them. RISE’s scoring of the questions about residence and employment assesses the legality and documentation of farm workers’ employment. It is assumed that the absence of residence and work permits, employment contracts and wage stubs reduces an employee’s ability to demand their social and financial rights.

The questions concerning child labor, other problematic working conditions such as bonded labor and discrimination are based on the human rights of freedom, self-determination and physical integrity enshrined in the Universal Declaration of Human Rights (UN, 1948). Article 2.1 of the International Labor Organization’s (ILO) Convention concerning Forced or Compulsory Labor defines forced labor as involuntary work or service which is exacted from any person under the menace of any penalty. A representative sample of personnel from different job categories on the farm should be interviewed, with the most negative responses for each category being scored. All members of the labor force have the right to form, join and organize the labor unions of their choice and for these labor unions to engage in collective bargaining with the farm management on their behalf; see ILO Conventions 11, 87, 98, 135 and 154.

Ideas and recommendations
Providing workers with a written contract and offering slight incentives could motivate your workers to excel in their tasks. You did not indicate any in-kind payments to your employees during our interview. Often workers receive meat, dairy, vegetables etc. or have the use of a farm vehicle when needed. You may not think about these perks, but they are important to capture in this type of evaluation. These “perks” are part of their total compensation package.

| Working hours | 75 |

Sustainability goal
Each person working on the farm has enough free time to recover physically and mentally, so that they can remain healthy and productive in the long run.

Content
Daily, weekly and annual working hours and annual vacation are recorded and evaluated against the regional standard.

Scoring
100 points = 5 days a week, 40 hours a week, 6 weeks’ paid vacation a year, overtime remunerated. These values may be adjusted at regional level.

Explanatory notes
Working time is a key factor in the assessment of working conditions. Excessive working hours can damage workers’ health by depriving them of the time needed to recover both physically and mentally (Ala-Mursula
et al., 2006; Härmä, 2006). Exhaustion and stress are often important causes of people taking time off work because of illness and accidents, and this can in turn lead to personnel shortages. Moreover, even when it does not cause people to be absent from work, being required to work excessive hours on a permanent basis still has a negative impact on workers’ productivity and quality of life.

In RISE, working time is calculated differently for different types of employment. Part-time work is adjusted to a full-time equivalent basis and compared against a reference scale. Workers on an hourly wage are fully compensated for all the work they perform, allowing their hourly rate to be compared directly against the reference scale. In the case of piece workers, it is necessary to record the amount of time taken to perform the task they are paid for. The assessments of working time are based on the ILO’s international conventions. These standards are also used by various certification schemes (e.g. BSCI, 2009). Although agricultural work is consistently excluded from these agreements, to our knowledge there are no medical grounds for treating agriculture differently to any other industry. On the contrary, the statistics show that agricultural workers are in fact subject to above-average physical demands and have above-average working hours (BFS, 2010; EWCS, 2007). The working times specified in the ILO conventions are regarded as minimum values and are awarded 34 points in the RISE evaluation (33 points or less indicates a need for action).

In order to allow the differences between self-employed workers and employees to be analyzed, the results for both categories are presented separately. To ensure that the personal circumstances of every individual are equally accurately recorded and are given the same weight in the evaluation, an average score is computed for all workers without any weighting based on annual working hours. It is therefore important to take a close look at the scores of individual workers when analyzing the results, in order to ensure that people working very long hours are identified.

The individual thresholds are as follows:

- **Working hours per week**: The working hours of persons employed in any public or private industrial undertaking or in any branch thereof shall not exceed eight in the day and forty-eight in the week (ILO Convention 1, Art. 2).

  Excessively long working hours are rated as problematic (<34 points = color-coded red). However, the threshold value in RISE is 4 hours a week higher than the ILO figure, since the latter relates to jobs where employees usually have to commute to and from work. On average, these people spend around 50 minutes a day traveling to and from their workplace. This unproductive but nevertheless stressful time is not an issue for the majority of agricultural workers.

  A weekly working time of 44 hours or less is rated as optimal (100 points). This is arrived at by taking the 40-hour figure for non-agricultural professions (based on five eight-hour days) and adding four hours to compensate for commuting time.

- **Working days per week**: The whole of the staff employed in any industrial undertaking, public or private, or in any branch thereof shall, except as otherwise provided for by the following Articles, enjoy in every period of seven days a period of rest comprising at least twenty-four consecutive hours (ILO Convention 14, Art. 2).

  In accordance with this principle, working arrangements providing less than one day off per week are rated as problematic (<34 points = color-coded red). The curve has been drawn in such a way as to give a 33 point difference for every half day. Accordingly, two days off per week is regarded as the optimal recovery time for workers.
• Vacation: Workers employed in agricultural undertakings and related occupations shall be granted an annual holiday with pay after a period of continuous service with the same employer (ILO Convention 101, Art. 1). The holiday shall in no case be less than three working weeks for one year of service (ILO Convention 132, Art. 3). If the period of employment is less than one year, vacation entitlement is reduced accordingly. Cases where less than 3 weeks’ paid vacation is provided or taken are rated as problematic.

• Overtime compensation: All hours worked in excess of the normal hours should be deemed to be overtime, unless they are taken into account in fixing remuneration in accordance with custom. (...) Overtime work should be remunerated at a higher rate or rates than normal hours of work (ILO Recommendation 116).

Ideas and recommendations
I understand being a dairyman requires lots of work. Being that this is a model designed to improve your quality of life, I would be remiss if I didn’t point out that your work week is long. You do take vacation which is not common for many farmers.

Continue to take time away to enjoy your family and friends not just during vacation time, but during the week too.

| Safety at work | 74 |

Sustainability goal
Appropriate measures are taken to ensure that the number of work-related accidents and cases of illness on the farm are minimized. Children are not harmed by any work they do on the farm.

Content
An assessment is made of the frequency of work-related accidents and cases of illness on the farm, the measures taken to prevent them and whether there is a risk of illegal child labor (Fig. 33).

Scoring
100 points = no work-related accidents and/or illnesses in the last 5 years / safety strategy implemented / safe storage and application of PPPs / only low-toxicity PPPs used / no problematic child labor.

Explanatory notes
Strenuous manual labor and exposure to harmful substances such as chemicals, pesticides and dust can lead to health problems and employees having to take time off work. Compared to other sectors, the health impacts of agricultural work are very high (EWCS, 2007). 62% of active agricultural workers report work-related health issues. The most common health problems include back pain, muscular pain, fatigue, stress, headaches, irritability, eye, hearing, skin and respiratory problems and allergies. The protection of children from exploitation is a pressing social problem. To determine which forms of on-farm labor are acceptable for children and which are not, we have adopted the definition used by the UN (Grimsrud, 2001).

Ideas and recommendations
You noted 2 accidents/illnesses in the last 5 years. You also noted that you do not have a professional occupational safety strategy in place. There are many dangers on a farm: machinery, livestock, silos, lagoons, medications etc. Having a safety plan in place helps to ensure proper treatment and procedures are followed so that risks are minimized.
Wage and income level

**Sustainability goal**
The people employed to work on the farm earn an hourly wage that allows them to live comfortably above the poverty line when working normal hours.
Self-employed workers (mainly family members who are not paid a wage) also receive appropriate hourly compensation (private consumption and non-monetary benefits) and the farm delivers a very positive financial return.

**Content**
The income of the people working on the farm is compared against their financial needs. Self-employed workers are also asked about the farm’s financial results (e.g. how the value of the business has changed, private account deposits/withdrawals, building up of reserves, equity capital formation), since it is possible that other assets may have been accumulated on the farm in addition to those used for private consumption.

**Scoring**
34 points = the people employed to work on the farm earn an hourly wage that allows them to live on the poverty line when working normal hours. 100 points = the hourly wage is double the poverty-line wage for an average household. For self-employed people (unpaid family members working on the farm), the same calculation is carried out based on the figure obtained by dividing private consumption plus all the non-monetary benefits enjoyed by the household by the total number of hours worked by all self-employed workers. The relevant threshold values (poverty line, factor for 100 points, household size, normal working hours) can be adjusted at regional level. Additional points are awarded or deducted (+/- 50) based on the farm’s financial results.

**Explanatory notes**
The remuneration and/or income that workers receive for their work is a central aspect of the working conditions in any business (EWCS, 2007). This indicator evaluates the level of income received for the number of hours worked and provides a measure of the financial attractiveness of working on the farm. To this end, a worker’s hourly wage is compared against the benchmark hourly wage of a job with standard working hours. This standardization is particularly important for part-time and temporary work. The benchmark wage and standard working hours are defined in advance in consultation with local experts and are verified in the field.

The scoring function is designed so that a score of 34 points (the bottom of the amber range) represents the poverty line. This is defined based on a consumer basket that is sufficient to meet basic subsistence requirements (food, clothing, housing, basic healthcare) and provide social security coverage (pension, disability, accidents, death) (SKOS, 2005). The results for a worker who receives a low hourly wage will thus appear in the red zone. The maximum score is awarded for people whose hourly wage is three times higher than the poverty-line wage. The calculation of the poverty line for employees is based on the needs of an average family and the assumption of fair and transparent personnel management that provides full compensation for the work performed. It is important to ensure that e.g. single people do not receive lower wages than people with a family for doing the same work.

In the case of family members who work on the farm, the monetary standard of living is calculated on the basis of effective expenditure, since no wages are received. In order to determine the poverty line, basic needs are adjusted based on family size and composition. A comparison then shows whether the family is
able to achieve a living standard above this poverty line when working normal hours. A low monetary standard of living per hour worked could be due to low farm profitability or the excessive and inefficient deployment of labor, but may also be caused by the farm management attaching a lower priority to this area (investment in the farm rather than in the well-being of the family). The assessment of whether a household is living in absolute poverty (despite possibly having a high standard of living per hour) is made using indicator ev_5 (Livelihood Security) under the Economic Viability topic.

**Ideas and recommendations**
I do not feel we accurately and adequately captured all the data that is necessary for this calculation. My recommendation is that if you have having trouble keeping employees then perhaps you need to look at your compensation package. If it isn’t an issue then likely this is not something that needs immediate attention.

---

**Quality of life**

| Calculation variant: RISE 3.0 | 84 |

A high level of satisfaction with their work and their life in general is important for the physical, mental and social well-being of the people living on the farm. Quality of life, satisfaction and happiness are important indicators of successful sustainable development. Quality of life is achieved when individual goals are currently being met.

**Occupation & Training**

| 83 |

**Sustainability goal**
All farm personnel are satisfied with their occupation and their initial and ongoing training.

**Content**
An assessment is made for all interviewees of how important their occupation and initial and ongoing training are to them and how satisfied they are with their current situation in this regard.

**Scoring**
100 points = very satisfied with current occupation (on-farm, sideline activities, household work, etc.: type of work, working hours, workload, relationship with employees, authorities, customers, etc.; satisfaction, motivation), initial training (duration, type and level of training, etc.) and ongoing training (courses, self-study, study groups, etc.).

**Financial situation**

| 88 |

**Sustainability goal**
All on-farm personnel are satisfied with their financial situation.
### Social relations

**Sustainability goal**
All on-farm personnel are satisfied with their social relations.

**Content**
All interviewees are asked how important social relations are to them and how satisfied they are with their current situation in this regard.

**Scoring**
100 points = very satisfied with family situation (relationship with partner, life together, communication, consideration, interaction, etc.) and social environment (friends, colleagues, neighbors, etc.; help, support, friendliness, trust).

### Personal freedom & values

**Sustainability goal**
All on-farm personnel are satisfied with their personal freedoms and their ability to live by their personal values.

**Content**
All interviewees are asked how important personal freedoms and the ability to live by their personal values are to them and how satisfied they are with their current situation in this regard.

**Scoring**
100 points = very satisfied with the stability of the overall political and economic situation (security, peace, corruption, inflation, prices, employment, etc.), personal freedoms (hobbies, relaxation, activities, contacts) and cultural and spiritual life (music, dance, local culture and traditions, theater, film, literature, visual arts, etc.; religion, spirituality, etc.).

### Health

**Sustainability goal**
On-farm personnel are satisfied with their health situation.

**Content**
All interviewees are asked how important their health (including time management) is to them and how satisfied they are with their current situation in this regard.
A farm is first and foremost a business that needs to deliver economic goals whilst working within the relevant environmental and social constraints. The aim is to ensure the short- and long-term profitability of the business and to maintain or even improve productivity so that the business can develop in a stable and self-determined manner that guarantees the livelihood of the farmer’s family and the income of the people employed on the farm. This topic addresses the following aspects of a farm’s economic viability:

- Liquidity
- Stability
- Profitability
- Indebtedness
- Livelihood security

**Sustainability goal**
The farm’s liquid assets are sufficient to meet its financial obligations at all times.

**Content**
An assessment is made of the ratio of cash reserves (liquid assets plus available credit lines) to average weekly expenditure (annual expenditure divided by 52 weeks), i.e. the number of weeks that the farm can live off its cash reserves. The farm’s reserves are deemed to be sufficient if, at any time in its production cycles, it is able to pay wages and salaries, accounts payable to suppliers, loan repayments and interest payments out of its own reserves.

**Scoring**
100 points = 40 weeks of cash reserves. 0 points = 0 weeks of cash reserves. These values may be adjusted at regional level.

**Explanatory notes**
A farm is considered to be liquid (solvent) if it is able to meet its financial obligations at all times. Liquidity is an indicator that expresses the ability of a business to pay any money that it may owe. Liquidity constraints can threaten the survival of the operation (Kutter & Langhoff, 2004). If we know the farm’s cash reserves, we can calculate how long the financial resources available for paying the money owed by the business will
last. These cash reserves are made up of the farm’s liquid assets plus credit lines obtained from lending institutions.

The ratio of cash reserves to payments due can be calculated and expressed in terms of how long the reserves will last. Figure 35 provides an example of a time-based assessment of a farm’s liquidity.

The measurements provided and their classification on a scale ranging from good to unsatisfactory are empirical in nature. As such, they will not always reflect the specific characteristics of a particular farm (Kutter & Langhoff, 2004). In Switzerland, farms’ cash reserves should be enough to last for 6 months (24 weeks), since they receive their direct payments twice a year (personal comment Steingruber, 2010).

In RISE, the farm’s total annual expenditure is divided by 52 weeks. If liquid assets plus available credit lines are enough for 15 weeks or less, a maximum of 33 points is awarded and the cash reserves are rated as clearly unsatisfactory (red). Cash reserves lasting more than 25 weeks are rated as sustainable (green). A more detailed investigation is recommended for anything falling in the uncertain range between these two cut-off points.

Ideas and recommendations
I do not feel we adequately captured all of the necessary information to adequately calculate this score. I recommend working with your accountant to make sure you liquidity level is sustainable.

<table>
<thead>
<tr>
<th>Profitability</th>
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<tr>
<th>Sustainability goal</th>
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<tr>
<th>Content</th>
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<table>
<thead>
<tr>
<th>Scoring</th>
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</table>
100 points = 40 weeks of cash reserves. 0 points = 0 weeks of cash reserves. These values may be adjusted at regional level.

<table>
<thead>
<tr>
<th>Explanatory notes</th>
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</table>
The farm’s income is sufficient to pay for ordinary upkeep costs, production inputs, staff expenditure in the case of paid employees and the private expenditure of family members who are not paid a wage. Enough is left over to produce a positive operating cash flow that allows the farm to make investments, repay any debts and earn a profit that recompenses the equity invested in the business. Farms that keep accounts enter depreciation of invested capital in their books, ensuring that they will be able to keep producing and thus remain profitable on a long-term basis.

<table>
<thead>
<tr>
<th>Ideas and recommendations</th>
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| Stability | 75 |
Sustainability goal
The farm is financially stable. This means that it is regularly able to break even over a period of several years with a normal level of household consumption, and that the long-term future of production on the farm is secure.

Content
The farm has several strings to its bow, maintains a modern infrastructure and is thus not wholly dependent on market price trends or individual customers. Guaranteed land access means that it is possible to plan and ensure the continuation of production on a long-term basis, whilst a high equity ratio allows the farmer to make their own decisions about how the business evolves.

Scoring
100 points = the farm’s infrastructure is in good condition, the farm has several customers in all of its key areas of activity, its main income source accounts for less than 20% of total business revenue (no concentration risk), long-term access to all land is guaranteed and it has a high equity ratio.

Explanatory notes
Stronger market fluctuations can be expected as agricultural markets become increasingly globalized. The resulting financial pressures are forcing agricultural businesses to lower their costs (i.e. become more efficient). Many businesses are turning to specialization (expansion of one area of the business at the expense of others) in order to differentiate themselves from their competitors and obtain a cost advantage. However, this also causes them to become more dependent on individual markets and customers, potentially posing a threat to their survival in the worst-case scenario.

Ideas and recommendations
You indicated that milk sales make up over 50% of your income. There is another potential business to ship your milk should things change with Organic Valley. And that you are in a fairly good position to invest in maintenance and expansion.

Indebtedness

<table>
<thead>
<tr>
<th>Sustainability goal</th>
<th>Content</th>
<th>Scoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>The farm’s level of indebtedness is not problematic and is in keeping with its financial resources. There is leeway for it to take on more debt if necessary, e.g. to see it through a period when it is short of funds.</td>
<td>Debt-to-equity ratio: gearing is calculated as the ratio between net debt and operating cash flow. This allows a figure to be calculated for the number of years that would be required to fully repay the farm’s debts with its current cash flow.</td>
<td>Debt-to-equity ratio: 100 points if the farm would require 5 years to repay its debts with its operating cash flow / 0 points for 20 years.</td>
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<tr>
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<td>Short-term debt service coverage ratio: this is the ratio between mandatory debt service (interest and mandatory amortization) and cash flow. It expresses the percentage of cash flow that is currently used to service debts and whether there is any leeway to take on more debt in the short term, e.g. to get through a period when the market is unfavorable or to make investments.</td>
<td>The indicator score is calculated as the average of the two components.</td>
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The indicator score is calculated as the average of the two components.
Debt service coverage ratio: 100 points for 0% debt service coverage ratio / 67 points for 50% / 0 points if 100% of cash flow is used to service debts. These thresholds may be adjusted at regional level. The indicator score is the average of the two components.

Explanatory notes

**Debt-to-equity ratio**

The debt ratio expresses the relationship between income and level of indebtedness. An operation with a high income can take on and service more debt. First of all, net debt is calculated as third-party debt minus cash. The resulting figure is then divided by the cash flow, which is itself composed of owner’s equity plus booked depreciation. The debt ratio calculated using this method expresses the number of years that the farm would need to repay its debts if the entire annual cash flow was used for this purpose. It should be noted that the calculation is based on the assumption that future business results will remain constant. If the debt ratio is 15 years or more, the bank will classify the farm as a risk, demand that it takes certain actions and, under certain circumstances, stop lending it money. A high level of debt often has a negative impact on the farm’s ability to repay its debts and can mean that there is no longer any financial leeway if no additional credit can be obtained during a liquidity crisis, for example. The debt ratio is a very powerful indicator of financial security when compared over several years, since if a company’s exposure increases, the numerator (net debt) normally increases while the denominator (cash flow) decreases. Farms with a low level of debt are far better placed to react to current market trends requiring investment. New business activities or the expansion of existing activities tie up cash, causing a leverage effect that exacerbates the adverse financial trend. This single indicator thus provides a clear indication of both the farm’s potential performance and its level of indebtedness (Kamber, 2009).

**Debt service coverage ratio**

The vast majority of the world’s poor live in rural areas. The economic development of these areas is therefore key to poverty eradication. One of the key requirements for this to be possible is a financial system tailored to the needs of farmers and small producers as well as non-agricultural businesses such as intermediaries and tradesmen. Access to secure savings arrangements is extremely important to households with small and irregular incomes and in particular to women, in order to provide cover for emergency situations or the money needed for their children’s education and other long-term investments. In addition to savings, loans can also facilitate participation in economic activity by allowing business opportunities to be realized and existing commercial activities to be expanded. Access to financial services can pave the way towards a financially independent, self-determined life. While the calculation of credit limits in developed countries is usually very complicated (in Switzerland, for instance, it is based on the lending limit, which in turn depends on the enterprise’s earning power), in developing countries it is often much simpler, since small producers are simply refused credit due to their lack of security and insufficient cash flow. This means that they are unable to invest and thus also unable to increase their well-being.

**Ideas and recommendations**

<table>
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<tr>
<th>Livelihood security</th>
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**Sustainability goal**

The farm’s income is sufficient to secure the economic livelihood of the household (family members who are not paid a wage).
Content
An evaluation is made of the ratio between private spending and a corrected minimum subsistence level. The minimum subsistence level is corrected for the size of the farmer’s family and any payments in kind received by the farm are deducted. The private spending of family members who are not paid a wage (farmer’s family) should clearly exceed the minimum subsistence level.

Scoring
Between 34 and a maximum of 66 points may be awarded for household spending amounting to between 100% and 200% of the poverty line (amber, critical). If household income is between two and a maximum of three times higher than the poverty line, the farm is awarded between 67 and a maximum of 100 points (green, sustainable).

Explanatory notes
The assessment of household income in relation to the minimum subsistence level is absolutely key to small producers. The eradication of poverty is the first of the UN’s Millennium Development Goals (www.un.org/millenniumgoals). The UN defines “absolute poverty” as a per-capita income of 2 USD a day. The same goal also calls for full employment.

The RISE topic “Economic Viability” assesses the family’s livelihood security based on its absolute private household spending, regardless of its level of employment. Only real spending is evaluated. This means that if the family lives on the farm and no actual rent is paid, then rent is not included in the calculation. Household consumption of farm-produced goods is also deducted from the regional basic needs figure, since the farm does not spend any money on buying these goods. This indicator addresses the question of whether the farm makes enough money (from its main and supplementary income sources) to keep its absolute and effective household spending above the regional minimum (poverty line) for a comparable family.

In combination with the “profitability” indicator (ev_2), it is possible to assess whether the farm has enough financial leeway to increase its household spending (i.e. the family is living well within its means, household spending is not a priority for the farmer) or whether the family has insufficient income to cover its private spending. Indicator wc_4 under the “Working Conditions” topic compares household spending against the number of hours worked by family members on the farm (hourly wage comparison). This allows the attractiveness of working on the farm to be determined: can family members live above the poverty line, assuming that they work normal hours? If a worker does not work full-time on the farm – and their paid employment is therefore not sufficient to secure their livelihood despite the fact that they receive a relatively good hourly wage – this is not considered to be problematic by the Working Conditions indicator.

Ideas and recommendations

<table>
<thead>
<tr>
<th>Farm Management</th>
<th>74</th>
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<td>Calculation variant: RISE 3.0</td>
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</table>
It may be perfectly viable to run a farm using traditional methods, even over the longer term. However, changes will need to be made if a poorly designed management process coincides with manifestly unresolved challenges. Where this occurs, it is necessary to modify the farm’s strategy by implementing measures that incorporate sustainability into management systems, processes and culture.

Sustainable farm management:
- Pursues goals and strategies that are in tune with the stakeholders’ personal values and take into account the natural limitations of people, animals, the environment, finances and society
- Has access to the knowledge needed to make informed decisions
- Regularly assesses internal and external risks so that proactive measures can be taken and resources can be employed productively, safely and profitably
- Cultivates sustainable relationships, ensuring that dealings with people and stakeholders both on and off the farm are characterized by respect and fairness.

### Business Goals, Strategy and Implementation

<table>
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<th>Sustainability goal</th>
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The people responsible for managing the farm consciously set goals, develop strategies to deliver these goals and implement the relevant measures. In this context, “conscious” means compatible with people’s personal values and the conditions on and around the farm. The chosen strategy should have a positive impact on economic, social and environmental sustainability.

#### Content

This indicator covers both the rational (planning and forecasting) and subjective (values) aspects of the farmer’s strategic development process. The goals, strategy and implementation challenges are analyzed and the business objectives are checked for compatibility with sustainability goals.

#### Scoring

100 points = The farmer has well thought-out goals and an appropriate strategy for the farm and implements them systematically. These aspects are evaluated both by the farmer (satisfaction with how he/she manages the farm) and the extension agent (how complete and well thought-out the strategy is and how successfully it is implemented). The strategy is also assessed in terms of how holistic it is, i.e. whether it takes social and environmental aspects into account as well as economic aspects.

#### Explanatory notes

A sustainably managed farm tries to find its own answers to the question of which goals should be pursued through which strategies under the farm’s own particular set of circumstances. Sustainable farm management requires a conscious approach to developing business goals and strategies. These should be based on the farmer’s own values and life goals and on the farm’s key strengths.

Sustainable farm management is the outward expression of values and life goals that are consciously or unconsciously influenced by all the stakeholders (Sereke et al., 2015). Family, tradition, political structures, property ownership, market conditions and competition all have an impact on how a farm is managed. If a farm has coherent goals, values and strategies, it is able to achieve a balance that affords it a degree of resilience against unforeseen external changes (Darnhofer, 2010). A farm’s strategy will either be consistent with its goals or not. Similarly, the business goals or vision may or may not be consistent with people’s personal values and life goals. A high level of awareness of values and goals enables the farmer to focus better on what they are trying to achieve, making it easier to spot problems and facilitating the participatory identification of adaptation strategies.
The strategy also needs to be coherent with the external context in which the farm exists. This requires an ongoing analysis of the external circumstances. What are the farm’s strengths? What is unique about it (USP)? Where are the best market opportunities to be found? Analyzing these aspects helps to organize work on the farm in a targeted manner so that individual strengths can be built on. The farm’s processes should be continuously reviewed to see whether they can be improved in order to prevent disruption, quality issues or delays.

Many farms lack an explicit long-term strategy. And even when they have one, it is often exclusively geared towards economic and/or agronomic performance indicators. The potential impacts of the chosen strategy on economic performance are relatively simple to measure and assess, e.g. cost reduction, increasing revenue through partnerships or contract farming. On the other hand, social and environmental sustainability are much harder to assess. Potential indicators of social sustainability include the social and gender-specific impacts of the chosen strategy and the existence of participatory processes involving both farm workers and the local community. The most effective way of preventing threats to the environment is by ensuring the sustainability of the agroecosystem by employing agricultural methods that maintain or increase productivity whilst at the same time helping to reduce emissions. Examples include agroecological approaches such as integrated soil fertility management, adapted crop rotation and diversified farming systems such as agroforestry (Wojtkowski, 2002; Altieri et al., 2015).

**Ideas and recommendations**

We did not get into a discussion on your business strategy and goals. Again, I encourage you to engage your accountant and family in planning for the future. Often conversations on the big picture get pushed aside because the everyday challenges appear more pressing. Taking time to construct a business plan and making sure to follow it can help relieve the burdens that arise from the unknown.

**Availability of Information**

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<th>Sustainability goal</th>
<th>63</th>
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Where necessary, the people responsible for managing the farm have access to adequate information and reliable planning tools so that they are able to manage the farm systematically and professionally.

**Content**

An assessment is made of whether the farm has access to adequate information and the reliable planning tools needed to manage the farm systematically and whether these are actually used if required.

**Scoring**

100 points = The farmer has access to all the necessary information and reliable planning tools and employs them as and when required in order to facilitate sustainable farm management.

**Explanatory notes**

Reliable information, adapted planning tools and comprehensible documentation all help to achieve targeted and transparent farm management based on best agricultural practice. These aspects are gaining in importance around the world as a result of globalized trade and increasing regulatory requirements.

The information required for sustainable farm management includes technical information relating to agricultural production and data on prices and markets. The availability of adequate information is particularly crucial to successful adaptation strategy planning, e.g. the decision to invest in renewable energy systems. Accurate bookkeeping is also a key planning and control tool.
In the case of the small producers found predominantly in developing countries, there is an increasing emphasis on the availability of information sources and planning tools that have been adapted to local conditions (Wettasinha & Waters-Bayer, 2010).

Ideas and recommendations
This section compiles all of the questions regarding access to information – energy and water consumption, biodiversity management, species and habitat conservation/protection, soil tests etc. As noted above, you can’t manage what you don’t know. Collecting information in these areas will help you to better manage your operations.

You do engage in soil testing and utilize the results in your fertilization planning. You also noted that you regularly observe your herd and manage them accordingly.

| Risk Management | 66 |

Sustainability goal
The people responsible for managing the farm are aware of the risks and dependencies that could pose a threat to the farm’s livelihood. They do everything in their power to minimize these risks.

Content
This indicator assesses how the people responsible for managing the farm deal with risks that pose a threat to its livelihood. An assessment is made of how much room for maneuver the farm management has internally, particularly in terms of risk prevention but also in terms of minimizing the negative impacts of any adverse events. The implementation of quality assurance measures is key to guaranteeing healthy and marketable produce.

Scoring
100 points = All risks posing a threat to the farm’s livelihood are known and adequate measures are in place to protect against them.

Explanatory notes
Stable yields are essential for ensuring food self-sufficiency, while production surpluses are key to farming families’ economic well-being. There are different reasons in different parts of the world for unstable yields, including a lack of knowledge, a lack of access to financial or natural resources and marginal site conditions. Crop failures are particularly serious in regions affected by poverty, since they can often result in famine.

In addition to crop failure, there are a number of other risks that can determine whether a farm succeeds or fails. It is therefore important to regularly review the internal and external risks to the business and implement risk minimization measures in order to guard against adverse events. On a social level, cooperation between farms can play an important part in risk management (Pulfer & Lips, 2010). The cultivation of stable relationships can lead to the establishment of a social network that helps farms to jointly overcome crises that threaten their livelihood (or prevents the crisis from occurring in the first place). At an agroecological level, the risk of total failures can be reduced by employing a higher number of different livestock and plant species, since every species responds differently to (generally species-specific) pests, adverse weather events or shortages.

Ideas and recommendations
You noted that you are aware of several areas of risk on the farm such as machinery, silos and the manure pit. You also indicated that you are fairly satisfied with the measures you have in place to protect against potential threats to the farm.

### Sustainable Relationships

<table>
<thead>
<tr>
<th>Sustainability goal</th>
<th>92</th>
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<tbody>
<tr>
<td>The farm’s internal and external relationships are managed in such a way as to provide a sound basis for its long-term success. The farm cooperates with colleagues and neighbors wherever it makes sense to do so. Conflicts are resolved by consensus and not by coercion.</td>
<td></td>
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#### Content

The stability of the farm’s internal and external relationships and partnerships is assessed.

#### Scoring

100 points = Stable relationships are successfully cultivated on and off the farm and provide a sound basis for its success. The farm engages in sensible, productive cooperation with other farms and individuals. Conflicts on or involving the farm are solved by consensus rather than through coercion.

#### Explanatory notes

Responsible behavior towards employees and society as a whole is a key attribute of businesses that achieve long-term success (William et al., 2003). This is the corporate culture described in the “co-evolution” approach where, rather than self-interest, the primary motivation is a willingness to cooperate and achieve meaningful collective added value (Anker, 2015). This approach is extremely important in agriculture, where cooperation between farms is especially critical (Pulfer & Lips, 2010). The importance of cooperation between farms has grown as a result of increasing and ever more expensive mechanization across the globe and because of the growing economic pressures in the agricultural sector. Growth is not an option for many family-run farms with limited land of their own and scant financial resources. Consequently, cooperation between farms is often the only way of reducing workload and lowering unit costs. If this potential for cooperation between farms is not already being exploited, professional consultants and coaches should encourage farmers to tap into it.

All farms are embedded in a social and societal context characterized by numerous different relationships and dependencies. Stable relationships are important to a farm’s long-term success. It is therefore necessary to ensure that all the relevant stakeholder groups are included in the strategic development process (Schaltegger & Figge, 1999). Farms’ social exposure is recorded using the following groups: internal stakeholders (workers, management); access to resources (land rights, water rights, etc.) and finance (lenders, etc.); value chain (customers, suppliers, consumers, etc.); the farm’s local environment (neighbors, local community, etc.); and the societal context (professional organizations, NGOs, media, etc.). It is essential for farmers to be self-critical about how they manage their farms. This includes the need to be aware of positive and negative external effects. For this to be possible, it is necessary to ensure the ongoing participation and inclusion of both employees and external stakeholders.

Within the farm, it is important to have clear rules so that decisions are communicated clearly and all members of the farm’s workforce are treated fairly and with respect. Employees’ commitment to their work is strongly influenced by whether they believe that what they are doing has a purpose and whether they feel that they are valued as a person (Anker, 2012). It is therefore recommended that workers should be given meaningful tasks to perform and shown appreciation for their efforts. Conflicts should be resolved
by consensus and not by coercion. Management should encourage workers to admit their mistakes without fear of punishment. The idea is to foster a learning process focused on finding solutions rather than apportioning blame. Process consultants can help people to recognize and understand their own situation and to develop new solutions. Farmers who are able to obtain new insights by looking at problems and their causes objectively and critically will find it easier to modify their way of doing business should this be necessary.

**Ideas and recommendations**
No noted challenges here.
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APPENDIX C: Sample of the Pretest
Thank you for agreeing to participate in this research project. This research is part of my PhD work at The Ohio State University.

Your responses will be kept confidential and results from this research will be aggregated and discussed with complete anonymity. Please be as accurate as possible with your responses. This survey is completely voluntary thus you may opt out at any time.

We define sustainable agriculture as an agriculture that:

- meets the population’s demand for high-quality food and agriculture-based raw materials
- does not degrade resources
- respects high standards for animal welfare, biodiversity and ecosystem quality
- provides attractive working conditions and a high quality of life
- is economically viable

Farm Demographics
Please tell us a little bit about your farm

1. Is any portion of your farm rented land?
   - Yes
   - No

2. What is the size of your farm?
   - **Owned land**
     - Less than 50 acres
     - 51 - 100 acres
     - 101 - 125 acres
     - 126 - 150 acres
     - More than 150 acres
   - **Rented land**
     - Less than 20 acres
     - 21 - 50 acres
     - 51 - 75 acres
     - 76 - 100 acres
     - More than 100 acres
     - Not Applicable – I do not rent any land for farming
3. How long have you or your family farmed this land?

<table>
<thead>
<tr>
<th>Owned land</th>
<th>Rented land</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Less than 5 years</td>
<td>☐ Less than 5 years</td>
</tr>
<tr>
<td>☐ 6 - 10 years</td>
<td>☐ 6 - 10 years</td>
</tr>
<tr>
<td>☐ 11 - 15 years</td>
<td>☐ 11 - 15 years</td>
</tr>
<tr>
<td>☐ 16 - 25 years</td>
<td>☐ 16 - 25 years</td>
</tr>
<tr>
<td>☐ 25 - 50 years</td>
<td>☐ 25 - 50 years</td>
</tr>
<tr>
<td>☐ More than 50 years</td>
<td>☐ More than 50 years</td>
</tr>
<tr>
<td>☐ Not Applicable – I do not rent any land for farming</td>
<td></td>
</tr>
</tbody>
</table>

4. How long have you been certified organic?

- ☐ Less than 5 years
- ☐ 6 - 10 years
- ☐ 11 - 15 years
- ☐ More than 15 years

5. Number of head?

**Milking cows**

- ☐ Less than 30
- ☐ 31 - 50
- ☐ 51 - 75
- ☐ 76 - 100
- ☐ 101 - 125
- ☐ 126 - 150
- ☐ More than 150

**Young stock/cows that aren’t being milked**

- ☐ Less than 10
- ☐ 11 - 20
- ☐ 21 - 35
- ☐ 36 - 50
- ☐ More than 50

6. Do you raise other livestock?

- ☐ Yes
- ☐ No

7. What livestock do you currently raise? (Please check all that apply)

- ☐ Laying hens
- ☐ Broilers
- ☐ Sheep
- ☐ Goats
- ☐ Horses
- ☐ Beef
- ☐ Hogs
- ☐ Other ____________________
- ☐ Not Applicable – We do not raise other livestock
8. In what county(s) is your farm located? __________________________

9. Number of people living on your farm?
   - 1 - 4
   - 5 - 7
   - 8 - 10
   - 11 - 15
   - More than 15

Farm’s Overall Sustainability
How would you rate your farm’s overall sustainability in the following areas?

Please place a mark on the slider that accurately represents how you view your current management strengths and weaknesses in the following areas.

For Example: If you would rate your farm about a 57 you would place an “X” as seen below

<table>
<thead>
<tr>
<th>Weak/Needs Improvement</th>
<th>Strong/Highly Sustainable</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 10 20 30 40 50 60 70 80 90 100</td>
<td></td>
</tr>
</tbody>
</table>

10. Soil Use
   This is defined by soil management crop productivity, soil organic matter supply, soil reaction, soil pollution, soil erosion and soil compaction

<table>
<thead>
<tr>
<th>Weak/Needs Improvement</th>
<th>Strong/Highly Sustainable</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 10 20 30 40 50 60 70 80 90 100</td>
<td></td>
</tr>
</tbody>
</table>
11. Animal Husbandry
   This is defined by herd management, livestock productivity, possibility for species-appropriate behavior and quality of housing and animal health

<table>
<thead>
<tr>
<th>Weak/Needs Improvement</th>
<th>Strong/Highly Sustainable</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 10 20 30 40 50 60 70 80 90 100</td>
<td></td>
</tr>
</tbody>
</table>

12. Nutrient Flows
   This is defined by Nitrogen balance, Phosphorus balance, N and P self-sufficiency, Ammonia emissions and waste management

<table>
<thead>
<tr>
<th>Weak/Needs Improvement</th>
<th>Strong/Highly Sustainable</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 10 20 30 40 50 60 70 80 90 100</td>
<td></td>
</tr>
</tbody>
</table>

13. Water Use
   This is defined by water management, water supply, water use intensity and risks to water quality

<table>
<thead>
<tr>
<th>Weak/Needs Improvement</th>
<th>Strong/Highly Sustainable</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 10 20 30 40 50 60 70 80 90 100</td>
<td></td>
</tr>
</tbody>
</table>
14. Energy and Climate
This is defined by energy management, energy intensity of agricultural production, share of sustainable energy carriers and greenhouse gas balance

Weak/Needs
Improvement

Strong/Highly
Sustainable

15. Biodiversity and Plant Protection
This is defined by plant protection management, ecological priority areas, intensity of agricultural production, landscape quality and diversity of agricultural production

Weak/Needs
Improvement

Strong/Highly
Sustainable

16. Working Conditions
This is defined by personnel management, working times, safety at work and salaries and income level

Weak/Needs
Improvement

Strong/Highly
Sustainable
17. **Quality of Life**  
This is defined by occupation and education, financial situation, social relations, personal freedom and values and health

<table>
<thead>
<tr>
<th>Weak/Needs</th>
<th>Strong/Highly Sustainable</th>
</tr>
</thead>
</table>

18. **Economic Viability**  
This is defined by liquidity reserve, level of indebtedness, economic vulnerability, livelihood security, cash flow - turn over ratio and debt service coverage ratio

<table>
<thead>
<tr>
<th>Weak/Needs</th>
<th>Strong/Highly Sustainable</th>
</tr>
</thead>
</table>

19. **Farm Management**  
This is defined by farm strategy and planning, supply and yield security, planning instruments and documentation, quality management and farm cooperation

<table>
<thead>
<tr>
<th>Weak/Needs</th>
<th>Strong/Highly Sustainable</th>
</tr>
</thead>
</table>
Current Management Practices

To what degree do you currently employ these management practices on your farm?

Please place a mark on the slider that accurately represents your current management practices.

Soil Use Practices

20. What percentage of your farm is tilled acreage?

![Slider for tilled acreage]

21. What percentage of your tillable acreage has perennials in your rotation?

![Slider for perennials]

22. What percentage of your tillable acreage is currently being managed by reduced tillage/no-till/conservation tillage?

![Slider for reduced tillage]

23. What percentage of your tillable acreage is planted with cover crops?

![Slider for cover crops]
Animal Husbandry Practices

24. How would you rate the quality of your forage?

Low High

0 10 20 30 40 50 60 70 80 90 100

25. What percentage of the time is your livestock given the opportunity for species appropriate behavior?

Low High

0 10 20 30 40 50 60 70 80 90 100

26. How would you rate the productivity of your livestock?

Low High

0 10 20 30 40 50 60 70 80 90 100

27. How would you rate the quality of livestock housing in all seasons? (access to shade, windbreaks, clean water etc.)

Low High

0 10 20 30 40 50 60 70 80 90 100

28. How would you rate the adequacy of pasture and shelter for your livestock? (We are referring to density of animals and availability of resources)

Low High

0 10 20 30 40 50 60 70 80 90 100
Nutrient Flow Practices

29. Do you have a nutrient management plan in place?
   - Yes
   - No

30. How closely do you follow your plan?

<table>
<thead>
<tr>
<th>Infrequently</th>
<th>Frequently</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
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<tr>
<td>20</td>
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<tr>
<td>80</td>
<td></td>
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<tr>
<td>90</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

   - I do not have a nutrient management plan in place.

31. How often do you spread manure on frozen ground or when it is or about to rain?

<table>
<thead>
<tr>
<th>Infrequently</th>
<th>Frequently</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>20</td>
<td>30</td>
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<tr>
<td>40</td>
<td>50</td>
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<td>70</td>
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<tr>
<td>80</td>
<td>90</td>
</tr>
<tr>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

32. What percentage of your tilled acreage is surrounded by filter strips and/or buffer zones?

   | 0            | 10         |
   | 20           | 30         |
   | 40           | 50         |
   | 60           | 70         |
   | 80           | 90         |
   | 100          |            |

33. What percentage of your inputs come from off farm sources?
34. How frequently do you address low soil fertility by locating feeding stations in these areas?

- Infrequently
- Frequently

Water Use Practices

35. What percentage of your waterways/sensitive areas are protected from livestock by fencing?

- 0%
- 10%
- 20%
- 30%
- 40%
- 50%
- 60%
- 70%
- 80%
- 90%
- 100%

36. What percentage of your buildings have proper drainage/run off control? (Water is diverted away from animal areas containing manure and other water contaminants)

- 0%
- 10%
- 20%
- 30%
- 40%
- 50%
- 60%
- 70%
- 80%
- 90%
- 100%

37. What percentage of your manure and wastewater is securely contained so as not to contaminate water supplies?

- 0%
- 10%
- 20%
- 30%
- 40%
- 50%
- 60%
- 70%
- 80%
- 90%
- 100%

38. What percentage of stream habitat on your farm have you improved or do you actively manage?

- I do not have any stream habitat on the farm
39. What percentage of the wetlands on your farm have you restored?

☐ I do not have any wetlands on the farm

Energy and Climate Practices

40. Have you upgraded to an energy efficient compressor with a heat recovery system?
   ☐ Yes
   ☐ No

41. Do you capture greenhouse gases from your lagoon?
   ☐ Yes
   ☐ No
   ☐ I do not have a lagoon

42. What percentage of your motors have variable speed drives?

43. What percentage of your energy comes from renewable energy installations on your farm? (solar hot water, solar electricity, wind power)

44. What percentage of the energy you purchase comes from renewable energy?
45. What percentage of your buildings have been upgraded with energy efficient light fixtures?

[Scale from 0 to 100]

46. Do you produce biofuels on your farm?
   ☐ Yes
   ☐ No

47. What percentage of your fuel use comes from biofuels produced on farm?

[Scale from 0 to 100]
   ☐ I do not use biofuels

48. Do you purchase biofuels to run your equipment on your farm?
   ☐ Yes
   ☐ No

49. What percentage of your fuel use is from purchased biofuels?

[Scale from 0 to 100]
   ☐ I do not use biofuels
Biodiversity and Plant Production Practices

50. On what percentage of your property have you established conservation cover to promote pollinator habitat?

[Percentage scale from 0 to 100]

51. What percentage of your field boarders have been planted in native grasses?

[Percentage scale from 0 to 100]

52. Have you completed any prairie restorations on your farm and/or do you currently actively manage any rare/declining habitats?
   - Yes
   - No
   - Not applicable

53. Have you completed any wetland/riparian habitat restorations on your farm?
   - Yes
   - No
   - We do not have wetlands or riparian zones on our farm

54. Do you currently construct or protect natural structures on your farm to encourage wildlife habitat? (i.e. downed trees, brush piles etc.)
   - Yes
   - No

Working Conditions Practices

55. How often do you make sure to wear proper safety gear?

Never                               Always

[Percentage scale from 0 to 100]
56. How reasonable do you think the length of your workday is?

Unreasonable                    Reasonable

57. How would you rate the heating/ventilation in your buildings?

Poorest                            Excellent

58. How diligent are you at maintaining equipment to safety standards?

Infrequently                       Frequently

Quality of Life Practices

59. Do you have health insurance?
   - Yes
   - No

60. Do you have employees working on your farm?
   - Yes
   - No

61. Do you provide health insurance to them?
   - Yes
   - No
   - I do not have employees
62. How would you rate your job security?

Low  

High

63. How adequate is your access to education? (including all members of your family)

Not Enough  

Adequate

64. How much encouragement do you give to freedom of expression?

Not Enough  

Adequate

65. How adequate do you feel your compensation is?

Not Enough  

Adequate

66. How would your employees rate their job security?

Low  

High

I do not have employees
67. How adequate is access to education for your employees?

Inadequate                      Adequate

0    10    20    30    40    50    60    70    80    90    100

☐ I do not have employees

68. How open are you to employees' freedom of expression?

Not Open                      Highly Open

0    10    20    30    40    50    60    70    80    90    100

☐ I do not have employees

69. How adequate do you feel your employees' compensation is?

Inadequate                      Adequate

0    10    20    30    40    50    60    70    80    90    100

☐ I do not have employees

70. Do you currently contribute to a retirement plan for yourself?

☐ Yes

☐ No

71. Do you currently contribute to a retirement plan for your employees?

☐ Yes

☐ No

☐ I do not have employees
Economic Viability Practices

72. How would you rate your liquidity reserve?

Too Low/Inadequate            Highly Adequate

73. How manageable do you feel your debt level is?

Too high                  Acceptable

74. How adequate is your cash flow?

Too Low/Inadequate            Highly Adequate

75. Do you have a plan to pass along the farm (succession plan)?
   ○ Yes
   ○ No

76. What best describes your situation?
   ○ I have thoughts, but do not have a formal plan in place
   ○ I have a formal plan in place
   ○ It is likely that someone in my family will take it over, but we have never discussed it
   ○ I haven't thought about it yet

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Farm Management Practices

77. Do you currently have a written long-term farm management plan that you are following?
   ☐ Yes
   ☐ No

78. How strictly do you follow your plan?

Loosely            Strongly Adhere

☐ I do not have a plan in place

Thank you for taking the time to complete this survey.
Your participation is greatly appreciated!

Please return your completed survey in the enclosed prepaid envelope.

I will be in contact with you shortly concerning the next phase of this research. You may be randomly selected to move on to the next stage. Phase II entails participation in an on farm sustainability assessment. Should your farm be selected for this next phase we will contact you within the next two weeks.

If you have any questions regarding this survey or the research being conducted please contact me, Jennifer Harrison, at harrison.497@osu.edu or 831-345-9392.

Thank you again for your participation!
APPENDIX D: Sample of the Posttest
Thank you again for agreeing to participate in this research project. As you know, this research is part of my PhD work at The Ohio State University and aims to improve the delivery and usefulness of sustainability assessments on US organic dairy farms.

The purpose of this survey is to better understand the impacts the sustainability assessment had on your long-term management plans. This is the final phase of the project. If you are interested in receiving the publishable results please indicate that at the end of the survey.

Your responses will be kept confidential and results from this research will be aggregated and discussed with complete anonymity. Please be as accurate as possible with your responses. This survey is completely voluntary thus you may opt out at any time.

We define sustainable agriculture as an agriculture that:
- meets the population’s demand for high-quality food and agriculture-based raw materials
- does not degrade resources
- respects high standards for animal welfare, biodiversity and ecosystem quality
- provides attractive working conditions and a high quality of life
- is economically viable

Future Management Practices

To what degree do you plan to employ these management practices on your farm in the next 3 years?

Based on the information you gained from your assessment, how will management changes you plan on implementing in the next 3 years change the values you provided in the initial survey? The X marked on the slider is to remind you of your pervious response. Please place a mark on the slider that accurately represents how the assessment has changed your views of the sustainability of your operations.
Soil Use Practices

1. What percentage of your farm will be tilled acreage?

2. What percentage of your tillable acreage will have perennials in your rotation?

3. What percentage of your tillable acreage will be managed by reduced tillage/no-till/conservation tillage?

4. What percentage of your tillable acreage will be planted with cover crops?

Animal Husbandry Practices

5. How do you expect to rate the quality of your forage?

6. What percentage of the time will your livestock be given the opportunity for species appropriate behavior?
7. How do you expect the productivity of your livestock to change?

8. How do you expect to rate the quality of livestock housing in all seasons? (access to shade, windbreaks, clean water etc.)

9. How do you expect to rate the adequacy of pasture and shelter for your livestock? (We are referring to density of animals and availability of resources)

**Nutrient Flow Practices**

10. Will you implement a nutrient management plan?
    - Yes
    - No

11. How closely do you expect to follow your plan?
    - Infrequently
    - Frequently

- I do not intend to implement a nutrient management plan.
12. How often will you spread manure on frozen ground or when it is or about to rain?

Infrequently       Frequently

13. What percentage of your tilled acreage will be surrounded by filter strips and/or buffer zones?

14. What percentage of your inputs will come from off farm sources?

15. How frequently will you address low soil fertility by locating feeding stations in these areas?

Infrequently       Frequently

**Water Use Practices**

16. What percentage of your waterways/sensitive areas will be protected from livestock by fencing?

17. What percentage of your buildings will have proper drainage/run off control? (Water is diverted away from animal areas containing manure and other water contaminants)
18. What percentage of your manure and wastewater will be securely contained so as not to contaminate water supplies?

![Percentage Scale]

19. What percentage of stream habitat on your farm will you improved or actively manage?

![Percentage Scale]

☑️ I do not have any stream habitat on the farm

20. What percentage of the wetlands on your farm will you restored?

![Percentage Scale]

☑️ I do not have any wetlands on the farm

**Energy and Climate Practices**

21. Will you upgrade to an energy efficient compressor with a heat recovery system?

☑️ Yes

☑️ No

22. Will you capture greenhouse gases from your lagoon?

☑️ Yes

☑️ No

☑️ I do not have a lagoon

23. What percentage of your motors will have variable speed drives?

![Percentage Scale]
24. What percentage of your energy will come from renewable energy installations on your farm? (solar hot water, solar electricity, wind power)

25. What percentage of the energy will you purchase from renewable energy?

26. What percentage of your buildings will be upgraded with energy efficient light fixtures?

27. Will you produce biofuels on your farm?
   - Yes
   - No

28. What percentage of your fuel use will come from biofuels produced on farm?
   - I am not planning on using biofuels

29. Will you purchase biofuels to run your equipment on your farm?
   - Yes
   - No

30. What percentage of your fuel will be from purchased biofuels?
   - I do not plan on using biofuels
Biodiversity and Plant Production Practices

31. On what percentage of your property will you establish conservation cover to promote pollinator habitat?

32. What percentage of your field boarders will be planted in native grasses?

33. Will you complete any prairie restorations on your farm and/or actively manage any rare/declining habitats?
   - Yes
   - No
   - Not applicable

34. Will you complete any wetland/riparian habitat restorations on your farm?
   - Yes
   - No
   - We do not have wetlands or riparian zones on our farm

35. Will you construct or protect natural structures on your farm to encourage wildlife habitat? (i.e. downed trees, brush piles etc.)
   - Yes
   - No

Working Conditions Practices

36. How often will you make sure to wear proper safety gear?

Never          Always

306
37. How reasonable do you think the length of your workday will be?

Unreasonable

Reasonable

0 10 20 30 40 50 60 70 80 90 100

38. How will you rate the heating/ventilation in your buildings?

Poor

Excellent

0 10 20 30 40 50 60 70 80 90 100

39. How diligent will you be at maintaining equipment to safety standards?

Infrequently

Frequently

0 10 20 30 40 50 60 70 80 90 100

Quality of Life Practices

40. Will you have health insurance?

☑ Yes

☐ No

41. How will you rate your job security?

Low

High

0 10 20 30 40 50 60 70 80 90 100

42. How adequate will your access to education be? (including all members of your family)

Not Enough

Adequate

0 10 20 30 40 50 60 70 80 90 100
43. How much encouragement will you give to freedom of expression?

Not Enough                             Adequate

44. How adequate do you expect your compensation to be?

Not Enough                             Adequate

45. Will you have employees working on your farm?

⊙ Yes
⊙ No

*Answer questions 46 – 51 if you answered “Yes” to question 45. If “No” skip to question 52.*

46. Will you provide health insurance to employees?

⊙ Yes
⊙ No

47. How will your employees rate their job security?

Low                              High

48. How adequate will access to education for your employees be?

Inadequate                             Adequate
49. How open will you be to employees' freedom of expression?

Not Open                      Highly Open

50. How adequate do you feel your employees' compensation will be?

Inadequate                                Adequate

51. Will you contribute to a retirement plan for your employees

☑ Yes
☑ No

52. Do you currently contribute to a retirement plan for yourself??

☑ Yes
☑ No

Economic Viability Practices

53. How would you expect to rate your liquidity reserve?

Too Low/Inadequate                  Highly Adequate

54. How manageable do you think your debt level will be?

Too high                      Acceptable
55. How adequate do you expect your cash flow to be?
   
   Too Low/Inadequate   Highly Adequate
   
   0 10 20 30 40 50 60 70 80 90 100

56. Do you plan to develop a written succession plan?
   
   ☐ Yes
   ☐ No

57. What will best describe your situation?
   
   ☐ I will have a formal plan in place
   ☐ It is likely that someone in my family will take it over, but likely won’t discussed it soon
   ☐ I don’t plan on thinking about it any time soon

Farm Management Practices

58. Will you have a written long-term farm management plan that you follow?
   
   ☐ Yes
   ☐ No

59. How strictly will you follow your plan?
   
   Loosely   Strongly Adhere
   
   0 10 20 30 40 50 60 70 80 90 100

   ☐ I do not plan on having a plan in place
Barriers to Implementing Management Changes

60. We understand that changing management practices can be challenging. Please share with us some of the barriers you face when making the decision to change current management practices in the following areas of your operation. Please consider the suggestions provided from your assessment when responding to the barriers to change.

Select all barriers that apply to each area of farm operations by placing an X where appropriate.

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<th></th>
<th>Too Expensive</th>
<th>Won't make a large enough impact</th>
<th>Don't have enough information</th>
<th>Don't think will work on my farm</th>
<th>Return on investment is too long</th>
<th>Take too much time to manage</th>
<th>Don't have the proper equipment</th>
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Please write in your response for the “Other” category

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<th>Too labor intensive/ don’t have enough labor</th>
<th>Don’t have community support</th>
<th>Don’t have enough land or sufficient capabilities</th>
<th>Other:</th>
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Survey Feedback

61. What assessment did you complete?
   - In person interview with farm tour
   - Self assessment
   - I did not complete an assessment

   Answer questions 62 – 6 if you answered “In person interview or self assessment.” If you did not complete an assessment please skip to question 72.

62. How would you rate the amount of time you had to spend to complete the assessment compared to the depth of information you received?

   Too long | Acceptable
   --- | ---
   0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100

63. How would you rate the quality of the information provided in your assessment?

   Weak | Excellent
   --- | ---
   0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100

   Answer questions 64 - 67 if you completed the interview assessment. If you completed the self-reporting assessment skip to question 68.

64. How would you rate the interviewer who completed your assessment?

   Not Knowledgeable/ Lacked Experience | Very Knowledgeable/ Experienced
   --- | ---
   0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100
65. How adequate do you feel the interviewer's knowledge was of your farm?

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<th>Very Knowledgeable</th>
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66. Did the interviewer's depth of knowledge concerning your farm matter to you?

☑ Yes
☑ No
☑ Please explain

67. Were the questions asked during the assessment easily understandable or did you need frequent clarification?

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<th>Difficult to Understand/ Needed Frequent Explanation</th>
<th>Easy to Understand/ Little Explanation Required</th>
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Answer questions 68 - 70 if you completed the self-reporting assessment. Otherwise skip to question 71.

68. Would you have preferred to complete this assessment on line instead of with the aid of an interviewer?

☑ Yes
☑ No
☑ Please explain

69. Would you have preferred to complete this assessment with the aid of an in-person interviewer who also toured your farm instead of the self-reporting survey?

☑ Yes
☑ No
☑ Please explain
70. How well did you feel you understood the questions on the survey?

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<th>Difficult to Understand/ Not Confident in my Responses</th>
<th>Easy to Understand/ Confident in my Responses</th>
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71. Would you recommend this assessment to other farmers?

- Yes
- No
- Please explain ___________________________________________________________

*Answer questions 72 and 73 if you did not complete an assessment. Those that did please skip to the end of this survey.*

72. Did you review any of the information sent to you regarding improving the sustainability of your farm?

- Yes
- No
How valuable was the information you received? (1 = Poor/of little value and 10 = Excellent)

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Thank you once again for taking the time to complete this final survey and for actively engaging in this journey with me. Your participation is greatly appreciated!

Please return your completed survey in the enclosed prepaid envelope.

If you have any questions regarding this survey or the research being conducted please contact me, Jennifer Harrison, at harrison.497@osu.edu or 831-345-9392.

**Thank you again for your participation!**