Factors Influencing Farmers' Readiness for Climate Change Adaptation: Southwest Washington, USA & Skåne, Sweden

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Abstract
Climate change impacts global agricultural systems through changes in average temperature, precipitation quantity and timing, and extreme weather events. Climate change adaptation (CCA) for agricultural systems will be based on changes to farms' day-to-day operations and long-range planning, governmental policies and regulations, and broad changes in supply chains. The purpose of this thesis is to increase understanding of factors influencing farmers' readiness to engage in climate change adaptation. The geographic regions of Southwest Washington, USA and Skåne, Sweden are used as contrasting case studies. Factors are identified through a quantitative survey of farmers and qualitative interviews with key informants. The survey measured farmers' attitudes toward climate change, CCA, potential barriers, and attributes of the social network they consult when making farm-related decisions.
Most quantitative factors differed between the regions. However, both showed positive correlations between how likely a famer is to engage in CCA and how strongly they perceive the barriers to CCA as well as how frequently they incorporate climate change in other decisions. Farmers' readiness to engage in CCA is influenced by factors which arise from their context (i.e., their social network and the organizations which they interact with) and personal characteristics (i.e., age, level of belief in climate change, perception of barriers, and type of farm). The results presented here can be used by organizations supporting farmers to inform outreach efforts concerning CCA, particularly in SWWA and Skåne, but also in similar areas.

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Summary

Climate change impacts global agricultural systems through changes in average temperature, precipitation quantity and timing, and extreme weather events (IPCC, 2019). Climate change adaptation (CCA) for agricultural systems will be based on changes to farms' day-to-day operations and long-range planning, governments' policy and regulation, subsidies, and supply chains (IPCC, 2019). International, national, and regional analyses examine CCA in agriculture from a broad system perspective, considering policy actions and actions farmers as a group may take to adapt (see Climate Impacts Group, 2009; IPCC, 2019; Rydberg et al., n.d.; TRPC, 2018). This thesis takes a different approach by focusing on individual farmers and specific actions they may take to adapt. Two case study regions are examined: Southwest Washington, USA (SWWA) and Skåne, Sweden. Both regions have urban and rural areas, mixed agricultural production, are in historically temperate climates, and expect somewhat similar impacts from climate change. In addition, expert analysis indicates that climate change will create new opportunities and challenges which require appropriate adaptation. Ultimately, this thesis answers the following research question: What factors influence farmers' readiness to engage in CCA activities in SWWA and Skåne?

To answer this question a mixed methods approach was applied using a quantitative survey of farmers and semi-structured interviews of key informants in both regions. The survey consisted of questions related respondents' demographics, farm characteristics, social network consulted when making farm-related decisions, attitude regarding climate change, perception of barriers to CCA, and likelihood of implementing certain climate change adaptive farm management practices. Interviews were conducted with academics, natural resource conservation agents, farm advisors, and farmers. Topics discussed during interviews included describing organizations available to help farmers adapt to climate change, what farmers are or could be doing to adapt, and how the interviewee's organization works with farmers (or vice-versa if the interviewee is a farmer).

Results revealed a variety of factors that correlate with how likely a farmer is to engage in CCA. Generally, these factors were different between SWWA and Skåne. However, both regions showed two factors with positive correlations ($p<0.1$) with how likely a famer is to engage in CCA: 1. how strongly they perceive the barriers to CCA and 2. how frequently they incorporate climate change in other decisions. The finding regarding perception of barriers agrees with similar findings in a larger study of Danish farmers (Woods et al., 2017). Organizations which work with farmers play a key role in their readiness to engage in CCA. The effectiveness of this support is limited by how much and with whom these organizations feel that they can talk about climate change. In Skåne, interviewees felt comfortable raising the topic of climate change including adaptation and mitigation with almost all farmers. By contrast, interviewees in SWWA viewed climate change as inherently tied to politics and identified various groups of farmers with whom climate change related topics had to be approached very cautiously, if at all.

This thesis identifies and describes key factors which influence farmers' readiness to engage in CCA activities. Such factors arise from the farmer's context (i.e., their social network and the organizations which they interact with) and personal characteristics (i.e., age, level of belief in climate change, perception of barriers, and type of farm). The results presented here can be used

by organizations supporting farmers to inform outreach efforts concerning CCA, particularly in SWWA and Skåne, but also in similar areas.

List of Abbreviations

CCA	Climate Change Adaptation
CD	Conservation District
ESN	Ego-centric Social Network
EU	European Union
FoN	Focus on Nutrients
FoSF	Federation of Swedish Farmers
IPCC	Intergovernmental Panel on Climate Change
NABC	Northwest Agricultural Business Center
NRPP	No Religion or Political Party
SWWA	Southwest Washington
TRPC	Thurston Regional Planning Council
UN FAO	United Nations Food and Agriculture Organization
USDA	United Stated Department of Agriculture
USDA NASS	USDA National Agricultural Statistics Service
USDA-NRCS	USDA – Natural Resources Conservation Service
WSDA	Washington State Department of Agriculture
WSDOE	Washington State Department of Ecology
WSU	Washington State University

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Introduction

Climate change is already impacting global agricultural production and food security through direct impacts on agricultural yields; changes in temperatures, precipitation patterns, and extreme events are and will continue to impact food production (IPCC, 2019). At the end of June 2021, Western Oregon and Washington, USA and surrounding areas as far north as British Columbia, Canada experienced an extreme and devastating heat wave; temperatures were well in excess of 40 °C throughout the region for three days (Philip et al., 2021). This heat wave caused a mass die-off of shellfish (Coletta & Westfall, 2021), contributed to an expected 25% loss of regional wheat yields (King, 2021), and endangered the health of farm workers (Shapiro, 2021). This heat wave was 150 times more likely due to anthropogenic climate change and more similar events are expected (Philip et al., 2021). Impacts of climate change on agriculture will continue as sea levels rise, precipitation patterns change, temperatures grow more extreme (Adelsman & Ekrem, 2012; Swedish Environmental Protection Agency, 2018), and agricultural pests expand their range (Bentz et al., 2019; Deutsch et al., 2018; Dunne, 2018). Under worst case models, up to 25% of global crop yields could be lost to climate change by 2100 (Wing et al., 2021).

The COVID-19 pandemic highlighted weaknesses in food systems at global and local scales by disrupting transportation infrastructure and labor leading to crops that could not be harvested, downstream processing challenges, and food shortages (Farcas et al., 2021; Kumar & Singh, 2021). One recommendation to avoid such shocks in the future is to strengthen local food systems, an action already supported by some consumers for environmental, economic, and social reasons (Kumar & Singh, 2021). To accomplish such localization, climate change must be considered, and adaptation options incorporated.

Like most industries, some level of climate change adaptation (CCA) will be needed throughout agricultural systems. This will include changes within farms' day-to-day operations and long-range planning, governments' policy, regulation, and subsidy programs, and supply chain structures (IPCC, 2019). Unlike other industries, farms are strongly tied to their geographic location. Water availability, temperature, light, soil conditions, and cultural heritage all shape the food and other agricultural production in an area. Consequently, the exact conditions and background of the farm and its farmer must be addressed when considering on-farm adaptation actions (European Environment Agency, 2019). On-farm CCA practices can mitigate losses, or exploit opportunities (Woods et al., 2017). In addition to adapting to direct impacts, some farmers may need to adapt to societal CCA actions. For example, one societal response to drought is to reallocate water rights away from agricultural uses; such a measure could require further adaptation from farmers who rely on that water for irrigation (Malek et al., 2020).

Scope and Intent

Many papers and grey literature discuss agricultural CCA. However, the scope and intent of much of the existing literature is often broad and high-level, focusing on policy interventions or systemic actions over large areas (e.g. Washington State or all of Sweden) (Climate Impacts Group, 2009; IPCC, 2019; Rydberg et al., n.d.; TRPC, 2018). Such broad analyses tend to view farmers as perfectly economically rational and informed. For example one broad analysis of CCA and agricultural land use notes that "farmer's [sic] adaptive behavior is expected to be governed by ambitions to minimize risks and to maximize profits" (Eckersten et al., 2008, p. 21). Realistically, human behavior is far more complex and involves a range of factors (Holt et

al., 2007; Klöckner, 2013). This thesis takes a different approach by focusing on individual farmers and specific actions they may take to adapt. Several previous papers have taken a similar approach to analyzing CCA attitudes and practices among farmers (see Ali, 2014; Hydbom et al., 2020; Limantol et al., 2016; Mitter et al., 2019; Ndamani et al., 2016; Woods et al., 2017). This work is distributed globally across biomes, social, agricultural, ecological, and economic contexts. Climate change, as well as local agricultural systems are highly influenced by these contextual factors. Thus detailed analysis at the regional level is both useful regionally and can help strengthen the general understanding of farmers' interaction with climate change (Mitter et al., 2019).

This thesis focuses on two climatically similar regions: Southwest Washington (SWWA), USA and Skåne, Sweden. These regions share key features in population distribution and general climate though they differ in cultural and governance strategies as well as historical development. Further background on these regions is provided below. Climate change is not expected to decimate the agricultural systems of either region, rather climate change brings both challenges and opportunities (Dalton et al., 2013; Eckersten et al., 2008). The opportunity for farmers to engage in CCA in the absence of significant negative pressure and with the opportunity for gain is a key feature of these regions. Some prior work has investigated farmers' perception of and response to climate change in Denmark and Skåne (Hydbom et al., 2020; Woods et al., 2017). Hydbom et al. (2020) focused on Skåne, though limited to farmers' attitudes regarding tillage practices rather than general CCA measures. No farmer-centric studies could be identified focused on the SWWA region examined here. This could be a result of the small agricultural production relative to surrounding areas, social taboos which make research related to climate change difficult, or the fact that SWWA is not a single political region.

Ego-centric social network (ESN) analysis was used to explore the role of farmers' social networks in their attitudes toward climate change adaptation. Informal social networks have previously been identified as important channels through which information spreads regarding improved crop varieties (Muange et al., 2014). Further, social network analysis has provided insight on how farmers discuss scientific results (Wood et al., 2014) and how information on conservation practices spreads (Zhang et al., 2020). Social network knowledge transfer is equally or more important than direct linear knowledge transfer from specialists (Wood et al., 2014; Zhang et al., 2020). Here, farmers described five people they consult in making decisions and this network was analyzed to understand attitudes related to CCA practices.

Purpose and Research Question

The purpose of this thesis is to increase understanding of factors influencing farmers' readiness to engage in climate change adaptation. In addition, individual and collective factors which influence farmers' readiness to engage in CCA are identified. Multiple potential components of change readiness were analyzed using a mixture of survey and interview-based data collection. Examination of two study areas allowed the identification of unifying trends and differences which present learning opportunities for both regions and enhanced the analytical generalizability of the results. This thesis addresses the following research question:

What factors influence farmers' readiness to engage in CCA activities in SWWA and Skåne?

Concepts and Theories

Subject Concepts

Three key questions define the scope of this study. What is agriculture? Who is a farmer? What actions constitute CCA? Answers to these questions better define and limit the research question.

Agriculture

The United States Department of Agriculture (USDA) defines agriculture broadly as "the science or practice of farming, including growing crops and raising animals for the production of food, fiber, fuel and other products" (National Agricultural Library, 2021). This definition encompasses terrestrial crop production, animal husbandry, aquaculture, and forestry. In practice there are not clear distinctions between these forms of agriculture. In fact, the distinction is increasingly unclear in some important CCA practices such as agroforestry – mixing plant agriculture and forestry – and silvopasture – mixing livestock and forestry (Patel-Weynand et al., 2017). However, to consider all these forms would be too broad. Aquaculture differs from the others in being under or in water and has a different set of climate change impacts, support organizations, and markets. Consequently, aquaculture was excluded. Forestry is sometimes considered a form of terrestrial crop agriculture and many of the same governmental organizations are involved. However, the crop cycle duration and therefore planning horizon for forestry are much longer than for crop production or animal husbandry. Therefore, forestry was also excluded from this study. Here, agriculture – or farming – is understood as the intentional act of growing plants or raising animals on land to produce food, fiber, and other important products.

Farmer and Farm

In this study, farmers are seen as the person or people "who make the major decisions regarding resource use and exercises management control over the agricultural holding operation" (UN FAO, 2015, p. 46). This agrees with the USDA definition of farm operators (National Agricultural Library, 2021). In both cases a further definition of agricultural holding or farm operation is needed. The USDA defines farms as "any operation with the potential to produce at least $1,000 worth of agricultural goods in a given year" (O'Donoghue, 2009). However, this definition relies on a valuation and thus changes with time, farm size, and – potentially – politics, including some and excluding others (O'Donoghue, 2009). By contrast, the European Union (EU) uses a definition which lacks a financial threshold but defines more thoroughly what types of activities qualify (Eurostat, 2019). The broader EU definition is used here to avoid the issues with value judgement and include small or self-sufficiency-oriented farms while excluding operations where aquaculture or forestry are the main objective. A farmer is a person who jointly or independently makes major decisions regarding how natural and financial resources are used where the primary intent is agriculture as described above.

Adaptation

USDA's Agriculture Research Service adopts the Intergovernmental Panel on Climate Change (IPCC) position and sees climate adaptation as "adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities" (Walthall et al., 2012, p. 94). The definition will be adopted here without modification. Critically, this definition allows CCA actions to create a benefit, not just avoid loss. In addition, it is important to remember that CCA can be a response to expected

changes that are not yet felt (anticipatory) or actual climatic changes (reactive). For natural systems reactive adaptation is appropriate; for human systems anticipatory adaptation is favored (Klein, 2003). In practice, climate change mitigation (see IPCC, 2018, p. 554) activities may be bundled with CCA activities.

Analytical Concepts

Change Readiness

A central concept in this thesis is change readiness. This research investigates factors influencing individual behavior and decision making. Relevant models such as the theory of planned behavior or norm activation theory are well established and are applied to problems of environmental decision making (Klöckner, 2013). Alternatively, CCA in the agricultural sector can be viewed as an organizational change initiative where the organization involves many individual farmers who each may or may not be ready to change. A model of organizational change readiness has been defined (Holt et al., 2007) and applied across multiple fields (Combe, 2014; Ilyas, 2018; Saragih, 2015), see Figure 1. Change readiness is influenced by external change initiatives (e.g., a government run conservation program) and a collection of factors internal to individuals. Such internal factors include content (what is changing or may change?), context (what else is happening in the organization?), process (how is the change happening?), and individual attributes (Holt et al., 2007). Individuals are the implementers of change, thus for systemic change to occur individuals must be ready (Holt et al., 2007). In addition, in complex systems no individual has a complete understanding of all the components (Holt et al., 2007). This recognition of individual agency and limited knowledge implies that change readiness should be assessed for individuals in the organization not only as an aggregate. Individual change readiness can be viewed as a composite, and even quantifiable, value influenced by a person's belief in the need to change and ability to affect change (Saragih, 2015). The methods used in this thesis measure farmers' likelihood of participating in the change (CCA) and assess external change initiatives and individual factors.

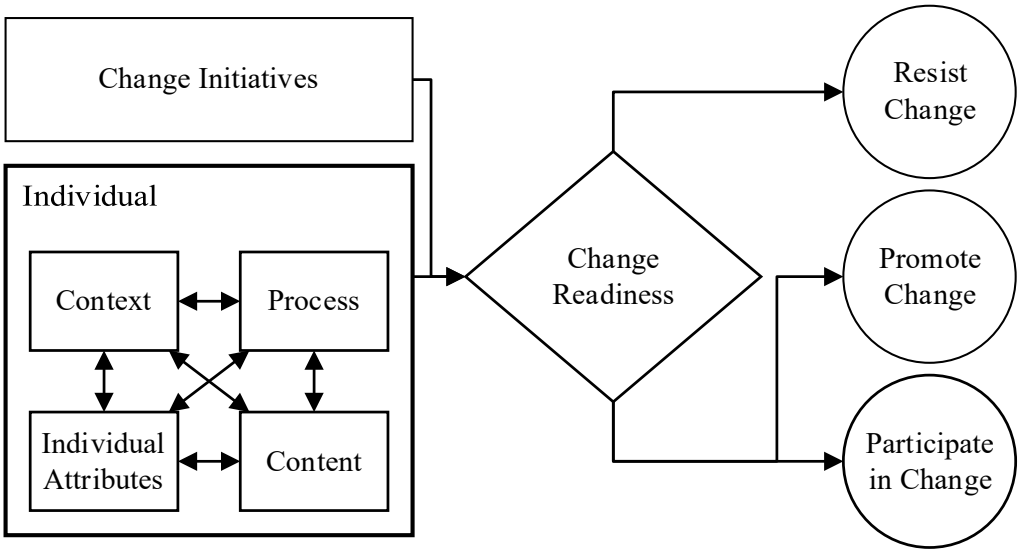

Figure 1. Conceptual model of change readiness. Adapted from Saragih, 2015.

Egocentric Social Network

Egocentric social networks (ESNs) describe connections between people centering around a single individual (the ego). Analysis of ESNs can help describe the context influencing change readiness. While ESNs can extend to many links beyond the ego, this research is limited to

direct connections to the ego and within those people. This level of data is known as a 1.5-degree ESN (Golbeck, 2013a). Edges can be described in terms of connection types (e.g., friend, family, professional service provider) and weighted based on strength (e.g., importance, familiarity, frequency of contact). People directly connected to the ego are alters.

Social networks, including such small ESNs, have a unique set of descriptive statistics. Two of these are clustering and betweenness centrality. Clustering measures how connected a network is: higher clustering means alters know each other while low clustering means the network is more open to the outside as alters do not know each other (Golbeck, 2013b). Here, a weighted clustering is used which accounts for the strength of connections. Betweenness centrality indicates the degree to which a node is critical in connecting other nodes (Golbeck, 2013b). An ego with high betweenness centrality can exert a lot of control over the flow of information in their network (Golbeck, 2013b). A clique is a group within network where all of the members are connected to each other (Golbeck, 2013a). Networks can be described with both the size of the largest clique (how many people are fully connected to each other) or the number of cliques (how many groups are there where all the members know each other).

Region Descriptions

Southwest Washington (SWWA), USA and Skåne, Sweden both feature urban and rural areas and have significant agricultural sectors and temperate climates with similar length growing seasons. Both regions will feel positive and negative impacts from climate change. Appropriate adaptation by farmers can enhance the positive while mitigating the negative (Hall et al., 2015).

Southwest Washington, USA

SWWA encompasses eight counties and spans from the Cascade Mountains west to the Pacific Ocean, the same definition is used by Washington State University Extension Forestry (WSU, n.d.). Much of the region is sparsely populated, though there are major metropolitan areas, see Figure 2. Farmers in this area may interact with government at the county, state, or federal level and roles and responsibilities overlap between these levels. The United States has a long history of governmental support to farmers, much of which was inspired by the intense topsoil erosion during the mid-west Dust Bowl of the 1930s (National Association of Conservation Districts, n.d.; USDA-NRCS, n.d.).

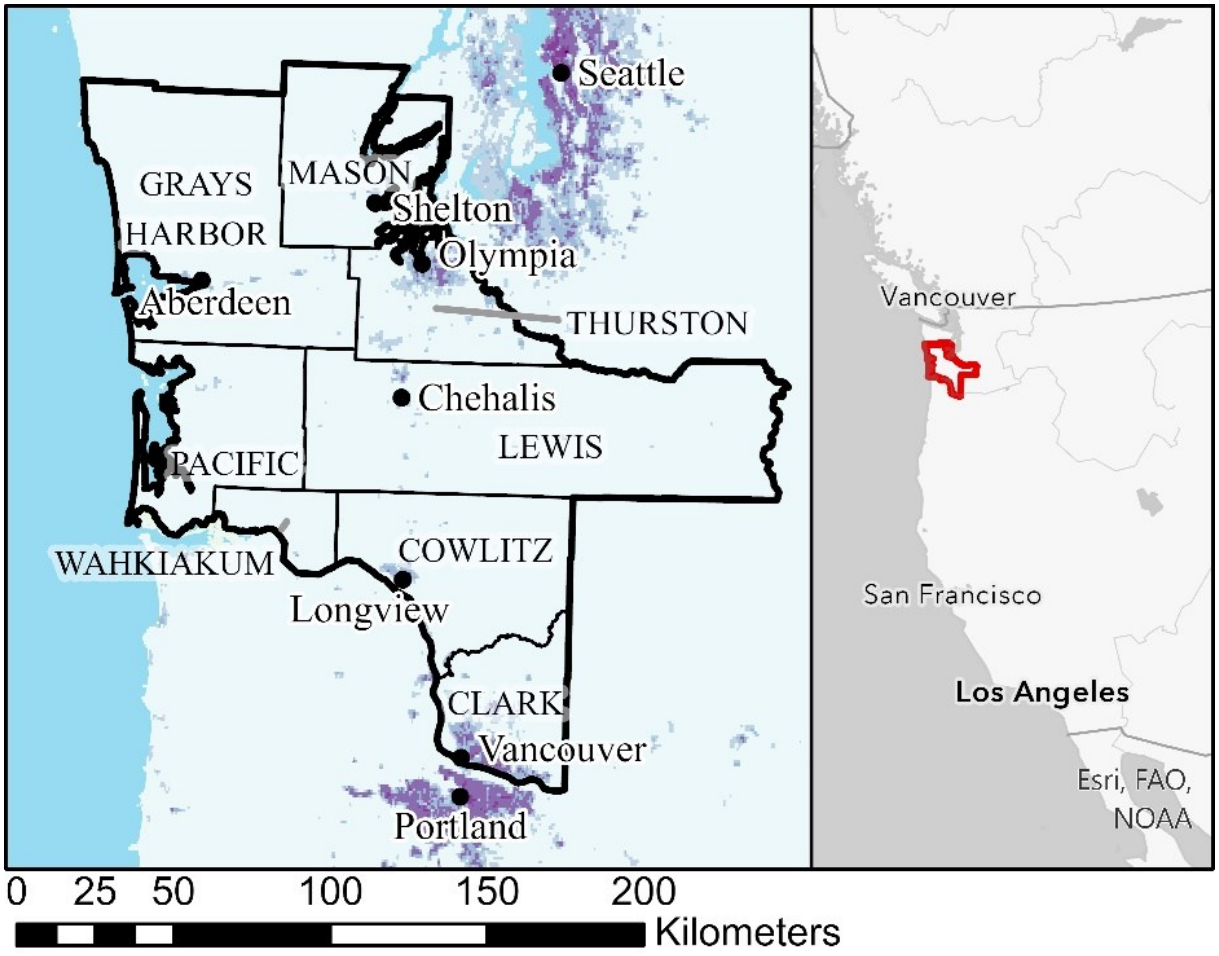

Figure 2. Geographical extent and population density of Southwest Washington (SWWA) study area. Darker colors indicate higher population density, county names are in CAPITALS, points show notable cities. Sources: (Center For International Earth Science Information Network-CIESIN-Columbia University, 2018; Kimpel, 2020; OpenCage GMBH, n.d.; Pacific Northwest Hydrography Framework, 2005; US Department of Interior, Bureau of Land Management, 2013; Washington State Department of Natural Resources, 2021)

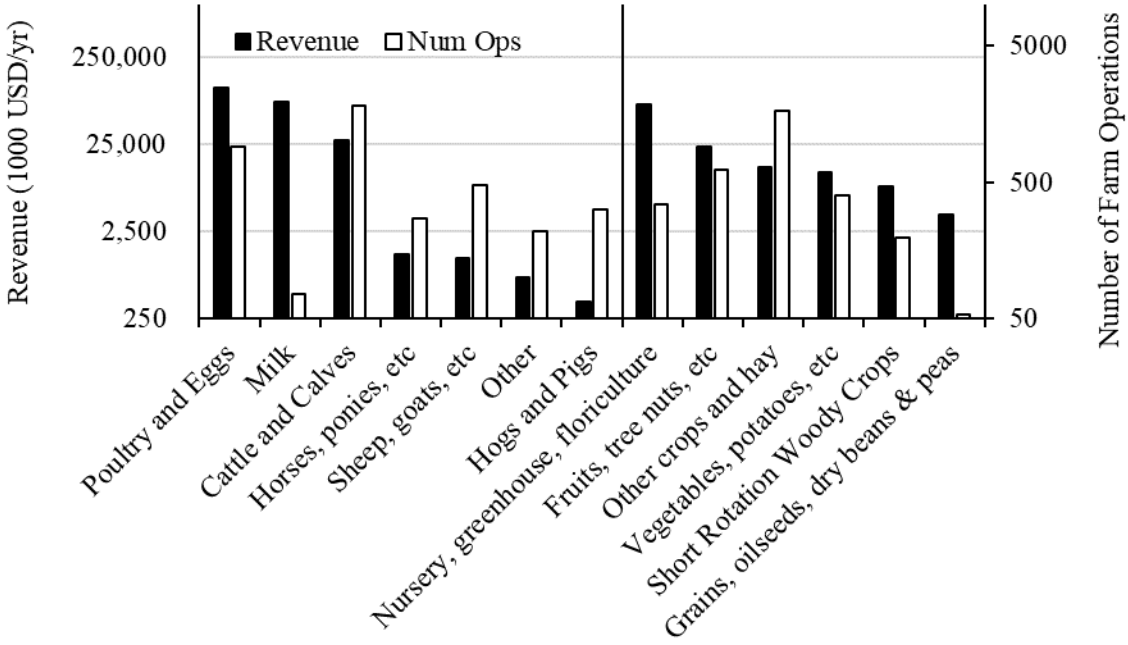

Figure 3. Annual revenue and number of producing farm operations in SWWA by product category for animal products (left) and plant products (right). Source: (USDA NASS, 2019).

Agricultural production in SWWA is very diverse (Dalton et al., 2013). Typical farms in the region are small family farms (96% family farms and 77% <50 acres or ~20 ha), though larger farms exist (USDA NASS, 2019). Agricultural revenue is primarily derived from animals and animal products, though a range of crops are also economically important, see Figure 3 (USDA NASS, 2019).

SWWA experiences a range of impacts from ongoing climate change. Best estimates indicate that parts of SWWA will experience 4 – 56 inches (10 – 140 cm) of sea level rise along with worsening storm surge events and ongoing coastal erosion (Adelsman & Ekrem, 2012; Climate Impacts Group, 2009; Miles et al., 2010; Snover et al., 2013; TRPC, 2018). This is after accounting for geologic uplift on the Olympic Peninsula which counteracts sea level rise. Consequently, surface water and groundwater flows of salt water may lead to salinization of coastal agricultural areas and critical aquifers (TRPC, 2018). Annual precipitation volume in SWWA is not expected to change; however, summers will be drier and longer while rain events will become more intense and concentrated in the fall, winter, and spring (Adelsman & Ekrem, 2012; Snover et al., 2013). Annual snowpack is declining and melting earlier in the year and glaciers are continuing to retreat (Climate Impacts Group, 2009; Snover et al., 2013). Resulting flooding in the spring and fall, as well as summer droughts, will stress agriculture. This will directly impact plant and animal health and yields, delay or limit planting and harvest, and contribute to erosion and nutrient loss (Adelsman & Ekrem, 2012; Dalton et al., 2013; Snover et al., 2013). Heat waves and high temperatures will become more common through SWWA with up to 11°F (6°C) of warming by 2080 and increasing frequency of heat waves (Adelsman & Ekrem, 2012; Climate Impacts Group, 2009; Snover et al., 2013). Increasing heat can stress animals, lower productivity of existing crops, and facilitate the spread of new and existing noxious plants and other pests (Dalton et al., 2013; TRPC, 2018). Increase in wildfires can also directly impact crop and animal health and cause indirect damage through smoke (Adelsman & Ekrem, 2012). Increased atmospheric CO2 may provide a fertilizing effect – though this may negatively impact forage quality (Dalton et al., 2013; Snover et al., 2013). A loss of winter

chilling will adversely impact fruit and nut trees, but will lead to longer growing and grazing seasons and the opportunity for new crops (Dalton et al., 2013; May et al., 2018).

Skåne, Sweden

Skåne is the southernmost county (Swedish: län) of Sweden and is further subdivided into 33 municipalities (Swedish: kommuner). The county is overall very flat and – like SWWA – has a significant amount of coastline. Though Skåne is generally sparsely populated, it is home to cities such as Malmö and Helsinborg, see Figure 4. Farmers in Skåne interact with municipal, county, and national governance structures. In turn, these are influenced by directives and policies from the EU. Sparked by impacts of excessive nutrient loads in both inland lakes and the Baltic Sea, a public-private partnership called Focus on Nutrients (FoN, Swedish: Greppa Näringen) was initiated in 2001 to provide advice to farmers in Skåne (Hoffmann et al., 2011). This program has become a prime source of advice on environment and climate issues for Skånian farmers.

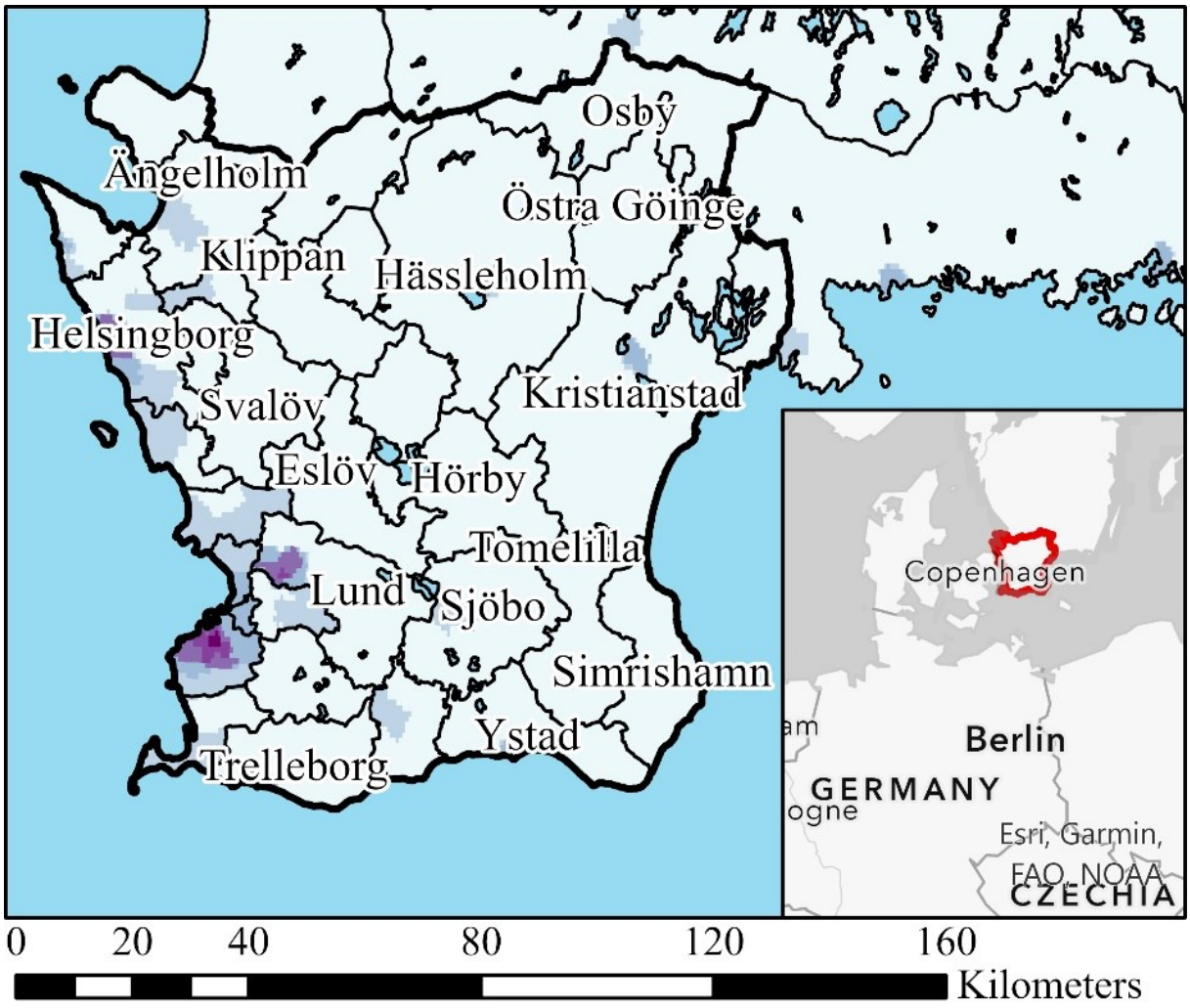

Figure 4. Geographical extent and population density of Skåne study area. Darker colors indicate higher population density Sources: (Center For International Earth Science Information Network-CIESIN-Columbia University, 2018; Lantmäteriet, 2020).

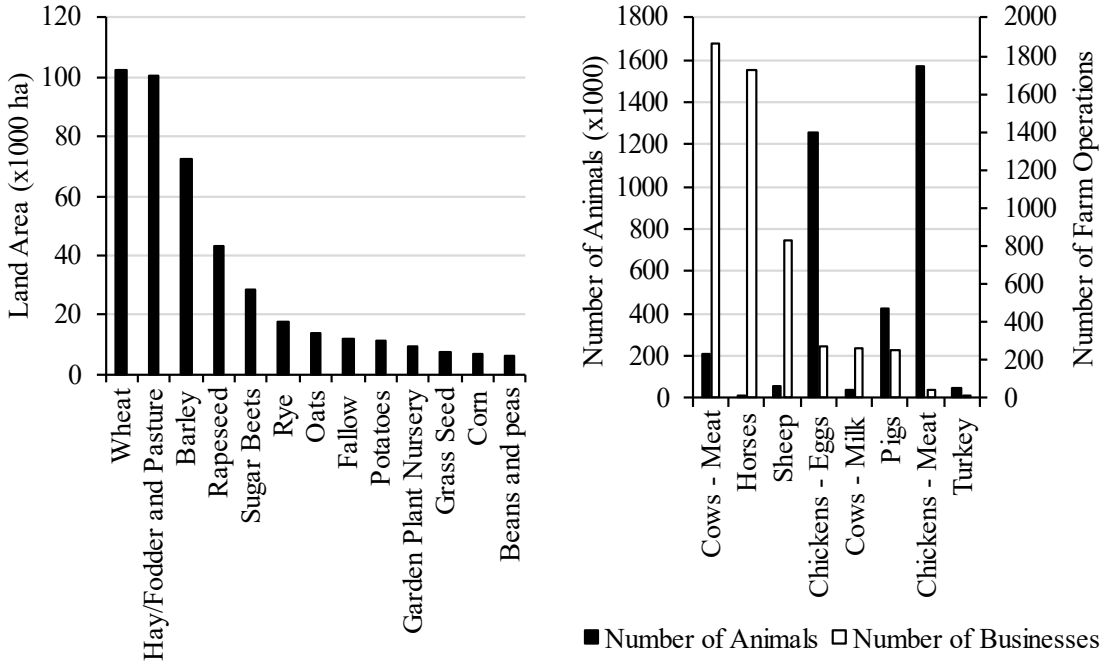

Figure 5. Production effort shown by dedicated land area (left), number of animals (right), or number of businesses(right) by agricultural product type for major products in Skåne. Crop products represent 98% of arable land in 2020. Source: (Jordbruksverket, 2021a, 2021b).

Roughly 40% of Skåne's land area is cultivated with major crops generally being cereal grains (wheat, barley, and rye), pasture and forage, and rapeseed (Jordbruksverket, 2021a). Animal production in Skåne focuses on beef, chicken, dairy, and eggs; there are many business that own horses, but relatively few horses per business (Jordbruksverket, 2021b), see Figure 5.

Climate change in Europe is causing climate zones to moving northward. In 2008, Skåne was in the Atlantic North Zone, by 2080 it is expected to fall under the milder Atlantic Central Zone (Eckersten et al., 2008). Skåne's average temperature is expected to increase, allowing for earlier planting dates and longer growing varieties (Eckersten et al., 2008). In combination with fertilization by increased atmospheric CO_2, crop yields are expected to increase (Eckersten et al., 2008). Climate change will also enable new crops in Skåne such as corn and perennial crops (Eckersten et al., 2008; Hall et al., 2015). Non-agricultural societal responses to climate change will impact agriculture, for example by increasing demand for energy crops (Hall et al., 2015) and through increased regulation. Southern Sweden also expects as much as 80 cm of sea level rise (Mobjörk & Johansson, 2009). Skåne will have the most sea level rise and shoreline erosion of any Swedish county (Swedish Environmental Protection Agency, 2018). As in SWWA, this can lead to salinization of nearshore agricultural areas and aquifers. New and stronger agricultural pests are almost certain (Jönsson et al., 2007; Mobjörk & Johansson, 2009). Increasing summer temperatures will lead to heat stress in all common animals and can occur at temperatures as low as 30 °C (Hall et al., 2015). More frequent intense rain events and flooding leads to vector-borne disease and direct health impacts on crops and animals (Hall et al., 2015). Skåne may also experience a shift in rainfall similar to SWWA; wetter fall/spring and drier summer (Hall et al., 2015). However, this impact is far less certain in Skåne than in SWWA.

Methods

Data collection consisted of a survey of farmers and a set of key informant interviews. To the extent possible, the same methods were replicated in the two study areas. In the case of the survey, this meant that the same questions were posed to all respondents, though using a Swedish translation in Skåne. For the interviews, the appropriate interviewees differed in the two regions and so, while the process of identifying them was similar, the roles of the key informants differed between the regions.

Survey Methods

The survey was designed to collect a broad amount of information while being applicable to all farmers in both regions and approachable to get as many complete responses as possible. Approachability was facilitated by using multiple choice questions rather than exact values and not asking for sentences or paragraphs. While some richness of information was sacrificed, the reduced burden on respondents likely resulted in more responses. For all survey items a response option of "Don't Know" and/or "Prefer not to say" was provided, in addition no questions were marked as required. Identifiable information (e.g., name, email, phone, farm name) was not collected. Over the course of the study, various versions of the survey were used. In the initial version, questions were ordered to avoid bias such as priming. For example, questions related to climate change attitude were presented at the end to avoid priming respondents and biasing responses regarding likelihood of engaging in CCA practices. On average, respondents who completed the survey took 15-20 minutes. Early responses indicated that respondents were uncomfortable answering questions regarding religiosity and political party preference, thus a version was created where these items were removed. Later versions emphasized shorter completion times to increase the number of responses. This was done by reordering questions based on importance and creating three sections of five minutes each where the second and third were explicitly described as optional. In total there are three survey versions: "Full" where all questions are present, "No Religion or Political Party (NRPP)" where these items are removed, and "Three Section" where questions are ordered by their importance. The exact phrasing of the questions, in both English and Swedish, as well as the question order and response choices can be found in Appendix 1: Survey. For the purposes of data analysis, responses from all versions were combined. The survey captured information in several areas:

- Demographic information regarding the respondent and their farm
- Information on the respondent's ESN
- Attitude toward climate change
- Likelihood of implementing CCA practices
- Perception of barriers to CCA

Questions were based on prior literature involving ESN data generation, surveys of farmers, and general social surveys, see Appendix 1: Survey.

CCA Practices

Respondents were presented with 15 potential CCA practices and asked to rate their likelihood of engaging in each. An option of "I already do this" was included to separate respondents who already use a practice since prior implementation does not indicate likelihood of further implementation. Recommended CCA practices were identified through a review of grey and white literature applicable to the study area. CCA practices which were useful in both regions

and generally agreed upon in literature were included in the survey, see Table 1. One frequently recommended action is changing what is produced. This can mean changing the type (wheat vs corn) or variety (heat tolerant vs high yield dairy cows) of crop/livestock to avoid losses from climate change (resistance to new pests) or exploit beneficial changes (newly possible high value crops). Following Woods et al. (2017), these categories were asked about separately.

Some question may be raised as to whether seeking alternative revenue sources constitutes an adaptive practice. For analyses focused on how the agricultural system will adapt, alternative revenue strategies mean farmers are exiting the system boundary and therefore are not a systemic adaptation. However, for individual farmers alternative revenue streams are a viable way to buffer the impacts of climate change (Valdivia & Barbieri, 2014) and are included here. Agritourism is a possible activity in both SWWA (WSU Extension, n.d.) and Skåne (Visit Skåne, n.d.).

Table 1. CCA practices agreed upon in literature and applicable to both SWWA and Skåne.

CCA Practice	Farm Management Practice for CCA	Supporting Literature
1 – 4	Change types or varieties of crops to avoid losses or exploit opportunities	Adelsman & Ekrem, 2012, pp. 131, 135; Dalton et al., 2013, pp. 160, 165; European Environment Agency, 2019, pp. 10, 81; Walthall et al., 2012, p. 121; Woods et al., 2017
5	Implement no - or low-till practices	Adelsman & Ekrem, 2012, p. 131; European Environment Agency, 2019, p. 10; Hydbom et al., 2020; TRPC, 2018, p. 82
6	Change timing of activities (planting, harvest, etc.)	Adelsman & Ekrem, 2012, p. 132; Dalton et al., 2013, p. 165; European Environment Agency, 2019, p. 10; Walthall et al., 2012; Woods et al., 2017, p. 121
7	Establish new flood protection measures	European Environment Agency, 2019, pp. 77 –85; TRPC, 2018, p. 78; Walthall et al., 2012, p. 121
8	Take some land out of production	European Environment Agency, 2019, pp. 77 –85; TRPC, 2018, p. 83; Walthall et al., 2012, p. 121; Woods et al., 2017
9	Take out more/better insurance policies	Walthall et al., 2012, p. 121; Woods et al., 2017
10	• On-farm water conservation • On-farm water storage	Adelsman & Ekrem, 2012, p. 131; European Environment Agency, 2019, pp. 10, 77 –85; Nelson et al., 2013; Walthall et al., 2012, p. 121; Woods et al., 2017
11	Introduce intercropping and/or other mixed land use approaches	European Environment Agency, 2019, pp. 77 –85; USDA Climate Hubs, n.d.; Woods et al., 2017
12	Increase use of cover crops	Adelsman & Ekrem, 2012, p. 131; European Environment Agency, 2019, p. 10; TRPC, 2018, p. 82
13	Introduce or modify crop rotations	Adelsman & Ekrem, 2012, p. 131; European Environment Agency, 2019, p. 10; Woods et al., 2017
14	Change use of pesticides	Dalton et al., 2013, p. 170; Woods et al., 2017
15	• Increase off-farm work • Invest in agritourism	Valdivia & Barbieri, 2014

Social Networks

In this study 1.5-degree ESNs are analyzed. Burt (1984) proposed a method for collecting the information necessary to construct these networks in conjunction with the verbally administered General Social Survey in the US. Those methods were modified to fit the scope of this study and accommodate data collection via an unguided online survey. Significantly, Burt (1984) begins by asking respondents to answer regarding "persons with whom the respondent discussed personal matters during the last six months" (p. 296). The survey used here focused respondents on "people with whom you discussed or sought advice regarding farm management decisions". Burt (1984) suggests collecting data on the alters' race, annual earnings, religion, and political party affiliation. The race and annual earnings items were dropped as they were seen as too personal considering the low expected utility. Religion and political party items were modified to be in line with their analogs asked about the ego. Despite their personal nature, these items were seen as a good way to measure how similar or different the alters are to the ego. Respondents were also asked to report their perception of each alter's belief in climate change and how many of, and how often, the alter's decisions are influenced by climate change.

Distribution of Surveys

The survey was constructed using an online survey administration software, QuestionPro (*QuestionPro*, 2021). This software was selected because it is free and can use respondent answers (e.g., alters' names) in future questions. Survey responses were collected from early February to the end of April 2021. The intended recipients of the survey were farmers in either study region. Formal and informal channels were used to distribute the survey.

Within the formal channel, local organizations which are trusted hubs of agricultural knowledge were identified in each region. In SWWA, this was offices of the Washington State University Extension Service (Extension) and Conservation Districts (CDs) in each county. Contacts at Extension and CDs were asked to distribute the survey to farmers in their area. In Skåne, the approach used by Hydbom et al. (2020) was followed, identifying the Federation of Swedish Farmers (FoSF, Swedish: Lantbrukarnas Riksförbund or LRF) as the central organization. Initially, the chairs of the 115 local FoSF chapters within Skåne were contacted and asked to complete the survey and forward to others in their chapter (see Hydbom et al., 2020). In addition, an invitation to complete the survey was distributed in the county-wide FoSF newsletter twice (LRF Skåne, 2021a, 2021b). The survey version distributed with the FoSF newsletter was the Three Section version, CD staff distributed the NRPP version, while all other formal channels used the Full version. Respondents were expected to be more likely to complete the survey if it is received from – and implicitly endorsed by – a trusted contact in the local farming community. In addition, distribution lists used by these formal actors were expected to be more complete and less biased compared to informal distribution.

Informal distribution consisted of two channels: farm-oriented Facebook groups and emailed invitations to SWWA farmers. The Three Section survey version was used in both informal channels. Facebook was searched for groups whose membership likely contained target respondents (see Table 2 for keywords used) and where the group's focus was not political or oriented on buying and selling, see Appendix 2: Informal Survey Distribution. This method of distribution allowed the survey to reach a large number or people, though the number who are farmers in the target region is unknown. A low response rate was expected because these channels do not have a pre-existing relationship or personal touch. Continuing low number of

responses prompted the final channel of survey distribution which was only used in SWWA. An invitation to participate was directly sent to publicly available email addresses of farms in the region. A variety of web resources including farmers' market vendor lists, local farm maps, and local food guides were used to identify farms in the region. Email addresses were identified in the same database or from the farm's website or Facebook page. This approach likely biased the sample toward smaller farms oriented toward individual consumers rather than those oriented toward wholesale or large-scale activities. This potential bias was accepted considering the need for additional responses. Approximately 350 farms from 12 lists were contacted in this way, see Appendix 2: Informal Survey Distribution.

Table 2. Keywords used to identify relevant Facebook groups.

Subject Term	Location Term
Farm, garden, permaculture, agriculture	Washington, Northwest, PNW, any county name
jordbruk, lantbruk, odling, permakultur	Sweden or Skåne

Data Manipulation and Analysis

Data manipulation and analysis used Python version 3.8.5 (Python Software Foundation, 2021) and supplemental libraries for data manipulation and visualization: pandas (McKinney, 2010), scipy (Virtanen et al., 2020), networkx (Hagberg et al., 2008), numpy (Harris et al., 2020), matplotlib (Caswell et al., 2020), and jenkspy (Viry, 2017). Respondents were removed from analysis if they did not provide any responses on the CCA practices items or indicated they were outside the study area. Some respondents did not provide location information and were assumed to be inside the study region. CCA practices 10 and 15 (concerning water stress and alternative revenue respectively) were split into two items for the Three Sections version, requiring some manipulation to combine the data with the other versions. For CCA Practice 10, responses to the divided items were averaged while for CCA Practice 15 the higher of the two component parts was used. This approach best matches the original phrasing of "and" for practice 10 and "or" for Practice 15. For the CCA practices, respondents were able to indicate that they already engage in a certain practice. This answer does not discriminate whether they have been doing this for a long time or recently adopted the practice in response to climate change. Because the intent of the question is to measure how likely the respondent is to change what they are doing, these responses were removed from further analysis. Two aggregate measures of the respondent's engagement in CCA were calculated. The Average Practice Likelihood is the simple mean of the likelihood of all practices for which an answer is given ('very unlikely' = 1, 'very likely' = 5). This can be interpreted as the overall likelihood of the respondent engaging in climate change adaptation generally. The CCA Likelihood Score was computed by giving one point for each 'likely' answer and two points for each 'very likely'. This measure can be interpreted as the extent of likely adaptation as it better reflects the number of potential adaptation measures while not lowering scores of respondents for whom one or more practices are marked as unlikely.

ESN properties were calculated using the Python library networkx (Hagberg et al., 2008). This approach is intended to analyze networks of individuals, however some respondents identified generic resources (e.g., google) as alters. In these cases, that alter was removed from analysis. Further, alters for whom the link to the ego was not provided were removed from analysis. Data on the nature of the ego's relationship with each alter was used to assess the overall formality of the ego's network. Each node was assigned as either a 'formal' or 'informal' based on the role(s) that the alter has to the ego where certain roles have a higher priority in determining formality than others, see Table 3. For example, an alter identified as an advisor and a friend is a formal link as the advisor role supersedes the friend role; an alter identified as a friend and coworker is an informal link as the friend role is seen as more important. The formality index is the fraction of formal alters of total alters. The Difference to Ego score represents the sum of how different an ego's alters are from the ego regardless of the direction of difference. This score captures differences in gender, age, education, climate change belief, and climate change actions.

Table 3. Formality assignment based on reported relationship between ego and alter.

Priority	Role	Formality
1	Advisor	Formal
2	Parent, Sibling, Spouse, Child, Other Family	Informal
3	Friend, Neighbor	Informal
4	Coworker, Comember	Formal
5	Other	Informal

Spearman correlation coefficients (R) and corresponding p values were calculated using the Python library scipy (Virtanen et al., 2020). Spearman correlation coefficients indicate the strength of association between ranked variables. Values can range from -1 to +1 where negative values mean that as one variable increases the other decreases and positive values mean that both variables increase or decrease together, values close to -1 or 1 indicate a strong relationship while values close to 0 indicate a weak relationship. The interpretation of correlation coefficients varies based on what is being studied; if the variables are countable and clear higher correlation coefficients are expected whereas difficult to measure variables (such as mental attitudes as here) give lower correlation coefficients (Shortell, 2001). For such difficult variables as are being considered here, correlation coefficients less than 0.2 are weak, 0.2 to 0.4 are moderate, 0.4 to 0.6 are relatively strong, and 0.6 and above are very strong and very rare (Shortell, 2001). P-values indicate the statistical significance of correlation coefficients. Here, a correlation coefficient was considered statistically significant if the p-value is less than 0.1.

Interview Methods

In addition to collecting information directly from farmers through the survey, interviews were conducted with key players in the local agricultural sectors. One interview consisted of written responses to open ended questions while the other 16 were semi-structured interviews conducted over the phone or video conference and lasted about one hour. Semi-structured interviews helped to ensure relevant topics were discussed with all interviewees while allowing the conversation to deviate somewhat to take advantage of each interviewee's unique

knowledge and experience and avoid introducing bias (Young et al., 2018). Some important topics did not need specific prompts. For example, interviewees frequently discussed barriers to adaptation throughout the interview and particularly in response to the question on what farmers should do to adapt. Interview guides were tailored to each interviewee based on their position and organization while ensuring that specific themes were addressed, see Appendix 3: Interview Topics.

Two methods were used to identify potential interviewees. First, starting from one key organization in each region, Extension in SWWA and FoN in Skåne, snowballing (see Young et al., 2018) was used to identify further relevant organizations. Based on interviewees' answers to questions on who else farmers talk to when making farm management decisions, new organization and potential interviewees were identified. This approach yielded 12 interviewees in SWWA across three organizations and three interviewees in Skåne across three organizations, see Table 4. Secondarily, informal survey distribution included an invitation for farmers to participate in an interview. Two interviews with farmers in SWWA were initiated this way. Additional organizations, including those with regulatory authority and a think tank, were approached for an interview but declined to participate or did not respond. Organizations are referred to here to provide context and credential interviewees. However, views expressed by interviewees are their own and may or may not align with their organization.

Interviews were analyzed using emergent coding or grounded theory (see Young et al., 2018) in NVivo (QSR International Pty Ltd., 2021). This technique allowed for the identification of themes mentioned by multiple interviewees which reach beyond those explicitly asked for in the interview guide.

Table 4. Interviewees by region and name, title, and organization if available. Views expressed by interviewees are their own. Affiliation with an organization should not be construed to imply that the organization endorses the views presented here.

	Region	Name	Title and Organization
1	Skåne	Mia Davidsson	Agronom/Landsbygdsutvecklare (Agronomist/Rural Developer) Länsstyrelsen Skåne (County Administrative Board Skåne)
2	Skåne	Ann Albihn	Assoc/Adjunct Professor National Veterinary Institute & Swedish University of Agricultural Sciences
3	Skåne	Marcus Willert	Växtodlingsrådgivare (Crop Production Advisor) HIR Skåne
4	SWWA	Kelly Bell	Shepherd Ovis Aries Farm
5	SWWA	Rachel Uberman	Executive Director HOPE Garden Project
6	SWWA	Gary Fredericks	Adminisitrative Director WSU Extension – Cowlitz County
7	SWWA		Small Farms Coordinator WSU Extension Grays Harbor
8	SWWA	Patrick Shults	Director WSU Extension – Lewis County
9	SWWA	Stephen Bramwell	Director & Agriculture Faculty Thurston County Extension & Washington State University
10	SWWA	Terry Koper	Small Acreage Program Coordinator WSU Clark County Extension
11	SWWA		Resource Technician Lewis Conservation District
12	SWWA	Megan Martin Aust	Agricultural Planner Pacific Conservation District
13	SWWA	Mike Nordin	District Manager Grays Harbor and Pacific Conservation Districts
14	SWWA	Sarah Moorehead	Executive Director Thurston Conservation District
15	SWWA		Soil Conservationist USDA-NRCS
16	SWWA	Ryan Wysocki	Resource Conservationist NRCS
17	SWWA	A Federal Employee knowledgeable and working in agriculture in Southwest Washington	
18	SWWA	A person knowledgeable about agriculture in SWWA	

Results

Survey Data

Though survey distribution differed between SWWA and Skåne, ultimate response rates – percent of survey views resulting in a valid response – were similar, see Table 5 In both contexts, the distribution channel where farmers are contacted individually and personally informed of the survey intent through e-mail stands out as having the highest conversion from viewing the informed consent to answering some questions. Survey data below is based only on valid responses (SWWA n=52, Skåne n=27), though not all respondents answered all items. Of the respondents that started the survey but did not finish, virtually all dropped out at the start of questions about their network, and none dropped out at questions about climate change. For survey items referenced below, the exact wording can be found in Appendix 1 under the appropriate item number.

Table 5. Analytics of distributed surveys.

	SWWA	Skåne
Total Views	521	188
Started Survey	86	42
Valid Responses	52	27
Started Survey of Views	17%	22%
Valid Response of Started Survey	60%	64%

Respondent Demographics

Survey respondents represented a diverse group of farmers. The distribution of land area managed and farm income for farmers in SWWA roughly followed the expected population distribution, see Figure 6. Skånian survey respondents generally represented larger and higher income farms than in SWWA. The distribution of agricultural product diversity showed a large group with very high product diversity and an otherwise decreasing trend from low diversity for SWWA, see Figure 8. Skåne lacks the very high diversity segment while having a higher proportion in the moderate diversity regime (4 – 9 products). The relative importance or nature of the products is unknown. Skånian respondents represent 13 of the 33 municipalities and are

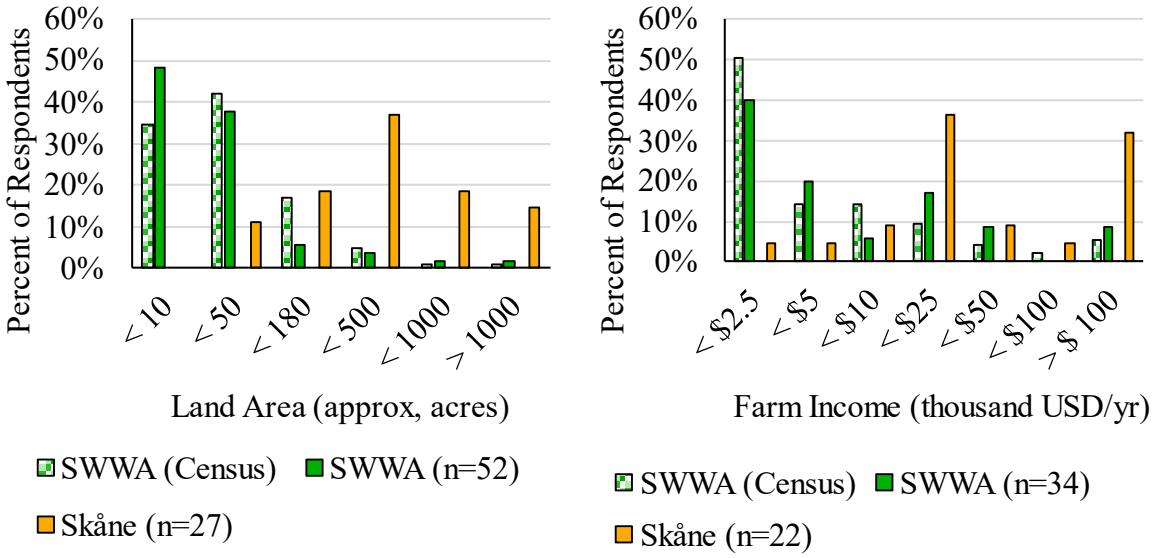

Figure 6. Land area managed (Item 10) and annual farm income (Item 12) for survey respondents and SWWA farmers. Source: (USDA NASS, 2019).

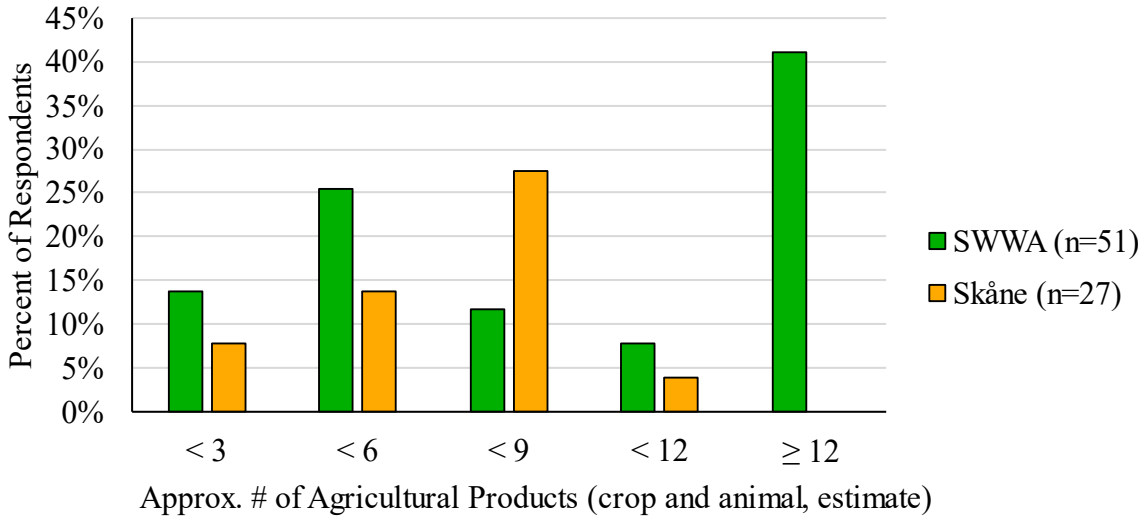

Figure 8. Agricultural product diversity (Item 9) in SWWA and Skåne.

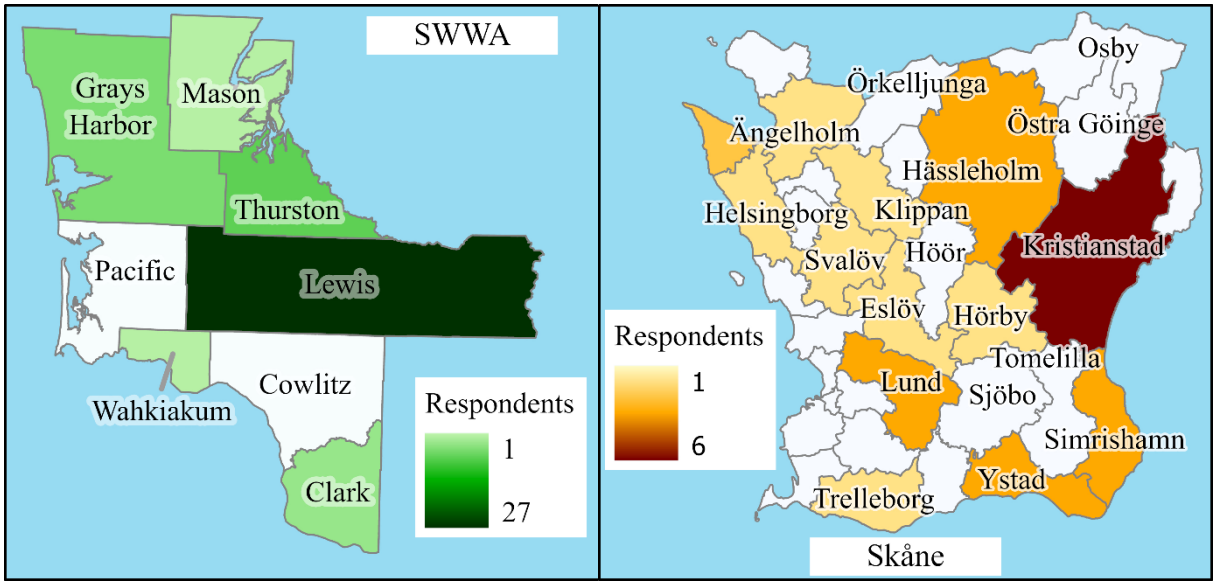

Figure 7. Geographic distribution (Item 6) of survey respondents in SWWA and Skåne.

well distributed throughout the county, see Figure 7. SWWA respondents represent 6 of the 8 counties but are mainly concentrated in Lewis County, see Figure 7.

The respondent gender ratio minorly favored female respondents in SWWA (58%) and strongly favored male respondents in Skåne (79%). Age distribution of respondents also roughly matched the expected age distribution for SWWA while respondents from Skåne are more concentrated in the 45 to 65-year range compared to SWWA, see Figure 9. Distribution of respondents' education levels was similar in both regions, especially when bachelor's and vocation/technical schooling are combined, see Figure 9. Cultural expectation and accessibility of education vary between the two regions making it hard to conclude anything about the difference in vocational/technical vs bachelor's proportions.

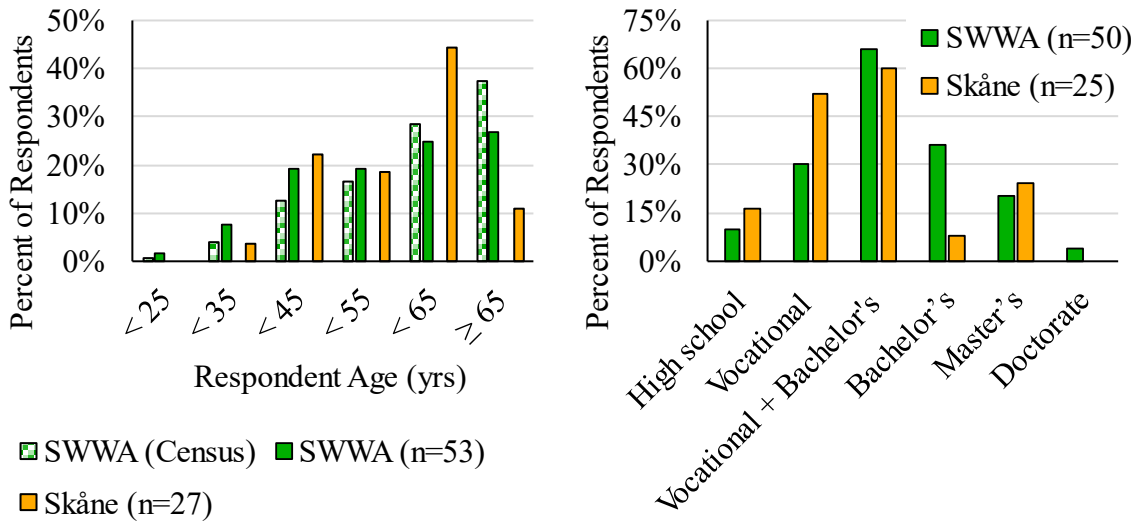

Figure 9. Distribution of age (Item 1) and educational level (Item 3) of survey respondents and SWWA farmers. Source: (USDA NASS, 2019).

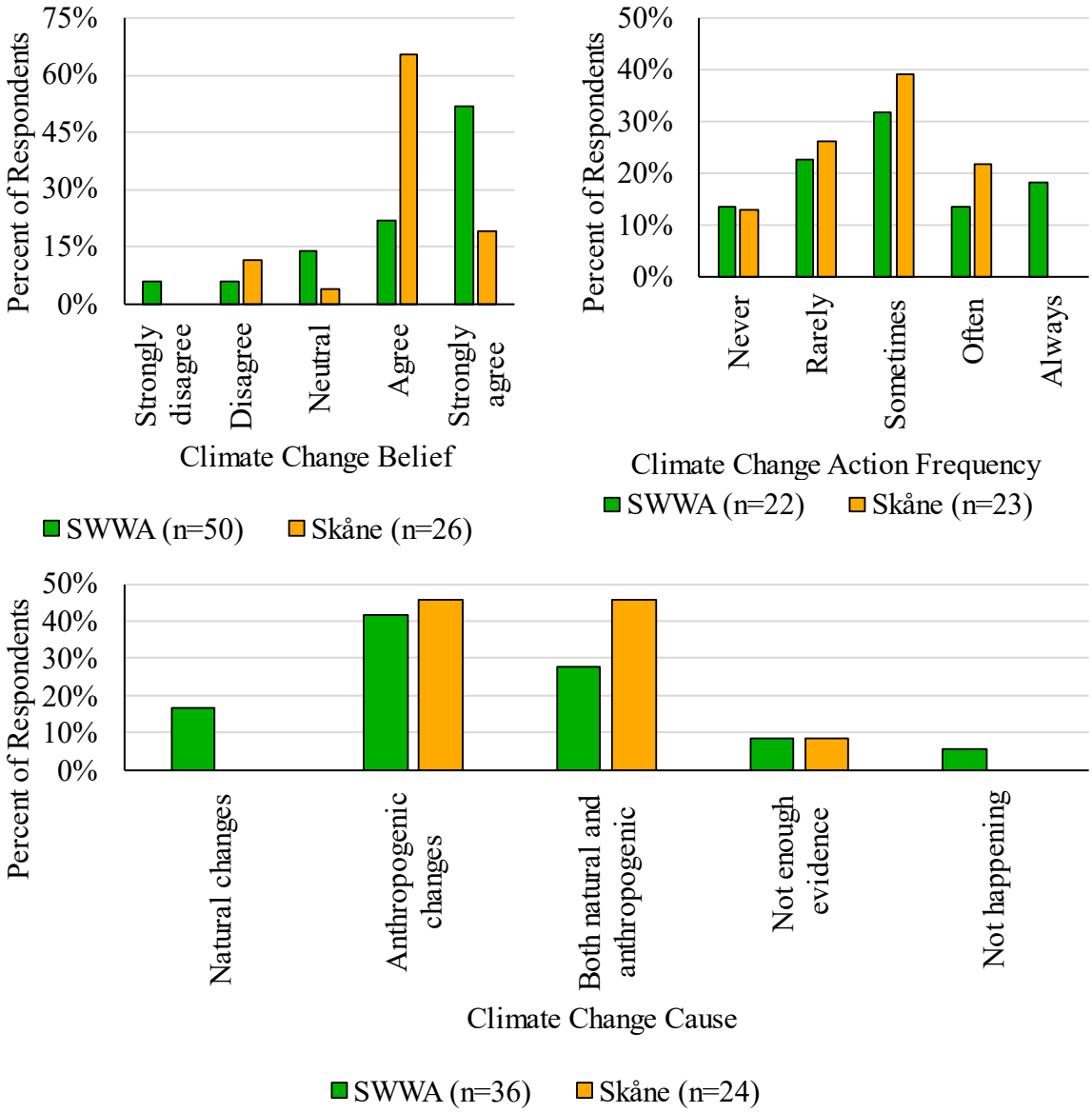

Figure 10. Climate change belief level (top left, Item 27), actions taken to adapt to or mitigate climate change (top right, Item 29), and perceived cause of climate change (bottom, Item 30) reported by survey respondents.

Three forms of information related to climate change were collected: level of belief that climate change is occurring, perception of what is driving climate change, and how frequently respondents' actions are motivated by climate change, see Figure 10. Within this data, respondents that disagree that climate change is happening would often acknowledge that it is happening in the cause item but never identified the cause as anthropogenic. Skånian respondents more often that SWWA respondents, indicated that they 'agree' rather than 'strongly agree' that climate change is happening and indicated a lower frequency of action. Skånian respondents more often attributed the driver of climate change to an anthropogenic source at least in part.

Practices and Barriers

SWWA farmers who 'agree' or 'strongly agree' that climate change is occurring more often indicated that they already engage in the selected CCA practices. On average, for each of the 15 practices, 31% of those who believe in climate change had already implemented the practice while for those who do not believe that climate change is happening the average was only 19%. Therefore, those who agree that climate change is occurring more often had their data removed from analysis. However, this is consistent with the analytical focus on factors influencing readiness to change. Complete response histograms for CCA practices and barrier perception are presented in Appendix 4: Survey Data.

The share of respondents who are 'likely' or 'very likely' to engage in each suggested practice provides an overview of which practices farmers are most likely to pursue in each region, see Figure 11. Skånian farmers are more likely to change their products (regardless of reason), increase insurance, and change pesticide use. Washingtonian farmers are more likely to change cropping practices through no-till, cover cropping, crop rotation, and altered timing and to

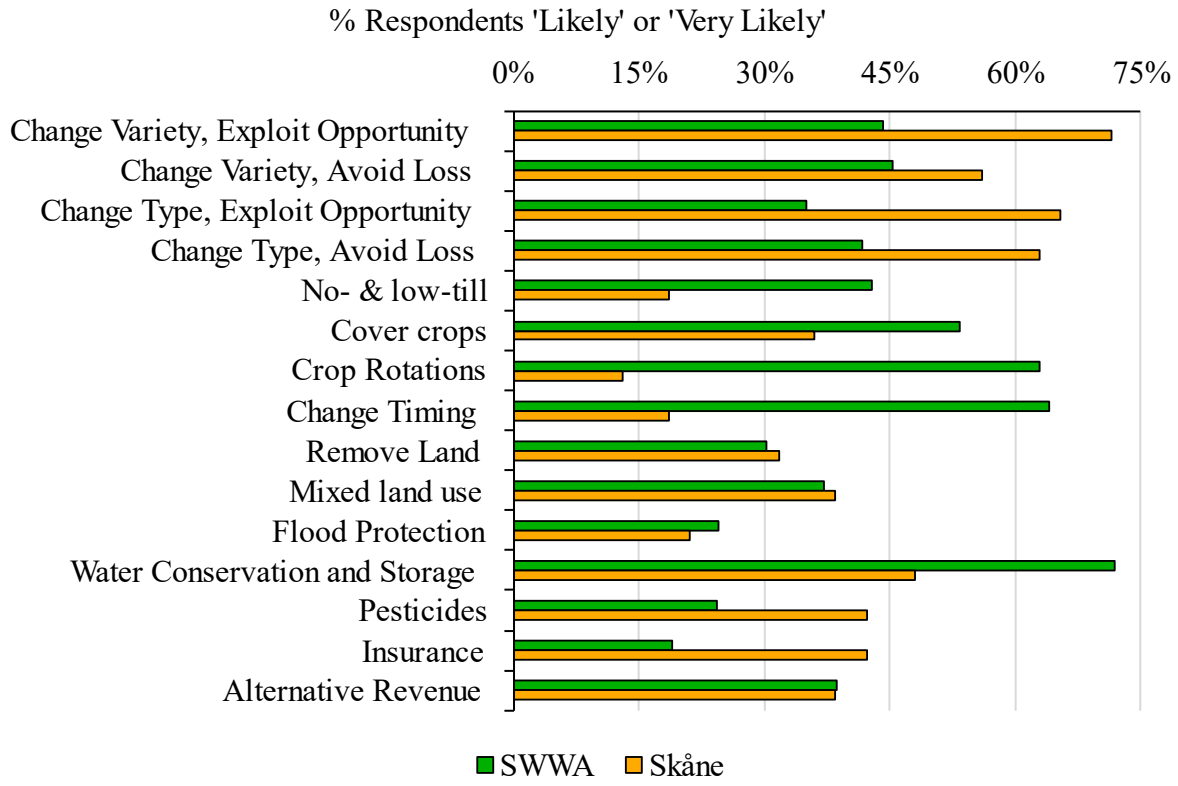

Figure 11. Respondents 'Likely' or 'Very likely' to engage in each CCA practice (Item 25) by region.

conserve or store water. Similarly, the share of respondents that view each barrier as 'significant' or 'very significant' provides an indicator of which barriers are most pressing in each region, see Figure 12. Regulatory (i.e., environmental, climate, and farming regulations) and financial barriers (i.e., cost of changing practices, lower subsidies, and financial constraints) are seen as the strongest in both regions. Skånian farmers showed higher overall perception of barriers. However, the two groups may have different cultural understanding of what constitutes a 'significant' barrier.

Responses on specific barrier and practice items were disaggregated based on respondents' demographic data. Two groups were created for each property, see Table 6. For binary variables (Items 2 and 'N/A') the two options form two groups; for ordinal variables (Items: 3, 10, and 12) the lowest two categories are compared to the others except for climate change belief (Item: 27) where 'neutral' is included with 'disagree'; continuous variables (Items: 1 and 9) were divided into two classes using Fisher-Jenks algorithm. CCA Likelihood Scores and Average Barrier Perception were determined for each group, see Figure 13. Those with higher climate change belief or lower income reported being more likely to adapt. In SWWA, those with smaller farms were more likely to adapt, while the opposite holds in Skåne. Barrier perception is generally similar between each set of groups.

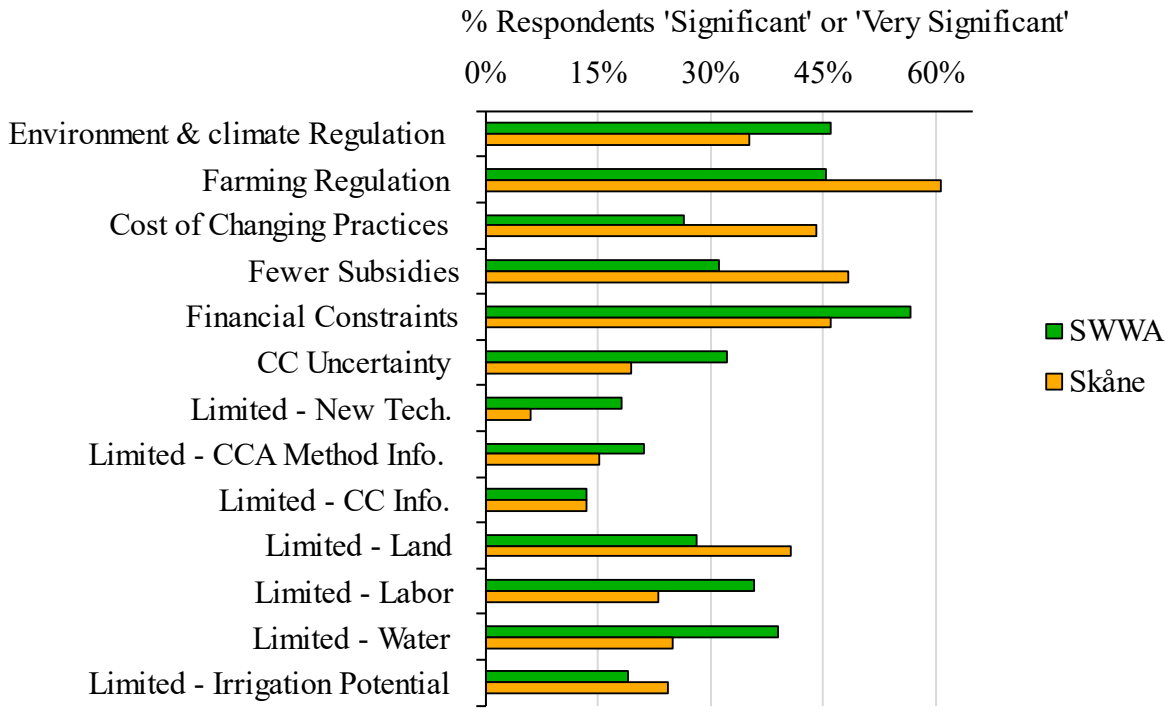

Figure 12. Respondents' perception of barriers to CCA (Item 26) by region.

Table 6. Data disaggregation groups. n=[SWWA], [Skåne].

Survey Item Number	Property	Group 1	Group 2
27	CC Belief	Strongly Disagree, Disagree, Neutral n = 13, 4	Agree, Strongly Agree n = 37, 22
N/A	CC Belief Ego vs Alter	Ego < Average of Alters n = 5, 2	Ego > Average of Alters n = 17, 13
2	Gender	Male n = 15, 19	Female n = 22, 5
3	Education	Highschool, Vocational/Technical n = 20, 17	Bachelor's, Master's, Ph.D. n = 30, 8
10	Farm Size	< 50 acres n = 45, 3	> 50 acres n = 7, 24
12	Farm Income	< $ 5,000 n = 20, 2	> $ 5,000 n = 14, 20
1	Age	< 52 years n = 23, 11	≥ 52 years n = 29, 16
9	Product Diversity	< 19 n = 37, 27	≥ 19 n = 15, 0

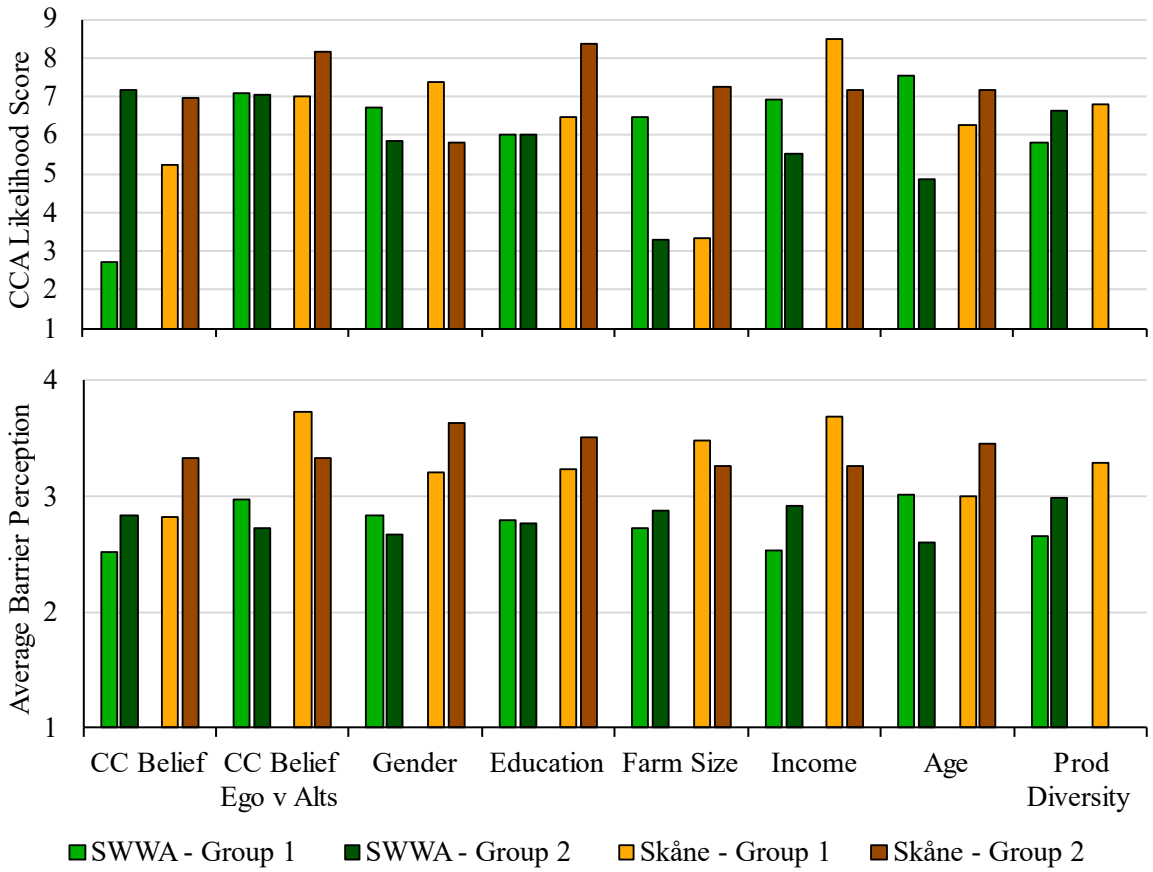

Figure 13. CCA Likelihood Score (top) and Average Practice Likelihood (bottom) for regional groups disaggregated on several demographic characteristics.

Social Network

Respondents in both regions provided information on their ESNs (SWWA: n=44, Skåne: n=22). However, some respondents provided fewer than 5 alters or did not answer all the questions about their alters. Key descriptive parameters of these networks include the betweenness centrality of the ego and clustering of the network. Networks were visualized to inspect the relationship between calculated properties and ESN appearance, see Figure 14. Findings are based on numerical analysis of these quantitative parameters; however this visualization serves to better understand the interpretation of this data.

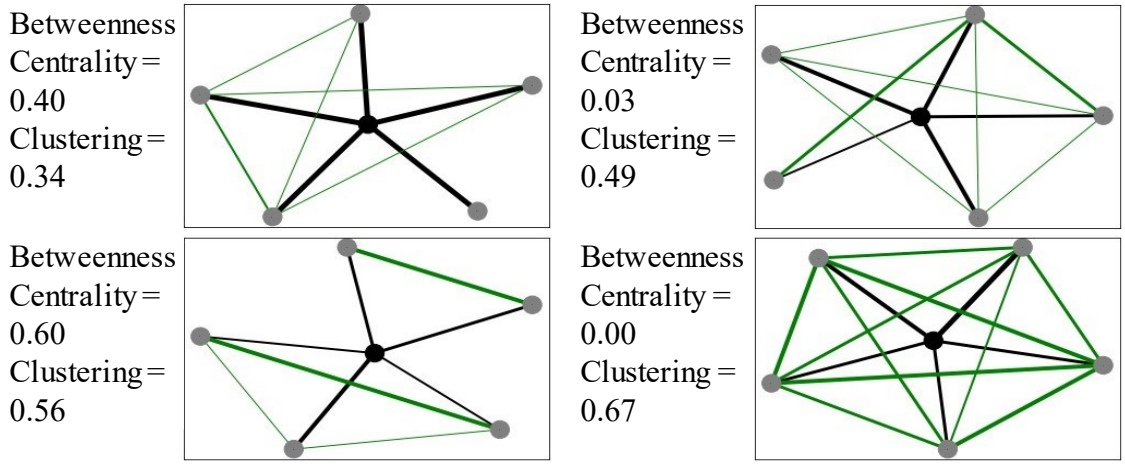

Figure 14. Four unique SWWA respondents' ESNs showing a range of clustering and betweenness centrality values. Ego in black, alters in grey, ego-alter connections in black, alter-alter connections in green, line thickness indicates the strength of each connection as reported by the alter.

ESN data also included identifiers for each alter. The survey prompt for this item indicated that respondents should provide a unique identifier they can use to track answers. However, in many cases, respondents gave descriptive alter monikers rather than anonymous names. These descriptive alter monikers were categorized and show trends in the type of resources farmers consult, see Figure 15. The resources category includes alter names such as "YouTube", "Google", and "Common Sense". The certification category includes organic, salmon-safe, and Department of Agriculture certifications. The special people category includes alters where a person's name is given but the person is known in this research as representing an organization involved the agricultural sector. In some cases, respondents named an agency or program (e.g.,

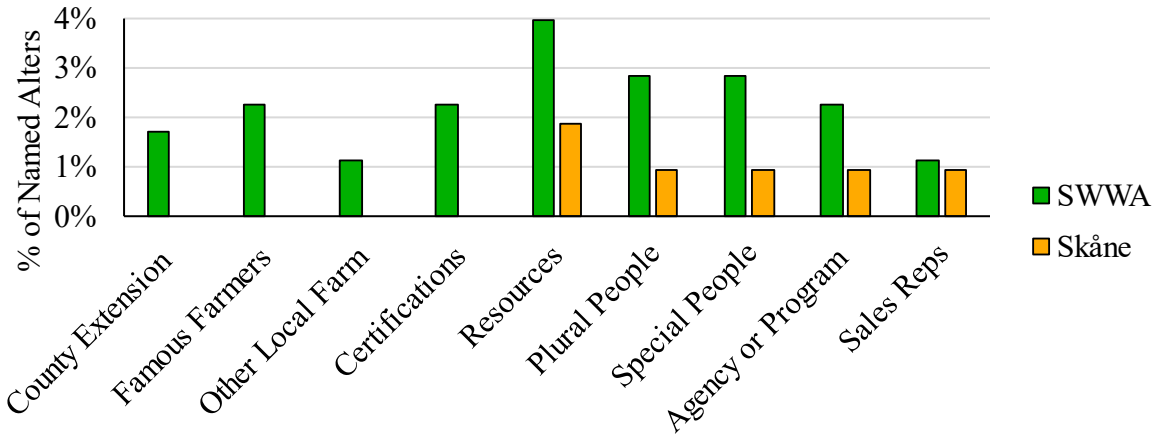

Figure 15. Distribution of descriptive alter monikers. Anonymous alter monikers are not shown but account for 80% of responses in SWWA and 94% in Skåne. Based on analysis of Item 14.

USDA-NRCS, FoSF). This may indicate that the respondent cares more about the agency affiliation of the alter than other personal attributes. Though this should be interpreted lightly as it may also be the case that the respondent simply used the agency affiliation of the alter as an identifier. As this information was not uniformly collected it could not be synthesized into a property of the network.

Analysis of calculated network properties for the two regions shows reasonably wide ranges in general, see Figure 16. Networks of SWWA farmers contained more informal networks and less clustered networks. While the distribution of Difference to Ego is similar in the two regions, Difference to Ego specific to level of climate change belief was – on average – higher in Skåne (1.00 vs 0.64).

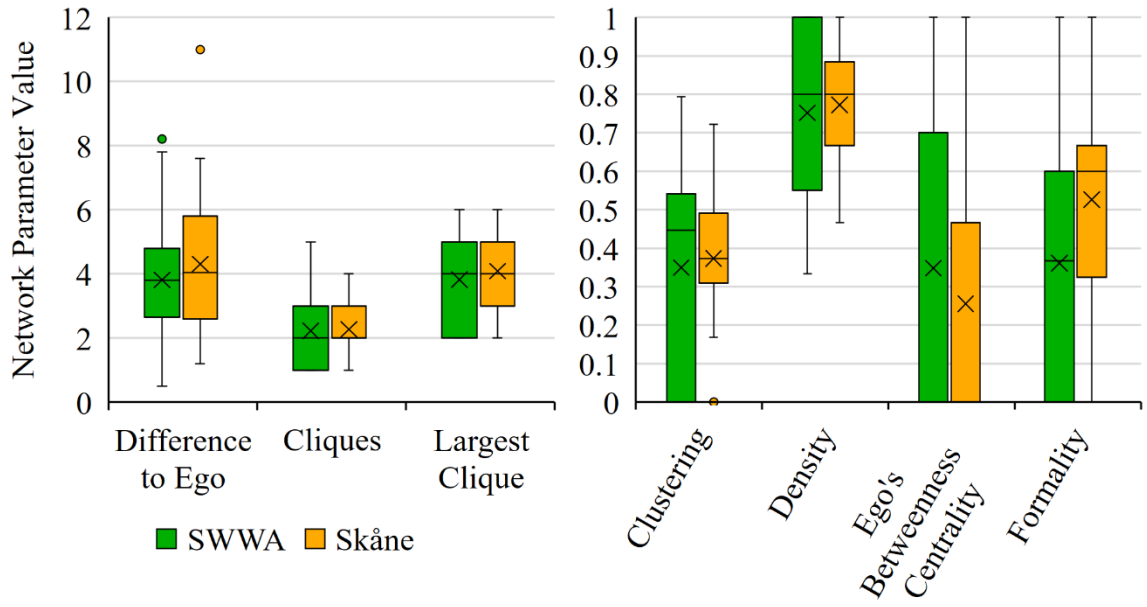

Figure 16. Distribution of ESN properties within SWWA and Skåne. (X: mean, bottom/top of line: minimum/maximum, bottom/middle/top of colored bar: 1st/2nd/3rd quartiles, dots: outlier values.

Correlations Within the Data

Most CCA practices correlated well to respondents' CCA Likelihood Score, see Figure 17. For practices that are well correlated to the CCA Likelihood Score, a farmer who engages in that practice is more likely to engage in other CCA practice. On the other hand, for practices that do not correlate with the CCA Likelihood Score (e.g., pesticide use in both regions and certain crop management or financial decisions in Skåne), respondents who engage in these practices cannot be assumed to be amenable to generalized CCA practices.

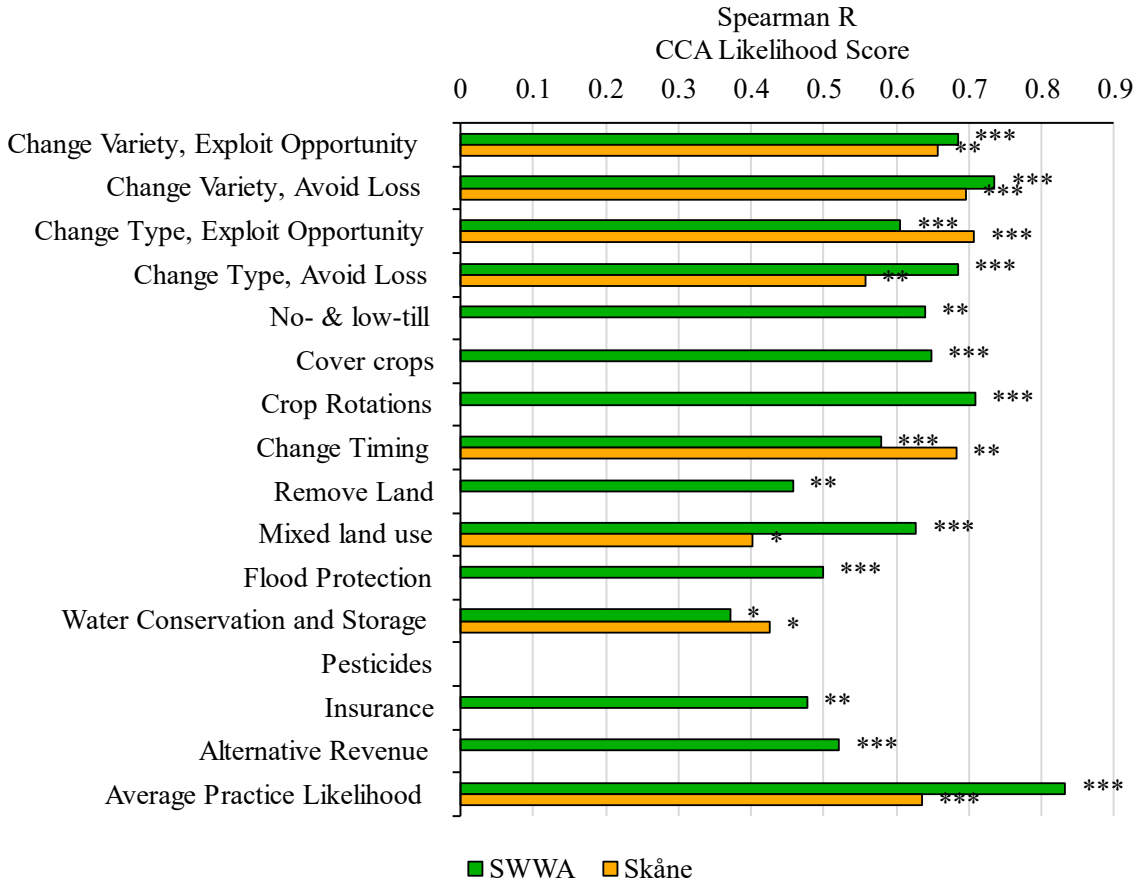

*Figure 17. Correlation strength (Spearman R) of individual CCA practices and average practice likelihood to respondents CCA Likelihood Score. Stars indicate statistical p values: * $p < 0.1$, ** $p < 0.01$, *** $p < 0.001$, $p \geq 0.1$ not shown.*

CCA Likelihood Score and Average Practice Likelihood correlate to some demographic, farm, ESN, or other properties based on Spearman correlation coefficients with $p<0.1$, see Figure 18. Few items were significantly correlated in both regions. Both the frequency with which the respondent engages in other climate change related actions and the extent to which they perceive barriers to CCA were positively correlated with Average Practice Likelihood. The average of alter's climate change belief was significantly correlated with CCA Likelihood Score in both regions. However, in SWWA having alter's with stronger CC belief leads to higher likelihood of adaptation while in Skåne the opposite is true. In SWWA, but not in Skåne, the ego's own level of climate change belief was positively correlated with both measures of CCA readiness. In SWWA, older and more experienced farmers are less likely to engage in CCA while these properties were not significantly correlated in Skåne. On the other hand, the average age of alters was negatively correlated in Skåne but not significant in SWWA. Diverse networks in Skåne (higher difference to ego) are more likely to adapt while in SWWA more insular networks (higher clustering and bigger largest clique) are more likely to adapt. Though, it may be the other way around; farmers who for other reasons are more likely to adapt create and seek insular networks.

In addition to the factors which correlated to the aggregate measures of CCA likelihood, some parameters only correlated with specific CCA practices or correlated with a specific practice far more strongly than with the aggregate, see Table 8. Climate change belief was only moderately correlated overall but was much more strongly correlated with all forms of crop/livestock changes and adoption of mixed land use practices. Network formality was not significantly correlated to the aggregate measures but did correlate with water conservation and storage in SWWA and several factors in Skåne. While network formality is generally positively correlated, in Skåne it is negatively correlated with removing land from production. In Skåne, age and years on farm did not correlate to the aggregates. However, they do both negatively correlate with likelihood of engaging in alternative revenue activities (as in SWWA) and years on farm is positively correlated with changing pesticide use and implanting no- or low-till practices. Few respondents supplied information on political party preference, in Skåne too few to be presentable. In SWWA, four respondents identified with the Democrat party and eight with the Republican party. On average, Democrats had a CCA Likelihood Score or 12 while Republicans had a CCA Likelihood Score of 3.6. Despite the small sample, the divide is very

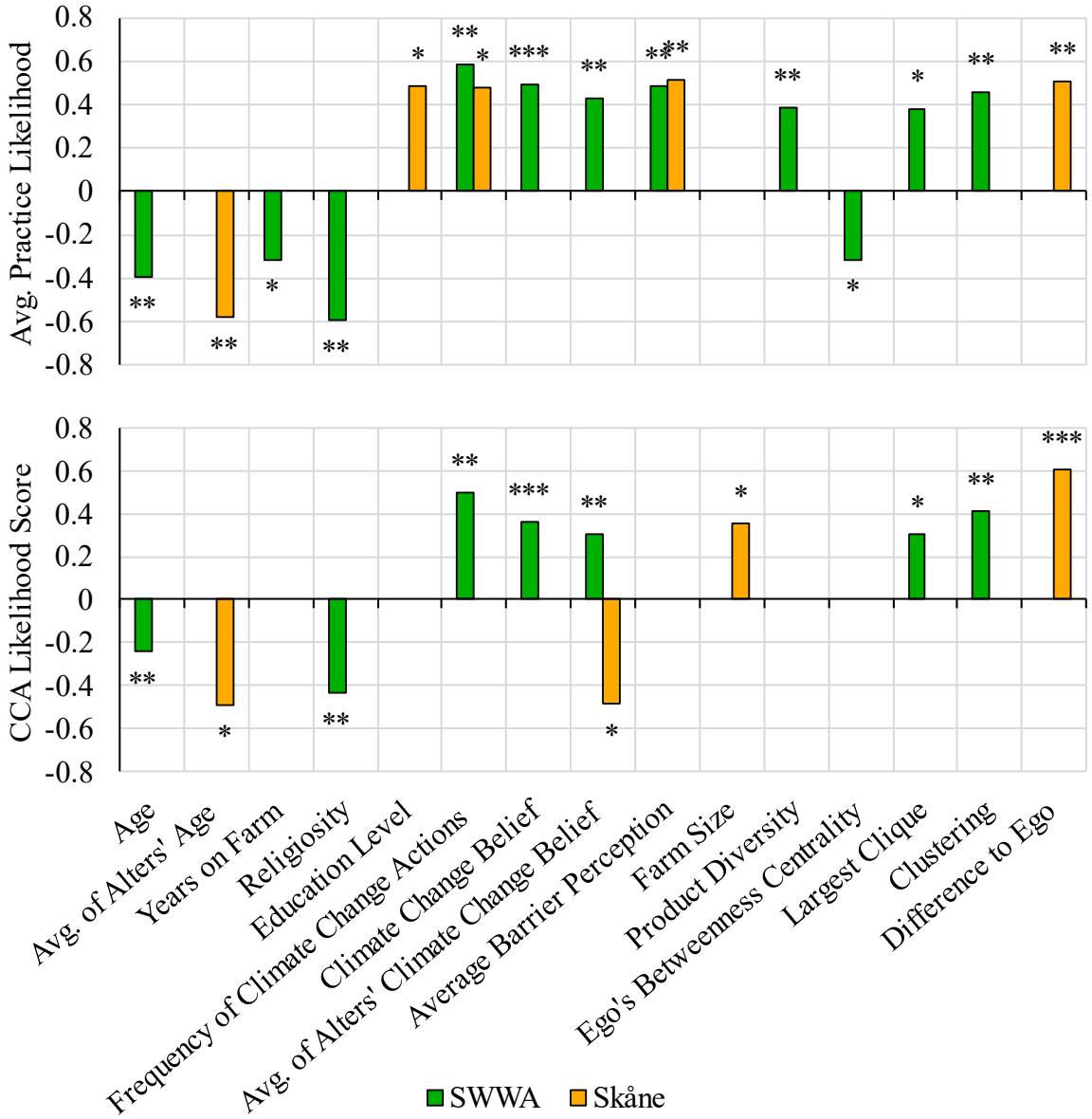

*Figure 18. Correlation strength (Spearman R) of respondent properties to Average Practice Likelihood (top) and CCA Likelihood Score (bottom). Stars indicate statistical p values: * $p < 0.1$, ** $p < 0.01$, *** $p < 0.001$, $p \geq 0.1$ not shown.*

large. The proposed practice of changing pesticide use was the only practice where Republican respondents were on average more likely; this agrees with the lack of correlation between changing pesticide use as a practice and CCA Likelihood Scores.

Clustering of ESNs correlated positively with several, primarily knowledge related, potential barriers to adaptation, particularly in SWWA, see Table 7.

Finally, respondents' perception of barriers was correlated to CCA practice likelihood. Following the interesting results presented by Woods et al. (2017), the correlation between individual and aggregate barrier perception and individual and aggregate CCA likelihoods were examined, see Table 9 (SWWA) and Table 10 (Skåne). In most cases correlations are positive indicating a high likelihood of implementing adaptive practices is linked to a higher perception of barriers. In general, more significant correlations are found in SWWA than in Skåne. This is particularly true for barriers related to subsidies, CCA method information, and climate change information.

*Table 7. Correlation between ESN clustering and potential barriers to CCA. Stars indicate statistical p values: * $p < 0.1$, ** $p < 0.01$, *** $p < 0.001$, $p \geq 0.1$ not shown.*

	SWWA	Skåne
Environment & climate Regulation		
Farming Regulation		
Cost of Changing Practices		
Fewer Subsidies	0.31*	
Financial Constraints		
CC Uncertainty	0.43*	0.41*
Limited - New Tech.	0.38*	
Limited - CCA Method Info.	0.59***	
Limited - CC Info.	0.38*	
Limited - Land	0.34*	
Limited - Labor		0.42*
Limited - Water		
Limited - Irrigation Potential		
Average Barrier Perception	0.33*	

*Table 8. Correlation strength (Spearman R) between individual CCA practices, their aggregate measures, and select properties where correlations for individual components differ from aggregate measures. Stars indicate statistical p values: * $p < 0.1$, ** $p < 0.01$, *** $p < 0.001$, $p \geq 0.1$ not shown.*

	SWWA				**Skåne**			
	Age	*Years on Farm*	*Climate Change Belief*	*Network Formality*	*Age*	*Years on Farm*	*Climate Change Belief*	*Network Formality*
Change Variety, Exploit Opportunity	-0.41**	-0.36*	0.61***					
Change Variety, Avoid Loss	-0.38*		0.61***					0.45*
Change Type, Exploit Opportunity	-0.33*		0.62***					
Change Type, Avoid Loss			0.53**					
No- & low-till						0.48*		
Cover crops	-0.35*		0.37*					
Crop Rotations								0.47*
Change Timing	-0.35*	-0.38*	0.44**					0.50*
Remove Land								-0.44*
Mixed land use			0.70***					
Flood Protection								
Water Conservation and Storage		-0.57**	0.29*	0.45*				
Pesticides						0.40*		
Insurance	-0.37*		0.53**					
Alternative Revenue	-0.32*	-0.43*	0.36*		-0.41*	-0.50*		
Average Practice Likelihood	-0.40**	-0.32*	0.49***					
CCA Likelihood Score	-0.24*		0.36*					

*Table 9. Correlation strength (Spearman R) between CCA practices and barriers in SWWA. Stars indicate statistical p values: * $p < 0.1$, ** $p < 0.01$, *** $p < 0.001$, $p \geq 0.1$ not shown.*

SWWA	Environment & climate Regulation	Farming Regulation	Cost of Changing Practices	Fewer Subsidies	Financial Constraints	CC Uncertainty	Limited - New Tech.	Limited - CCA Method Info.	Limited - CC Info.	Limited - Land	Limited - Labor	Limited - Water	Limited - Irrigation Potential	Average Barrier Perception
Change Variety, Exploit Opportunity			0.44*	0.73***	0.64***	0.55**	0.57**	0.69***	0.51**	0.42*	0.44*		0.36*	0.58***
Change Variety, Avoid Loss				0.63***	0.51**	0.41*	0.50**	0.51**	0.38*		0.40*			0.34*
Change Type, Exploit Opportunity			0.39*	0.58**	0.39*	0.40*		0.54**	0.33*					0.33*
Change Type, Avoid Loss				0.52*	0.39*	0.50*	0.45*	0.53**	0.33*		0.34*			0.39*
No- & low-till				0.75**			0.67**	0.48*	0.50*				0.55*	0.50*
Cover crops						0.49*								
Crop Rotations	-0.50*			0.43*	0.59**	0.57*	0.68**				0.44*			
Change Timing				0.59**				0.35*						
Remove Land				0.39*		0.43*	0.37*		0.48*		0.35*	-0.38*		
Mixed land use				0.46*	0.55**	0.42*	0.46*	0.47*	0.55**	0.39*	0.36*			0.49**
Flood Protection				0.39*			0.45*	0.37*						
Water Conservation and Storage				0.40*	0.33*		0.38*	0.39*				0.37*	0.50**	0.40*
Pesticides												0.45*		0.33*
Insurance			0.36*	0.46*	0.39*		0.46*	0.39*						0.37*
Alternative Revenue				0.49*	0.46*				0.66***	0.37*	0.32*		0.37*	0.39*
Average Practice Likelihood				0.62***	0.60***	0.37*	0.51**	0.55**	0.52**	0.34*	0.34*			0.48**
CCA Likelihood Score				0.40*	0.31*		0.29*	0.42*	0.39*					

*Table 10. Correlation strength (Spearman R) between CCA practices and barriers in Skåne. Stars indicate statistical p values: * $p < 0.1$, ** $p < 0.01$, *** $p < 0.001$, $p \geq 0.1$ not shown.*

Skåne	*Environment & climate Regulation*	*Farming Regulation*	*Cost of Changing Practices*	*Fewer Subsidies*	*Financial Constraints*	*CC Uncertainty*	*Limited - New Tech.*	*Limited - CCA Method Info.*	*Limited - CC Info.*	*Limited - Land*	*Limited - Labor*	*Limited - Water*	*Limited - Irrigation Potential*	*Average Barrier Perception*
Change Variety, Exploit Opportunity								-0.47*						
Change Variety, Avoid Loss														
Change Type, Exploit Opportunity												0.52*		
Change Type, Avoid Loss												0.42*		
No- & low-till	-0.75**						0.47*			-0.70**				
Cover crops									0.52*					
Crop Rotations						0.40*	0.46*							
Change Timing			0.55*		0.51*		0.52*				0.51*			0.56*
Remove Land												0.45*		
Mixed land use			0.46*				0.58*		0.49*					0.48*
Flood Protection			0.46*						0.42*		0.45*	0.42*		0.48*
Water Conservation and Storage						-0.69***				-0.47*	-0.42*	0.48*		
Pesticides														
Insurance			0.56*		0.44*								0.41*	0.42*
Alternative Revenue													-0.75***	
Average Practice Likelihood			0.38*				0.39*		0.51*			0.60**		0.51**
CCA Likelihood Score		0.36*										0.40*		

Interview Data

Interviews were conducted with 15 key informants in SWWA and three in Skåne. In SWWA, interviewees represented Extension, CDs, the United States Department of Agriculture – Natural Resources Conservation Service (USDA-NRCS), and farmers; in Skåne, interviewees represented a private agriculture advisory service, the government-backed agriculture advisory service – FoN, and an agricultural researcher, see Table 4. Interviewees described several concrete examples of adaptive actions farmers have already taken. This includes working with CDs in SWWA to create safe spaces for livestock during floods (Spurr, 2012). In Skåne, cultivation of corn is increasing, and farmers remain focused on keeping land drained and maintaining drainage ditches while also building irrigation ponds to store water. Farmers in both regions are taking advantage of the longer growing and grazing seasons.

Access to Information

Farmers' readiness to engage in CCA is strongly influenced by what information they access. Information is accessed by farmers with or without the involvement of formal organizations. Interviewees described a variety of organizations that interact with farmers. The networks of such organizations were synthesized from interviewees' responses and therefore may not be complete but represent the key organizations in each region, see Figure 19. Some organizations provide more information to farmers than others. This relative importance was based on interviewees descriptions of where farmers get information and what organizations they see as important. Primarily this is drawn from Interview Topic 9, see Appendix 3. In both regions, organizational actors consist of academic institutions, trade groups, and governmental agencies at multiple levels. In SWWA, Extension provides the main link between research and farmers' practice. Research and communication priorities are set both by what farmers are asking for and what researchers see as needs. Extension is primarily an educational organization with a goal of providing research-backed information to farmers. Extension agents will work with any farmer, however, in practice, the emphasis is on small and beginning commercial farmers. The two farmers interviewed here expressed frustration in getting their needs met when working with Extension including when seeking information on CCA practices. Researchers in Skåne work to provide information to farmers, however there is no specific clearinghouse like Extension. USDA-NRCS and CDs are oriented around preserving and enhancing the utility of natural resources (soil, water, air, plants, and animals). FoN is focused on the environmental impact of farms. All these organizations work with a wide range of farmers.

Organizational interviewees mentioned plans or desires to integrate climate change aware practices into all their activities. However, currently, most climate change information is provided at broad geographic levels and implications for individual farmers are not obvious. One interviewee suggested providing relevant climate information to farmers through multi-stakeholder workshops which could serve as entry points to CCA specific support for farmers.

Organizations' interactions with farmers are either voluntary or compulsory. In SWWA, various state agencies, the national agricultural agency, and local governments set and enforce regulations that apply to farmers. Undoubtedly, similar interactions exist in Skåne; however, interviewees did not include them when describing organizations with which farmers interact. Several interviewees in SWWA stressed the importance of their organization's voluntary nature as a factor in encouraging farmers to implement conservation measures. One organizational interviewee described CDs as "a safe place that [farmers] can call for recommendations without

getting in trouble." Farmers are generally happy to work with organizations where the interactions are voluntary. Though this does not mean farmers are happy to engage on every topic; it is difficult to initiate discussion on climate change related topics. Interviewees all used voluntary interactions to build trusting relationships and eventually present fact-based information on climate change relevant to ongoing conversations with each farmer. Organizations that work with farmers on a voluntary basis were described as not being bound to strict standards and therefore able to compromise. For example, CDs, USDA-NRCS, and Washingto State Department of Ecology all support farmers in creating riparian buffers. Of these CDs are most able to support or create a small buffer that a farmer will accept and is still better than no buffer because they are not held as strictly to design standards. Interviewees also felt that the presence of a regulatory backstop encouraged farmers to participate voluntarily. Long-term relationships between farmers and organizations were seen as more effective at increasing readiness to adapt to climate change than short-term relationships.

Besides interacting with formal organizations, interviews discussed several other ways in which farmers access information that shapes their readiness for CCA. Most significantly, farmers talk to each other. Interviewees confirmed the survey data result that farmers discuss farm management decisions with friends, family, neighbors and within industrial circles (local Farm Bureau chapters or product specific groups). Farmers are also learning from online sources including trade groups, social media, and influential farmers and researchers. Such online sources are often based outside of the farmer's own region but in areas that are seen as similar; for example, resources based in Australia, Midwest USA, Southeast Canada, England, Germany, were mentioned being used by farmers in Skåne. Some organizations facilitate peer learning by organizing demonstration days where farmers can see new practices at work. One Extension agent put it well by saying, "farmers learn best when they see it, so it's all about providing really good examples and tapping into the things that are important to them" including profitability but also an emotional connection to their land. In some cases, farmers generate new information themselves through experimentation. Only two interviewees brought up trial and error, indicating it may be somewhat rare as an intentional route to learning. However, Extension interviewees see room to partner with farmers to facilitate such efforts. One producer interviewed made a significant observation about access to information, saying "the biggest handicap is you don't know what you don't know".

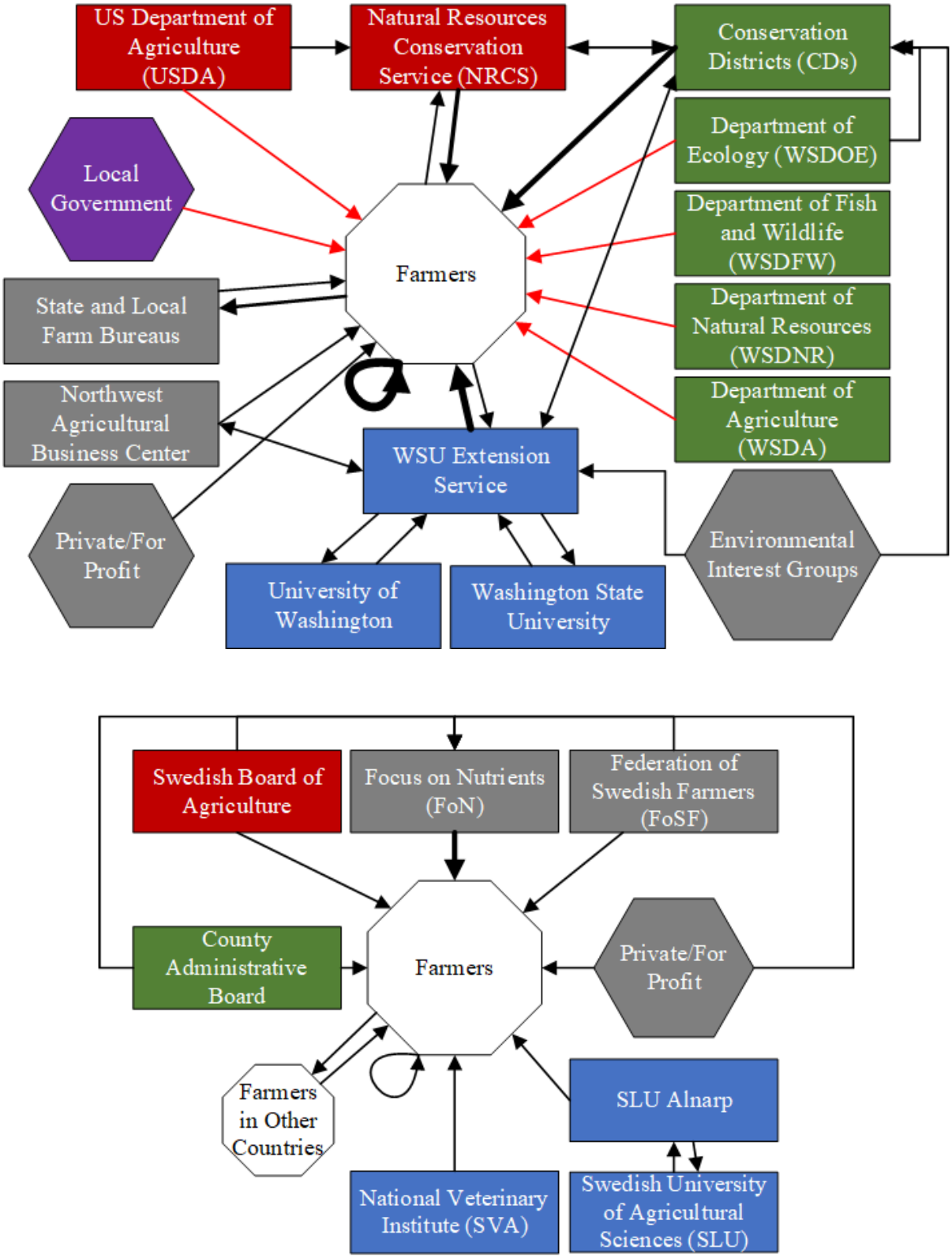

Figure 19. Network of organizations interacting with farmers in SWWA (top) and Skåne (bottom) based only on interviewee responses. Systems may be incomplete but represent a synthesis of interviewees descriptions of important organizations. Hexagons: multiple organizations, rectangles: specific organization. Red: National government, green: state government, purple: local government, blue: academia, grey: other (including trade groups and private companies). Qualitative relative importance of organizations is shown by line thickness. Regulatory organizations are shown with red lines.

Access to Money

Perhaps the clearest message from interviewees was the idea that farmers will not or cannot adapt if the adaptive action does not make financial sense. The decision of whether investment in adaption makes sense is highly personal. Interviewees in both regions felt that farmers do not yet see impacts of climate change as a near-term issue and are therefore unlikely to invest in CCA. One interviewee in SWWA emphasized the importance of farmers' planning horizon in this decision making. They noted that foresters incorporate climate change more than annual crop farmers and attribute this to the multi-decade planting cycles of forestry operations.

In general, interviewees saw connecting farm profitability and CCA as very difficult. Particularly when it comes to climate related farming practices, interviewees point out that farms do not exist in isolation. For example, one suggested CCA practice is transitioning to growing short rotation woody biomass as an energy crop. One interviewee points out that this was once considered likely to be profitable, however, after the falling natural gas prices around 2014 highlighted the fragility of this market, producers have become wary. In both regions, farming was described as a very low profit margin activity leaving farmers little extra to invest. Interviewees in SWWA felt that farmers who work off the farm (maintaining full or part time work as their primary or supplemental income) are more able and, therefore, willing to make investments in conservation and CCA practices.

Like access to information, farmers' access to money is also linked to interactions with formal organizations. USDA-NRCS and CDs offer cost-share programs for conservation and climate-oriented activities, USDA and WSDA offer grant and loan programs some of which are specific to climate related issues. FoN and the Swedish Board of Agriculture provide free or subsidized farm advisory services, and the county administrative board provides direct financial support. In most cases, farmers start by asking for information and later transition to working with a formal organization to get funding. While this financial support is available, the thin margins and high costs of typical projects often mean that farmers do not undertake such projects. One interviewee described a situation where a conservation project would cost $10,000 with only $1,000 paid by the landowner, even with the subsidy the landowner did not see the investment as worthwhile.

Access to Markets

Farmers' ability to get products to market determines their access to money and it certainly determines their ability to successfully transition to a new type of crop as may be necessary under climate change. In Skåne, one interviewee indicated that much of Swedish agricultural inputs are not stored in any significant quantity either on farms or domestically, leading to susceptibility of agricultural supply and distribution chains to acute shocks. Interviewees in both regions indicated that too few slaughterhouses are available and those that do exist are not well distributed. In effect, this limits farmers income and therefore ability to invest in CCA as they cannot maximize profit from livestock.

Besides these infrastructure challenges, demand needs to exist for farmers' products. SWWA farmers currently are missing large scale contracts; a major frozen foods producer canceled contracts, a grocery store chain that emphasized local produce was bought and changed purchasing priorities, and local institutions (correctional facilities, military bases, schools, etc.) do not purchase from local farms. On the other hand, individual consumers in SWWA provide a strong market for diversified vegetable and meat producers through farmers markets and

consumer-supported agriculture (an alternative model of food distribution where consumers pay ahead of time for a set share of the harvest received throughout the season).

In SWWA, NABC and Extension (see Figure 19) support farmers by ensuring that markets exist for farm products and that farmers can deliver goods to those markets. For example, NABC led a multistakeholder initiative to improve rail infrastructure after being approached by farmers who saw an opportunity to produce and sell malting barley but needed additional infrastructure for this potentially adaptive action to make financial sense.

Advice Seeking

Interviewees described patterns in which farmers seek advice concerning climate and environmental topics. The most raised distinction was between new and established farmers. In SWWA, new farmers are most likely to reach out to support organizations. Interviewees said that older, more established farmers feel more confident and have figured out what works for them. Interviewees throughout SWWA, but especially in more urban counties, described a specific sub-group composed of young, former urbanites, operating diversified farms, and selling direct-to-consumer who are highly pro-environmental. Within this group, one interviewee noted that “there's a lot of enthusiasm around coming at it from a new way, in a more sustainable way”. In Skåne, new and beginning farmers are less likely than their established counterparts to seek advice (e.g., from FoN). One interviewee attributed this to the high rates of university education among new farmers in Sweden leading to their feeling that they already know the right way.

In both regions, interviewees work with the full range of farm sizes and incomes. Gender was never mentioned as determinant of advice seeking behavior. In SWWA, livestock farmers were somewhat less likely to seek advice, however interviewees also pointed out that most livestock farmers are older and well established.

Policy and Regulation

Interviewees in both regions identified regulation as a substantial burden and a key barrier to farmers’ action on CCA and conservation. The black-or-white nature of regulations applying to SWWA farmers impairs their ability to adapt. Strict all-or-nothing standards for some subsidized practices limit farmers’ ability to tailor interventions to their site and land’s needs. Both a producer and an Extension agent described tax and regulatory frameworks that are tailored to conventional row-cropping and ill-suited for mixed land used practices such as silvopasture or agroforestry. SWWA interviewees also consistently brought up the complicated water rights system. As drier summers are becoming the norm and more people are looking to irrigation, increasing effort is being placed on tracking water rights. This system is sufficiently complex that it is beyond the scope of this research

In SWWA, the environmental conservation movement is focused on protecting habitat for spawning salmon. This societal goal creates funding opportunities which conservation organizations use to support farmers. However, it also creates an unequal distribution of these opportunities where farmers closer to sensitive habitat (Puget Sound area) have more access to funding.

Interviewees in Skåne mentioned two regulatory challenges related to CCA. First, the generally slow speed with which some on-farm improvement projects receive approval. Second, the general trend toward chemical regulation in Sweden and the European Union specifically

concerning glyphosate containing herbicides (e.g., Roundup). One interviewee was very clear in saying that if these herbicides are prohibited, farmers will immediately return to mechanical tillage.

Climate Change Acceptance and Polarization

Throughout this thesis, there is discussion of farmers' level of belief that climate change is occurring. This was framed by interviewees as the extent to which farmers accept or understand that climate change is likely to continue and how much they think it will impact their farm. In SWWA, this level of acceptance strongly controls how organizational interviewees felt they could engage with farmers on climate change topics as these issues are seen as political and are highly polarized. Many interviewees described a personal process of determining how to frame climate related issues when working with farmers using indicators such as age, type of crops produced, and political signs to determine whether climate change can be openly discussed. For employees in positions of public trust (e.g., Extension, USDA-NRCS, CDs), some interviewees viewed openly discussing climate change as a breach of political neutrality. Many interviewees described a strategy best described as 'meeting folks where they are'. This means focusing the conversation on climate issues relevant to the farmer (i.e., if they are asking about drought tolerance, not talking about flood resilience) and avoiding triggering language (i.e., say 'climate change' rather than 'global warming'). Several interviewees also mentioned sticking with logical fact-based arguments. One commonly referenced tactic was simply waiting. For some, this meant waiting for older farmers to retire and working with the new landowners on climate and conservation projects. For others, it meant waiting to develop a connection and trust with individual farmers so that climate change related messages will at least be heard.

In Skåne, interviewees felt more comfortable directly addressing climate change and did not see the topic as inherently political or polarized. Some effort was still put into cautiously framing climate change and focusing the conversation on impacts likely to affect the farmer's land. Overall, the topic seemed far more approachable between Skånian organizations and farmers than in SWWA.

Discussion

Survey and interview data revealed several categories of factors which influence farmers' readiness to engage in CCA activities. Farmers' readiness to engage in CCA was quantified using the CCA Likelihood Score – which estimates the farmer's expected extent of adaptation – and Average Practice Likelihood – which estimates the likelihood of engaging in any type of adaptive practice. Interview data described readiness as a more general concept. The results given above represent a portion of the total data collected and emphasis is given to the discussion of findings that are strong, important, interesting, or rationally explainable.

Farmers' Traits

A variety of factors related to farmers were shown to be correlated to CCA Likelihood Score or Average Practice Likelihood. Only a few characteristics were correlated in the same direction in both regions. These were how frequently the respondent's actions in general were based on concern for climate change or the environment, the perceived strength of all barriers, and specific barriers related to the availability of new technology and information about climate change. The number of products produced on the respondent's farm also correlated to the Average Practice Likelihood in SWWA. This trend matches analysts' conception that local agricultural diversity enhances adaptability (Dalton et al., 2013) and extends this to an individual farm scale. Farmers who believe in climate change were more like to have already implemented some CCA practices, however even farmers who do not believe in climate change also have already implemented some of these practices. This may result from either of two reasons. First, farmers do not need to believe in climate change to feel and respond to its impacts without acknowledging them as such. Second, many of these suggested practices can make sense for a other reason. For example, economic risk mitigation through insurance or alternate revenue and improved soil health through cover crops or mixed land use practices. In SWWA, farmer's level of belief in climate change positively correlates to Average Practice Likelihood and CCA Likelihood Score; this is not true in Skåne. This may indicate that Skånian farmers are not yet as aware of regional impacts and thus are less likely to adapt despite their similarly high level of belief in climate change. This could not be tested as no data was collected on whether farmers have noticed regional climate change impacts.

Interviews in SWWA showed that people working with farmers often use indicators such as age, political signs, and farm experience to guess how farmers will respond to climate change related discussions. Survey data for SWWA matches the interviewee's views regarding farmer's age and years on farm as this is negatively correlated with whether the farmer will adapt (Average Practice Likelihood). While this correlation is strong, similar studies in literature have mixed results. Danish farmers showed a weak negative correlation between years on farm and expanding cropping areas (Woods et al., 2017), though this may be a reluctance of older people to increase their workload. For Ethiopian smallholder farmers, age and farming experience were rarely significant factors and were either positive or negative depending on the adaptive action (Belay et al., 2017). By contrast, the SWWA data was consistent: when significant, the correlation between individual practices and age/years on farm was negative. Interviewees also see age as such a strong factor against farmer's CCA adoption, noting that it is easier to wait for the farmer to retire before pushing for adaptive action on the land. This correlation is not seen in Skåne, possibly due to the greater extent of involvement of older farmers in the pro-environmental advisory service, FoN.

Political party affiliation was alluded to by interviewees and survey data matches expectations: respondents that identify with the Republican party have far lower CCA Likelihood Scores than those that identify with the Democrat party. Other research similarly found that New York City residents that identify with the Democrat party are more likely to invest in flood protection measures (Botzen et al., 2016). In addition, a study of ranchers and farmers in Nevada found that people identifying as Republican saw climate change as a low priority and not harmful (Liu et al., 2014). Political party affiliation also links with belief in climate change and data here are insufficient to decouple the two. Political party preference survey data were not conclusive for Skåne, though it is notable that no interviewee even alluded to party politics as a factor in their conversations concerning CCA.

Religiosity is also negatively correlated to both Average Practice Likelihood and CCA Likelihood Score in SWWA, though this was not explicitly discussed by interviewees. Wardekker et al (2009) noted that while pro-environmental and Christian sentiment are often negatively linked, this is likely because religiosity is positively linked to political and moral conservatism which is negatively linked to pro-environmental sentiment rather than a direct link between religiosity and environmentalism. Consequently, while religiosity may be an indicator of CCA readiness it should not be considered a causal factor.

Formal education may play a role in CCA likelihood. Despite interviewee's concerns in Skåne about the limited involvement of highly educated farmers, survey data shows a positive correlation between education and Average Practice Likelihood. Though this finding was not confirmed in SWWA survey data, the interviewee's opinions would agree with the positive correlation.

The planning horizon used by farmers influences their readiness to implement CCA practices. Interview data suggested that foresters, who have long planning cycles, are more often concerned with CCA than crop farmers who can plan on cycles as short as one year. On one hand, this may make it hard for a farmer to notice when the time is right to implement an adaptive action. On the other hand, the short planning cycles give farmers many chances to adapt. Just because they are unlikely to do something this year, by next year they may be completely ready.

Skånian survey data showed a positive correlation between farm size and CCA Likelihood Score (extent of likely adaptation). Skånian respondents also generally view a lack of land as a barrier to adaptation. Together this may mean that farmers with more land feel this barrier less and are therefore more likely to engage in CCA practices. This is further supported by the fact that the Average Practice Likelihood (which does not account for multiple practices as well) does not significantly correlate to farm size in Skåne. Based on interview data, the opposite correlation would be expected in SWWA where smaller farms are seen as more nimble and likely to test new practices. No such correlation was found in the survey data for SWWA.

Peers

Farmers are strongly influenced by their peers and share considerable knowledge and ideas through informal networks. Some interviewees indicated this is the main way farmers learn. Clearly peer networks and peer learning are a – if not the – critical factor in farmers' readiness for CCA. Previous work confirms this finding and suggests two reasons: farmers either learn from their peers or conform to them (Zhang et al., 2020). Research on the role of social networks

on private forest-land owners' decisions to sell timber showed that small (about seven people) social networks are involved and are composed of a mix of people related formally and informally to the ego (Kittredge et al., 2013). While the number of people in the ESNs studies here was fixed at five, survey data and interviews align with the idea that decision making networks around CCA practices similarly consist of peers, community members, and professional advisors.

Farmers in SWWA appear to be in echo chambers, based on their higher degree of clustering and larger clique size compared to peers in Skåne. Possibly because of these echo chambers, SWWA shows a positive correlation between the average of alter's climate change belief and the ego's climate change belief while Skåne showed no such correlation. However, ESNs in Skåne showed marginally more diversity in climate change belief scores and this diversity was positively correlated to CCA likelihood which was not seen in SWWA. An analysis of climate related posts on Twitter showed that most users belong to echo chambers of either climate sceptics or climate activists with relatively few users in mixed-attitude communities (Williams et al., 2015). Such mixed-attitude settings provide opportunities for exchange of divergent views and new knowledge, a prerequisite for action (Williams et al., 2015). Based on this element of the data, Skånian farmers may be more ready to change as ideas may spread faster.

In both regions, the average of alter's CC belief is correlated to the ego's CCA likelihood. However, in SWWA the correlation is positive while in Skåne the correlation is negative. SWWA's positive correlation may reflect conformity and the role of peer pressure, or it may result from the existence of echo chambers. Skåne's negative correlation is harder to explain. Perhaps Skånian farmers are learning from peers who have already implemented adaptive practices and found them unnecessary. Information on alters' CCA practices would be needed to test this hypothesis. Alternatively, this result may be because Swedes typically have higher trust in their government than do Americans (Ortiz-Ospina & Roser, 2016) and consequently expect public support in CCA. Thus, higher alter belief in climate change may emphasize the notion that the state should support any CCA that is necessary.

In SWWA, betweenness centrality of the ego and clustering were both correlated to Average Practice Likelihood. Zhang et al. (2020) previously studied these factors in the dissemination of conservation agriculture practices in rural Cambodia using a broad social network approach. In that context, betweenness centrality, but not clustering, was positively correlated with adoption of conservation practices (Zhang et al., 2020). Zhang et al.'s (2020) construction of a whole social network makes the comparison slightly unfair. However, it is notable that in both cases betweenness centrality is a significant factor, though the direction of correlation is different.

Network clustering is also positively correlated with perception of knowledge related barriers to CCA, four barriers in SWWA and one in Skåne. This may indicate that highly clustered networks have trouble accessing and integrating new information which in turn is a factor in CCA likelihood.

Access to Information and Financial Support

A network of organizations was described by interviewees as being influential in farmer's decision making generally and particularly around CCA practices, see Figure 19. Non-anonymous alters provided in the survey responses, see Figure 15, agree with this network.

These organizations have the capacity to play a central role in providing information, financial and material support to farmers. With 45% of SWWA farmers and 36% of Skåne farmers viewing a lack of information on CCA methods as a moderate or stronger barrier to their adoption, clearly there is room for organizational support in disseminating this information. Regarding SWWA, Extension has been specifically identified as an organization that should be working with farmers "to assess available information and make value assessments that are needed to determine the best responses to climate change", though other organizations are included (Dalton et al., 2013, p. 169). SWWA survey respondents seem to agree; in cases where alter monikers were linked to specific organizations, Extension related names were far more frequent than any other type of organization. However, based on interview findings, no specific organization is explicitly filling this role on CCA. Rather, organizations take an issue centered approach and work CCA into measures addressing other issues. In SWWA, interview data suggest that this issues-centered approach helps to maintain engagement with farmers while addressing climate change head on may be off-putting. In Skåne, the reason for the issue-centered approach is less clear. The historic, and to a lesser extent, current focus on eutrophication and climate change mitigation may play a role. In both regions, CCA related information provided to farmers is generally specific to which impact is being addressed, and different organizations address different issues. This fractured system may make it difficult for farmers to adapt holistically.

The extent to which farmers are connected to recent research is also a factor in their change readiness. In SWWA, the role of explicitly conveying research results from university academics to farmers is held by Extension. In theory, this can provide a clear path for farmers to access this information. In addition to conveying research findings to farmers, Extension is also able to facilitate research based on farmers' ideas or questions. As one Extension agent said, "there's a lot of people driving around on tractors coming up with ideas, […] you just need the resources and time and partner […] for somebody to be experimenting on their behalf". This could create the opportunity for farmers to have research backed answers to modern problems. In practice, Extension itself may be too complex and difficult to navigate. Both farmers interviewed in SWWA felt that their needs were not met by Extension or that they were connected to the wrong resources within Extension. While this is little more than anecdotal, it may be that additional effort is needed to clarify who farmers should contact on climate change related topics. In Skåne, the role of communicating research findings is fractured across several organizations including academics at various institutions and FoN. While several efforts are made to collect and communicate research results, Skåne may learn from SWWA and benefit from a clear assignment of this role.

There are multiple financial incentive programs and supports available to farmers in each region. These programs are oriented to support conservation programs, reduce eutrophication, and enable healthy habitat for important species. These topics can incorporate CCA, however no holistic CCA financial support was identified.

The key factor determining whether the informational and financial support offered by these organizations makes a difference in a farmer's readiness to change is whether the farmer is connected to them. While many farmers are connected to at least one of these organizations, some are not connected or do not connect around CCA topics. Interviewees in SWWA reported difficulty and hesitance in talking explicitly about climate change with certain groups of

farmers. Organizations in Skåne also struggle to reach all farmers, though in this case it is younger more educated farmers that are less connected to advisory organizations. In both cases, these groups are less connected to advisory organizations and may not have the information they need to adapt adequately and holistically. Outreach activities and training for outreach staff on how to comfortably talk about climate change would help to ensure that all farmers are aware of adaptation measures and their benefits. It should be recognized though that the organizations interviewed here described constrained organizational budgets and time. In Skåne, there is a positive correlation between farm income and network formality. This may indicate that wealthier farms are more able to access information from advisory services. This also reflects a fundamental difference between the regions: most advisory services are free to farmers in SWWA and there are few options for paid farm advisors while in Skåne free advisory services exist for specific topics, subsidized through FoN or various governmental agencies, but there are many options for paid farm advisory services.

Barriers

Survey respondents were directly asked how strongly they perceive certain potential barriers to CCA, see Figure 12. The strongest perceived barriers relate to regulation (both environmental/climate and farming specific) and financial challenges. Interestingly, uncertainty concerning climate change is more frequently seen as a significant barrier than the limited amount of climate change information. This may indicate an opportunity for those providing advice to farmers to specifically address robust decision making as a tool for handling uncertainty.

Surprisingly, perception of barriers to CCA is often positively correlated with Average Practice Likelihood. This is true for aggregate scores and for several pairs of barriers and practices, see Table 9 and Table 10. A similar survey of a larger sample of Danish farmers saw a similar pattern and suggested that "farmers who are more likely to adapt may be more aware of the presence of barriers" (Woods et al., 2017, p. 116). The hypothesis is certainly reasonable when considering certain barrier/practice pairs. Consider two examples: taking out more or better insurance is positively correlated with perception of financial constraints; farmers more likely to take out insurance may be more aware of the cost of doing so. Water conservation is positively correlated with perception of limited water availability; the more a farmer sees water as limited, the more they would be likely to want to implement such a practice.

On the other hand, some barrier/practice correlations are negative, indicating that presence of a barrier may suppress farmers' interest in implementing the practice. Skånian farmers have a strong negative correlation between environment and climate regulations and no- and low-till practices. One potential explanation of this was proposed by an interviewee who said that a ban on the use of glyphosate-based herbicides would immediately lead to intense tillage as the need for mechanical weed suppression jumps up. This statement was supported by literature which further found that a glyphosate ban would cost Swedish famers in Southern or Southeastern Sweden up to 165 USD per hectare per year (Kudsk & Mathiassen, 2020). Despite the environmental and health impacts herbicides such as glyphosates contribute to CCA by allowing practices such as minimal tillage, leading to better soil health which better weather impacts such as droughts and flooding. Clearly, there is a complex relationship between perception of barriers to adaptation and likelihood of adaptation. While barriers are significant

factors in shaping farmers' readiness for climate change, additional work will be needed – likely on a case-by-case basis – to identify the causal direction and factors.

This complex relationship does not mean that barriers should not be addressed to increase adoption of CCA practices. In the case of negative correlations, lowering the barrier may encourage farmers to shift toward being more likely to engage in one or more practices. In the case of positive correlations, it is farmers who may move from very likely to implementing a practice that see the barrier most strongly, lowering the barrier may allow the actual implementation.

Interviewees repeatedly emphasized the financial limitations on farms and the necessity that CCA practices make financial sense. This is also reflected in survey data as farmers perceived financial barriers to be very significant. Farmers are also limited by the amount of time available to test new practices, to implement innovative practices, or even to make a multiyear plan that incorporates climate change. Financial and planning support focused on holistic CCA planning could help lower these barriers and make a farmer's desire to adapt become reality. Organizations in both regions already support farmers in developing multiyear farm plans around conservation and nutrient management practices; this work could expand to include CCA planning. Financial capacity to adapt can be seen as step one. Before implementing an adaptive measure, a farmer also needs to want to adapt, and finally they need to feel and urgency and want to implement the measure now.

An important way in which farmers are likely to adapt is by changing crops. Interviews showed that presence of a market demand and infrastructure to get goods to buyers remains a barrier in SWWA. Recently, the Northwest Agricultural Business Center, Extension agents, farmers, local government, and state government have worked together on the Southwest Washington Grain Project which has expanded rail access, enabling export of malting barley and import of feed grains at lower prices. Additional similar efforts may be necessary. Regional analysis indicated that proximity to urban markets will be beneficial here (Dalton et al., 2013), and this fits with the reportedly high level of direct to consumer sales in interviews and confirmed by the census of agriculture (USDA NASS, 2019). However, as the Southwest Washington Grain Project shows, for new commodity crops, infrastructure and market support may be necessary.

Survey and interview data are also in strong agreement that regulations are a significant barrier to CCA adoption. The example of potential glyphosate regulation was given above. Another example comes from SWWA: policy and regulation treat forestry and crop/animal agriculture very differently. In practice the boundary is already fuzzy. USDA-NRCS and CDs deals with both, Extension employees move between the two, and some farmers work with crops, animals, and small forests. This distinction becomes a significant barrier, according to an Extension agent and a farmer, when trying to implement adaptive mixed land use practices such as agroforestry or silvopasture.

Limitations

The data collected here is subject to limitations and findings should be considered in that light. First, the survey deals with climate change and therefore may be perceived as inherently biased by respondents (Abdel-Monem et al., 2014). While neutral phrasing was used, the perception of bias may have influenced response rates and responses. In addition, early versions of the survey asked about politics and religion. Doing so was motivated by previous studies which

showed that political party identity and religiosity both are linked to recognition of climate change impacts (Abdel-Monem et al., 2014, p. 155). However, asking about these topics was off-putting to several respondents and may have influenced response rates, especially for questions regarding alters' politics and religion. Limited sample size is core limitation of this study. Of the over 6,588 farms in SWWA (USDA NASS, 2019), only 52 responses were obtained. In Skåne, of the 8196 farms (Persson, 2017), there were only 27 responses. This limited sample size undermined the strength of statistical tools that were used (Spearman R) or could have been used (standard deviations on average values).

A central part of the survey was the likelihood of engaging in selected CCA practices. For some farmers, one or more listed practice may have been non-applicable. However, while respondents were not forced to answer, no suitable 'not applicable' option was given possibly resulting in respondents selecting the 'very unlikely' options. For example, a farm located on a hillside or hilltop has very little exposure to flooding and therefore may rate the likelihood of engaging in a flood adaptive practice as 'very unlikely' though this has no bearing on their overall CCA likelihood. This could lower the aggregate measures of CCA likelihood. Finally, while the survey elucidated the role of ESNs as a factor, farmers were not asked about the relative importance of their social interactions compared to independent learning (classes, books, internet, etc.). Missing this information makes it difficult to determine the relative importance of the factors presented below. Overall, more factors influencing CCA readiness were described in SWWA than in Skåne. This may be because more data was collected in SWWA, or it may be because farmers there follow more predictable patterns than do farmers in Skåne.

Conclusions

This thesis examined several factors which influence farmers' readiness to engage in CCA in two temperate agricultural regions. Because of the strong role of cultural, political, and climatic influence in agricultural and CCA activities, location specific purposive sampling cannot create geographically generalizable conclusions (Kristjanson et al., 2012). However, some of the general ideas are expected to be transferable to areas with similar climatic conditions and where agriculture is similarly highly-developed (Woods et al., 2017).

Key Findings

Factors which are associated with farmers' change readiness stem from individual attributes, external change initiatives from supporting organizations, and the interaction between these. Such individual attributes include the farmer's age and experience with farming, belief that climate change is happening and will impact their farm, extent to which they act on climate change in general, perception of barriers to CCA, and the type of network with which they are surrounded. The most robust predictors of readiness for CCA were the extent to which climate change is incorporated in farmers' general decision making and their perceptions of barriers. These factors increased with farmers' likelihood of engaging in CCA in both regions. One of the most interesting findings is that farmers who perceive significant barriers to CCA are also those most likely to start engaging in new CCA practices. This supports similar findings from Denmark (Woods et al., 2017) and begins to suggest that this may be a more general pattern.

This research presented one simple way of describing the network farmers consult in making farm management decisions. While the size of the networks analyzed was small, data suggested a general trend. For farmers in SWWA, more insular networks are linked with higher likelihood of adaptation. For farmers in Skåne, more diverse networks are linked with higher likelihood of adaptation. This shows that network type likely does not have a universally similar impact on readiness to engage in CCA. Rather, within each cultural setting, different network types may influence CCA readiness in different ways.

Farmers are influenced by the information and funding opportunities available from the organizations around them. However, when more individuals from these formal organizations are in a farmer's network (i.e., higher network formality) there was no impact on overall likelihood of adaptation. Based on this analysis, existing organizations seem well positioned to support farmers in CCA efforts. However, additional streamlining and coordination could be helpful. While there is an abundance of suggestions on how agriculture should adapt at large geographic scales, farmers are missing farm or community level guidance specific to CCA. Climate change uncertainty, information, methods, and lack of related subsidies are seen as significant barriers to CCA by those more likely to adapt.

Next Steps

Many farmers are already engaging in at least one CCA practice, 81% in SWWA and 63% in Skåne, and organizations involved in agriculture are supporting systemic and individual adaptation efforts. Despite the significant steps already being taken, more work is needed to keep pace with climate change. Both SWWA and Skåne have strong organizations in place to support and advise farmers already. As one farmer said, "you don't know what you don't know". In the context of CCA this means these organizations may need to take a more active outreach role and go beyond answering questions to providing unsolicited information. Organizations

such as FoN, CDs, and Extension are commonly consulted resources for farmers in their regions. By continuing to provide voluntary advice that focuses on real challenges or opportunities felt by each farmer, these organizations can facilitate adaptation. As one Extension agent said, “the first thing that needs to happen is establishing landowner interest in these practices.” This requires providing information about potential CCA methods, expected impacts, and associated uncertainties and not just when asked.

To support this, further research is always helpful. This thesis provided a simple analysis of ESNs. Broader social network analysis could help elucidate additional factors which determine CCA readiness and in a very practical sense identify people or groups that would be most beneficial to target with outreach efforts. Additional survey-based research could be useful. A larger sample size would allow for additional disaggregated analysis. In addition, responses should be linked to objective climate related hazards and more detailed information on what is grown. Such information could help disentangle farmers adaptation tendencies based on their unique farm situation. For example, is a farmer unlikely to adapt to increased flooding expected in the region because they know their farm will not be affected or for some other reason? A mechanistic analysis of why farmers who are more likely to adapt perceive barriers to be stronger would help understand how to modify outreach efforts in reaction to this finding. Similar work should also be completed focusing on aquaculture and forestry.

Results of this research may be used by natural resource managers, agricultural Extension agents, researchers, and others who seek to support farmers in adapting to climate change to identify who to work with and how to shape outreach efforts. Demographic and social network information may be used to identify target groups for outreach efforts informing farmers about CCA, or to identify farmers with whom to work on implementing CCA practices.

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Appendix 1: Survey

All survey items are presented below in the order they appear in the Full survey versions. The section within the Three Section survey version is also provided. Notes and sources provide additional information such as what literature inspired the question or how the response choices were selected. Substantial edits to the Swedish translation were made for the Three Section version to improve clarity. The Swedish text as used in the Full and NR,PP versions is shown in plain text while the Swedish text as used in the Three Section version is shown below in *italic*.

Item 1: Ego Age

How old are you?

Hur gammal är du?
Ålder

Three Section Version: Question 1, Section 1

Source: (Hydbom et al., 2020; Woods et al., 2017)

Item 2: Ego Gender

Which best describes your gender?

1. Male
2. Female
3. Other
4. Prefer not to say

Vilket beskriver bäst ditt kön?
Kön:

1. Man
2. Kvinna
3. Övrigt
4. Föredrar att inte säga

Three Section Version: Question 15, Section 3

Source: (Hydbom et al., 2020; Woods et al., 2017)

Item 3: Ego Education

What is the highest level of education you have completed?

1. Did not complete High School
2. High school
3. Trade / vocational / technical
4. Bachelor's
5. Master's
6. Doctorate
7. Other
8. Prefer not to say

Vad är den högsta utbildningsnivån du har slutfört?
Vilken din högsta slutförda utbildningsnivån?

1. Avslutade inte gymnasiet
2. Gymnasiet
3. Yrkeshögskola
4. Kandidatexamen
5. Master/Magister
6. Doktorsexamen
7. Övrigt
8. Föredrar att inte säga

Three Section Version: Question 2, Section 1

Source: (Hydbom et al., 2020; Woods et al., 2017)

Item 4: Ego Political Party Preference

Which political party's platform most aligns with your views?

1. Republican
2. Democratic
3. Libertarian
4. Green
5. Socialism and Liberation
6. Socialist Workers
7. None of these/Other
8. Prefer not to say

Vilket politiskt partis plattform passar bäst med dina åsikter?

1. Sveriges Socialdemokratiska arbetarparti
2. Moderata samlingspartiet
3. Sverigedemokraterna
4. Centerpartiet
5. Vänsterpartiet
6. Kristdemokraterna
7. Liberalerna
8. Miljöpartiet de Gröna
9. Inget av dessa / annat
10. Föredrar att inte säga

Note: SWWA parties are those received votes for a presidential candidate in Washington in November 2020 (Washington Secretary of State Elections Division, 2021). Skåne parties are those with representatives in Swedish national parliament (Swedish Institute, 2017).

This question did not appear in the NR, PP (No Religion, Political Party) or Three Section survey versions.

Source: (Burt, 1984)

Item 5: Ego Religiosity

Would you say that currently you are...

1. not at all religious
2. not very religious
3. somewhat religious
4. very religious
5. Prefer not to say

Skulle du säga att du för närvarande är ...

1. inte alls religiös
2. inte särskilt religiös
3. något religiös
4. mycket religiös
5. Föredrar att inte säga

Note: Religiosity was chosen over religion or denomination as this was expected to be a more acceptable question and possibly provide a better indicator of ESN metrics. Response choices are modelled on a general social survey in the UK (Centre for Research Into Elections and Social Trends, 1998).

This question did not appear in the NR, PP (No Religion, Political Party) or Three Section survey versions.

Source: (Burt, 1984)

Item 6: Farm Location

In which county is the farm located?

1. Clark County
2. Cowlitz County
3. Grays Harbor County
4. Lewis County
5. Mason County
6. Pacific County
7. Thurston County
8. Wahkiakum County
9. Somewhere else

I vilken kommun ligger gården?
Vart ligger ditt lantbruk?

1. Bjuv
2. Bromölla
3. Burlöv
4. Båstad
5. Eslöv
6. Helsingborg
7. Hässleholm
8. Höganäs
9. Hörby
10. Höör
11. Klippan
12. Kristianstad
13. Kävlinge
14. Landskrona
15. Lomma
16. Lund
17. Malmö
18. Osby
19. Perstorp
20. Simrishamn
21. Sjöbo
22. Skurup
23. Staffanstorp
24. Svalöv
25. Svedala
26. Tomelilla
27. Trelleborg
28. Vellinge
29. Ystad
30. Åstorp
31. Ängelholm
32. Örkelljunga
33. Östra Göinge
34. Någon annanstans

Three Section Version: Question 3, Section 1

Item 7: Years on Farm

About how many years have you worked at this farm?

Ungefär hur många år har du arbetat på den här gården?
Hur många år har du varit verksam på din nuvarande gård?

Three Section Version: Question 16, Section 3

Source: (Hydbom et al., 2020; Woods et al., 2017)

Item 8: Off Farm Experience

Do you have experience working off a farm?

1. Yes
2. No
3. Prefer not to say

Har du erfarenhet av att arbeta på annan arbetsplats än en gård?

1. Ja
2. Nej
3. Föredrar att inte säga

Three Section Version: Not asked

Source: (Hydbom et al., 2020; Woods et al., 2017)

Item 9: Product Diversity

Approximately how many different crop or animal types are produced on the farm? (e.g. chickens, cows, apples, and strawberries = 4)

Ungefär hur många olika grödor eller djurtyper produceras på gården? (t.ex. kycklingar, kor, äpplen och jordgubbar = 4)

In the Three Section version this question was split into two questions and posed as multiple choice with the same options:

Approximately how many different crops are produced on the farm? (e.g. apples and strawberries = 2)

Hur många olika grödor odlar du? (till exempel: äpplen, potatis, och jordgubbar = 3)

Approximately how many different animal products are produced on the farm? (e.g. eggs, beef, cheese, honey = 4)

Vilka produkter från lantbruksdjur producerar du? (till exempel: grisar och nötkreatur = 2)

1. 1 - 2
2. 3 - 5
3. 6 - 9
4. 10 - 20
5. More than 20
6. Prefer not to say

1. 1 - 2
2. 3 - 5
3. 6 - 9
4. 10 - 20
5. Mer än 20
6. Föredrar att inte säga

Note: This item is included in response to literature suggesting that higher product diversity inherently enhances capacity to adapt (Snover et al., 2013).

Three Section Version: Question 4, Section 1

Item 10: Farm Area

What area of land do you actively manage?

1. 0 - 10 acres
2. 11 - 50 acres
3. 51 - 180 acres
4. 181 - 500 acres
5. 501 - 1000 acres
6. 1001 - 2000 acres
7. More than 2000 acres
8. Prefer not to say

Hur stort markområde hanterar du aktivt?
Hur stort markområde brukar du?

1. 0 - 5 hektar
2. 6 - 20 hektar
3. 21 - 75 hektar
4. 76 - 200 hektar
5. 201 - 400 hektar
6. 401 - 800 hektar
7. Mer än 800 hektar
8. Föredrar att inte säga

Note: Response options align with the USDA's Census of Agriculture (USDA NASS, 2019). For Skåne the response options are converted to hectares and rounded to give logical and approximately comparable bins.

Three Section Version: Question 5, Section 1

Source: (Hydbom et al., 2020; Woods et al., 2017)

Item 11: Land Ownership

What percent of the land managed by you is owned by you?

1. None
2. 1 - 20%
3. 21 - 40%
4. 41 - 60%
5. 61 - 80%
6. 81 - 100%
7. Prefer not to say

Vilken procent av den mark som du förvaltar ägs av dig?
Hur många procent av marken äger du?

1. Ingen
2. 1 - 20%
3. 21 - 40%
4. 41 - 60%
5. 61 - 80%
6. 81 - 100%
7. Föredrar att inte säga

Three Section Version: Question 17, Section 3

Source: (Hydbom et al., 2020; Woods et al., 2017)

Item 12: Farm Income

Roughly, what is the gross income from farming activities for this farm in a typical year?

1. $ 0 - 2,500
2. $ 2,501 - 5,000
3. $ 5,001 - 10,000
4. $ 10,001 - 25,000
5. $ 25,001 - 50,000
6. $ 50,001 - 100,000
7. $ 100,001 - 500,000
8. More than $ 500,000
9. Prefer not to say

Vad är den ungefärliga bruttoinkomsten för jordbruksverksamheten för denna gård under ett typiskt år?

Vad har din lantbruksverksamhet för bruttoinkomst?

1. 0 - 20 000 SEK
2. 20 001 - 40 000 SEK
3. 40 001 - 85 000 SEK
4. 85 001 - 200 000 SEK
5. 200 001 - 400 000 SEK
6. 400 001 - 850 000 SEK
7. 850 001 - 4 000 000 SEK
8. Mer än 4 000 000 SEK
9. Föredrar att inte säga

Note: Response options align with the USDA's Census of Agriculture (USDA NASS, 2019). For Skåne the response options are converted to hectares and rounded to give logical and approximately comparable bins.

Three Section Version: Question 18, Section 3

Source: (Hydbom et al., 2020; Woods et al., 2017)

Item 13: Annual Farm Work Time

Out of all the time you spend working in a year, roughly what proportion is spent on crop production activities?

1. 0 - 25%
2. 26 - 50%
3. 51 - 75%
4. 76 - 100%
5. Don't know
6. Prefer not to say

Av all tid du arbetar på ett år, hur stor andel spenderar du på produktion av grödor?

Hur många procent av din arbetstid spenderar du på att producera grödor?

1. 0 - 25%
2. 26 - 50%
3. 51 - 75%
4. 76 - 100%
5. Vet inte
6. Föredrar att inte säga

Three Section Version: Question 19, Section 3

Source: (Hydbom et al., 2020; Woods et al., 2017)

Item 14: Name Generator

First, please identify five (5) people with whom you discussed or sought advice regarding farm management decisions. You can just give their first name, initials, or any other description so that you can identify them. Next there will be several questions about these people.

Person 1
Person 2
Person 3
Person 4
Person 5

Först måste du identifiera fem (5) personer som du diskuterat med eller sökt råd från om beslut kring jordbruksförvaltning. Du kan ange endast deras förnamn, initialer eller någon annan beskrivning så att du kan identifiera dem. Därefter kommer det att finnas flera frågor om dessa människor.

Du kommer börja med att identifiera 5 personer som du brukar rådfråga när du ska ta olika beslut inom din lantbruksverksamhet. Du behöver inte ange deras hela namn, utan det räcker med ett förnamn, initialer eller någon annan beskrivning. De följande frågorna kommer handla om dessa personer.

Person 1
Person 2
Person 3
Person 4
Person 5

Three Section Version: Question 8, Section 1

Source: (Burt, 1984)

Item 15: Alter Importance

For each of these people, how important is their input to you?

1. Not at all important
2. Slightly important
3. Moderately important
4. Very important
5. Extremely important
6. Don't know / Prefer not to say

Hur viktiga är var och en av dessa personers råd för dig?

Hur viktiga är dessa personers råd för dig?

1. Inte alls viktigt
2. Något viktigt
3. Måttligt viktigt
4. Mycket viktigt
5. Extremt viktigt
6. Vet inte / Föredrar att inte säga

Note: This question was asked for each of the names provided in the name generator above.

Three Section Version: Question 9, Section 1

Source: (Burt, 1984)

Item 16: Alter Gender

To your knowledge, what gender does each of these people identify with?

1. Male
2. Female
3. Other
4. Don't know / Prefer not to say

Såvitt du vet, vilket kön identifierar var och en av dessa människor sig med?
Enligt dig, vilken könstillhörighet har dessa personer?

1. Man
2. Kvinna
3. Övrigt
4. Vet inte / Föredrar att inte säga

Note: This question was asked for each of the names provided in the name generator above.

Three Section Version: Question 22, Section 3

Source: (Burt, 1984)

Item 17: Alter Age

About how old is each of these people?

1. Under 18
2. 19-24
3. 25-34
4. 35-44
5. 45-54
6. 55-64
7. Above 64
8. Prefer not to say

Hur gammal är var och en av dessa människor?
Vad är dessa personers ålder?

1. Under 18
2. 19-24
3. 25-34
4. 35-44
5. 45-54
6. 55-64
7. Över 64
8. Föredrar att inte säga

Note: This question was asked for each of the names provided in the name generator above.

Three Section Version: Question 10, Section 1

Source: (Burt, 1984)

Item 18: Alter Education

To your knowledge, what is the highest level of education completed by each of these people?

1. Did not complete High School
2. High school
3. Trade / vocational / technical
4. Bachelor's
5. Master's
6. Doctorate
7. Don't know / Prefer not to say

Såvitt du vet, vad är den högsta utbildningsnivån för var och en av dessa människor?
Vad har dessa personer för högsta slutförda utbildningsnivån?

1. Avslutade inte gymnasiet
2. Gymnasiet
3. Yrkeshögskola
4. Kandidatexamen
5. Master/Magister
6. Doktorsexamen
7. Vet inte / Föredrar att inte säga

Note: This question was asked for each of the names provided in the name generator above.

Three Section Version: Question 11, Section 1

Source: (Burt, 1984)

Item 19: Alter Relationship

For the following questions consider your relationship to each person. Are you their Parent or coworker? Maybe both? You could be comembers with someone if you both belong to the same organization. For example, a Grange chapter, church group, Rotary club, or any other organization.

1. Spouse
2. Sibling
3. Parent
4. Child
5. Other Family
6. Coworker
7. Comember
8. Neighbor
9. Advisor
10. Friend
11. Other
12. Prefer not to say

För följande frågor överväg din relation till varje person. Är du deras förälder eller kollega? Kanske båda? Ni är organisationskollegor om ni båda tillhör samma organisation. Till exempel en LRF avdelning, kyrkogrupp, Rotaryklubb eller liknande.

Vilken relation har du till dessa personer? Du kan ange flera.

**Organisationskollega innebär här att ni tillhör samma nätverk, så som kyrkogrupper, Röda Korset Kupan, Lantbrukarnas riksförbund eller liknade.*

1. Make/maka
2. Syskon
3. Förälder
4. Barn
5. Annan familj
6. Medarbetare
7. Organisationskollega
8. Granne
9. Rådgivare
10. Vän
11. Övrigt
12. Föredrar att inte säga

Note: This question was asked for each of the names provided in the name generator above.

Three Section Version: Question 23, Section 3

Source: (Burt, 1984)

Item 20: Alter Religiosity

To your knowledge, how religious are each of these people currently?

1. not at all religious
2. not very religious
3. somewhat religious
4. very religious
5. Don't know / Prefer not to say

Så vitt du vet, hur religiös är var och en av dessa människor för närvarande?

1. inte alls religiös
2. inte särskilt religiös
3. något religiös
4. mycket religiös
5. Vet inte / Föredrar att inte säga

Note: This question was asked for each of the names provided in the name generator above. Response choices are modified to match those asked of the ego and reflect religiosity rather than Burt's (1984) use of religion. This question did not appear in the NR, PP (No Religion, Political Party) or Three Section survey versions.

Source: (Burt, 1984)

Item 21: Alter Frequency

How often do you talk to each of these people?

1. Daily
2. Weekly
3. Monthly
4. Less Often
5. Don't know / Prefer not to say

Hur ofta pratar du med var och en av dessa människor?
Hur ofta pratar du med dessa personer?

1. Dagligen
2. Varje vecka
3. Månadsvis
4. Mindre ofta
5. Vet inte / Föredrar att inte säga

Note: This question was asked for each of the names provided in the name generator above.

Three Section Version: Question 24, Section 3

Source: (Burt, 1984)

Item 22: Alter Duration

About how long have you known each of these people?

1. Less than 1 year
2. 1 - 3 years
3. 3 - 6 years
4. More than 6 years
5. Don't know / Prefer not to say

Ungefär hur länge har du känt var och en av dessa människor?
Ungefär hur länge har du känt dessa personer?

1. Mindre än 1 år
2. 1 - 3 år
3. 3 - 6 år
4. Mer än 6 år
5. Vet inte / Föredrar att inte säga

Note: This question was asked for each of the names provided in the name generator above.

Three Section Version: Question 25, Section 3

Source: (Burt, 1984)

Item 23: Alter Political Party Preference

To your knowledge, what political party's platform does each of these people most identify with?

1. Republican
2. Democratic
3. Libertarian
4. Green
5. Socialism and Liberation
6. Socialist Workers
7. None of these / Other
8. Don't know / Prefer not to say

Så vitt du vet, vilket politisk partis plattform identifierar var och en av dessa människor mest med?

1. Sveriges Socialdemokratiska arbetarparti
2. Moderata samlingspartiet
3. Sverigedemokraterna
4. Centerpartiet
5. Vänsterpartiet
6. Kristdemokraterna
7. Liberalerna
8. Miljöpartiet de Gröna
9. Inget av dessa / Annat
10. Vet inte / Föredrar att inte säga

Note: This question was asked for each of the names provided in the name generator above. Response options reflect those asked of the ego.

This question did not appear in the NR, PP (No Religion, Political Party) or Three Section survey versions.

Source: (Burt, 1984)

Item 24: Alter Inter-relationships

How would you characterize [Person X]'s relationship with each of the following:

1. Strangers
2. Known but not close
3. Somewhat close
4. Close
5. Very close
6. Don't know

Hur skulle du karakterisera [Person X]s förhållande till var och en av följande:
Vad har [Person X] för förhållande till de följande personerna?

1. Främlingar
2. Bekant men inte nära
3. Ganska nära
4. Nära
5. Mycket nära
6. Vet inte

Note: This question was asked for each person named above such that each pair is asked about only once.

Three Section Version: Question 13, Section 1

Source: (Burt, 1984)

Item 25: CCA Practice Likelihoods

How likely is it that you will implement each of the following practices?

1. Very unlikely
2. Unlikely
3. Neutral
4. Likely
5. Very likely
6. I already do this
7. Don't know

Hur sannolikt är det att du kommer att genomföra var och en av följande metoder?
Hur sannolikt är det att du i framtiden kommer att genomföra någon utav de följande metoderna?

1. Mycket osannolikt
2. Osannolikt
3. Neutral
4. Sannolikt
5. Mycket sannolikt
6. Jag gör det redan
7. Vet inte

Respondents answered the above question regarding these potential CCA Practices:

Table 11. Phrasing of potential CCA practices. Respondents completed a matrix where these practices were the rows and the column options were those presented above.

	English Text for All Survey Versions	**Swedish Text for Full and NR, PP Survey Versions** ***Swedish Text for Three Section Survey Version***
1	Change varieties of current crops or breeds of animals to exploit possible future opportunities from climate change	Ändra sorter av nuvarande grödor eller djurraser för att utnyttja potentiella framtida möjligheter från klimatförändringar *Ändra nuvarande sorter av grödor eller djurraser för att utnyttja potentiella möjligheter som kan uppstå av klimatförändringar*
2	Change varieties of current crops or breeds of animals to protect against possible negative future impacts of climate change	Ändra sorter av nuvarande grödor eller djurraser för att skydda mot eventuella negativa framtida effekter av klimatförändringar *Ändra nuvarande sorter av grödor eller djurraser för att skydda mot potentiella negativa effekter som kan uppstå av klimatförändringar*
3	Adopt new types of crops or animals to exploit possible future opportunities from climate change	Anta nya typer av grödor eller djur för att utnyttja potentiella framtida möjligheter från klimatförändringar *Använda nya typer av grödor eller djurarter för att utnyttja potentiella möjligheter som kan uppstå av klimatförändringar*
4	Adopt new types of crops or animals to protect against possible negative future impacts of climate change	Anta nya typer av grödor eller djur för att skydda mot eventuella negativa framtida effekter av klimatförändringar *Använda nya typer av grödor eller djurarter för att skydda mot potentiella negativa effekter som kan uppstå av klimatförändringar*

5	Implement no- or low-till practices	Implementera plöjningsfria alternativ eller reducerad jordbearbetning *Använda direktsådd eller reducerad jordbearbetning*
6	Change timing of activities (planting, harvest, etc.)	Ändra tidpunkten för aktiviteter (plantering, skörd osv.) *Ändra tidpunkten för olika lantbruksaktiviteter*
7	Establish new flood protection measures (floodwalls, tide-gates, dikes)	Inrätta nya översvämningsskyddsåtgärder (översvämningsväggar, tidvattenportar, vallar) *Inrätta översvämningsskydd så som översvämningsväggar, diken, eller likande*
8	Take some land out of production (including as conservation protection area, voluntary stewardship program, or permanent set aside)	Ta lite mark ur produktion (inklusive som skyddsområde för bevarande, frivilligt förvaltarprogram eller permanent avsättning) *Ta mark ur produktion*
9	Take out more/better insurance policies	Ta ut fler / bättre försäkringar *Förbättra försäkringsskyddet*
10	On-farm water conservation and storage (e.g. rainwater harvesting, retention basins, improved irrigation efficiency)	Bevara och lagra vatten på gården (t.ex. skörd av regnvatten, kvarhållningsbassänger, förbättrad bevattningseffektivitet)
	In the Three Section version, this item was separated into two and rephrased as:	
	On-farm water conservation (e.g. improved irrigation efficiency)	*Använda ett mer effektivt bevattningssystem*
	On-farm water storage (e.g. rainwater harvesting, retention basins)	*Lagra vatten*
11	Introduce intercropping and/or other mixed land use approaches (silvopasture, agroforestry)	Införa avgrödning och / eller andra metoder för blandad markanvändning (silvopastur, agroforestry) *Blandad markanvändiningsmetoder eller samodling*
12	Increase use of cover crops	Öka användningen av täckgrödor *Öka användningen av mellan- eller fånggrödor (MF grödor)*
13	Introduce or modify crop rotations	Införa eller modifiera grödorotationer *Införa eller justera växelbruk*
14	Change use of pesticides	Ändra användningen av bekämpningsmedel *Ändra användningen av bekämpningsmedel*
15	Increase off-farm work or agrotourism	Öka arbetet utanför gården eller agroturism
	In the Three Section version, this item was separated into two and rephrased as:	
	Increase off-farm work	*Arbeta mer på arbetsplatser utanför lantbruket*
	Invest in agrotourism	*Investera i agroturism*

Note: The inspiration for the specific CCA practices used is described in more detail in the methods section above.

Three Section Version: Question 7, Section 1

Item 26: Perception of Barriers to CCA

To what extent do you think each of the following may be a barrier to implementing adaptation measures?

1. Not a barrier
2. Small barrier
3. Moderate barrier
4. Significant barrier
5. Very significant barrier
6. Don't know

I vilken utsträckning tror du att något av följande kan vara ett hinder för att genomföra anpassningsåtgärder?
Vilka utav de följande tror du kan vara ett hinder för att genomföra anpassningsåtgärder?

1. Inte ett hinder
2. Litet hinder
3. Måttligt hinder
4. Betydande hinder
5. Mycket betydande hinder
6. Vet inte

Respondents answered the above question regarding these potential barriers to CCA:

Table 12. Phrasing of potential barriers to CCA. Respondents completed a matrix where these barriers were the rows, and the column options were those presented above.

	English Text for All Survey Versions	**Swedish Text for Full and NR, PP Survey Versions** ***Swedish Text for Three Section Survey Version***
1	Environmental and climate regulations	Miljö- och klimatbestämmelser *Regeringsbeslut kring miljö- och klimatfrågor*
2	Farming policy regulations	Jordbrukspolitiska bestämmelser *Regeringsbeslut kring lantbruksfrågor*
3	Economic losses related to changing practices	Ekonomiska förluster i samband med förändrade metoder *Potentiella ekonomiska förluster i samband med förändrade arbetsmetoder*
4	Economic losses from fewer and/or smaller subsidies	Ekonomiska förluster från färre och / eller mindre subventioner *Potentiella ekonomiska förluster i och med färre och / eller mindre lantbrukssubventioner*
5	Uncertainty regarding the magnitude of climate changes	Osäkerhet om klimatförändringarnas omfattning *Osäkerhet kring framtida klimatförändringars omfattning*
6	Financial constraints at the farm	Ekonomiska begränsningar på garden *Privata ekonomiska begränsningar*
7	Shortage of land	Brist på mark *Brist på mark*
8	Availability of new technologies	Tillgången till ny Teknik *Dålig tillgång till ny teknik*
9	Lack of information on climate change adaptation methods	Brist på information om anpassningsmetoder för klimatförändringar *Brist på information om klimatanpassningsmetoder*

10	Access to climate information	Tillgång till klimatinformation *Brist på klimatinformation*
11	Shortage of labor	Brist på arbetskraft *Brist på arbetskraft*
12	Water scarcity constraints	Begränsningar av vattenbrist *Vattenbrist*
13	Poor potential for irrigation	Dålig potential för bevattning *Små möjligheter för bevattning*

Three Section Version: Question 14, Section 2

Source: (Woods et al., 2017)

Item 27: Ego Climate Change Belief

To which degree do you agree/disagree that global climate change is occurring?

I vilken grad håller du med / håller inte med om att globala klimatförändring sker?

In the Three Section version this question was rephrased as:

Do you think climate change is occurring?

1. Strongly disagree
2. Disagree
3. Neutral
4. Agree
5. Strongly agree
6. Prefer not to say

Tycker du att klimatet förändras?

1. Håller inte med alls
2. Håller inte med
3. Neutral
4. Håller med
5. Håller helt med
6. Föredrar att inte säga

Three Section Version: Question 6, Section 1

Source: (Woods et al., 2017)

Item 28: Ego Climate Change Actions

How many actions have you already taken to adapt to and/or mitigate climate change? (for example: recycling, certain farm management practices, using public transit, etc.)

1. No actions taken
2. A couple actions taken
3. A few actions taken
4. Many actions
5. Prefer not to say

Hur många åtgärder har du redan vidtagit för att anpassa dig till och / eller mildra klimatförändringar? (till exempel: återvinning, vissa metoder för jordbrukshantering, användning av kollektivtrafik osv.)

Hur många klimatanpassningsåtgärder har du redan vidtagit? (t ex. återvinning, nya jordbrukshanteringsmetoder, användning av kollektivtrafik).

1. Inga åtgärder
2. Ett fåtal åtgärder
3. Några åtgärder
4. Många åtgärder
5. Föredrar att inte säga

Three Section Version: Question 21, Section 3

Item 29: Ego Climate Change Action Frequency

How frequently are your actions based on concern for climate change or the environment? (for example: recycling, certain farm management practices, using public transit, etc.)

1. Never
2. Rarely
3. Sometimes
4. Often
5. Always
6. Prefer not to say

Hur ofta är dina handlingar baserade på oro för klimatförändringar eller miljö? (till exempel: återvinning, vissa metoder för jordbrukshantering, användning av kollektivtrafik osv.)

1. Aldrig
2. Sällan
3. Ibland
4. Ofta
5. Alltid
6. Föredrar att inte säga

Three Section Version: Not asked

Item 30: Climate Change Cause

Which of the following best describes your views about climate change?

1. Climate change is happening mostly because of natural changes in the atmosphere.
2. Climate change is happening mostly because of human activity such as burning fossil fuels.
3. Climate change is happening equally because of human activity and natural changes.
4. Climate change is happening but there is not enough evidence to determine its cause.
5. Climate change is not happening.
6. Other
7. Don't know / Prefer not to say

Vilket av följande beskriver bäst dina åsikter om klimatförändringar?
Vilket av de följande påståenden beskriver bäst dina åsikter om klimatförändringarna?

1. Klimatförändringar sker främst på grund av naturliga förändringar i atmosfären.
2. Klimatförändringar sker främst på grund av mänsklig aktivitet som att bränna fossila bränslen.
3. Klimatförändringar sker på lika grund av mänsklig aktivitet och naturliga förändringar.
4. Klimatförändringar sker men det finns inte tillräckligt med bevis för att avgöra orsaken.
5. Klimatförändringar sker inte.
6. Övrigt
7. Vet inte / Föredrar att inte säga

Three Section Version: Question 20, Section 3

Source: (Abdel-Monem et al., 2014)

Item 31: Alter Climate Change Belief

To which degree does each of these people agree/disagree that global climate change is occurring?

1. Strongly disagree
2. Disagree
3. Neutral
4. Agree
5. Strongly agree
6. Don't know

I vilken grad är var och en av dessa människor överens / oense om att globala klimatförändringar sker?

Enligt dig, till vilken grad tycker dessa personer att klimatet förändras?

1. Håller inte med alls
2. Håller inte med
3. Neutral
4. Håller med
5. Håller helt med
6. Vet inte

Note: This question was asked for each of the names provided in the name generator above. Question matches the corresponding question of the ego.

Three Section Version: Question 12, Section 1

Item 32: Alter Climate Change Actions

To what extent have each of these people taken actions to adapt to and/or mitigate climate change? (for example: recycling, certain farm management practices, using public transit, etc.)

1. No actions taken
2. A couple actions taken
3. A few actions taken
4. Many actions
5. Don't know

I vilken utsträckning har var och en av dessa människor vidtagit åtgärder för att anpassa sig till och / eller mildra klimatförändringarna? (till exempel: återvinning, vissa metoder för jordbrukshantering, användning av kollektivtrafik osv.)

Enligt dig, hur många klimatanpassningsåtgärder har dessa personer redan vidtagit? (t ex. återvinning, nya jordbrukshanteringsmetoder, användning av kollektivtrafik).

1. Inga åtgärder
2. Ett par åtgärder
3. Några åtgärder
4. Många åtgärder
5. Vet inte

Note: This question was asked for each of the names provided in the name generator above. Question matches the corresponding question of the ego.

Three Section Version: Question 26, Section 3

Item 33: Alter Climate Change Action Frequency

How frequently are each of these people's actions based on concern for climate change or the environment? (for example: recycling, certain farm management practices, using public transit, etc.)

1. Never
2. Rarely
3. Sometimes
4. Often
5. Always
6. Don't know

Hur ofta är var och en av dessa människors handlingar baserade på oro för klimatförändringar eller miljön? (till exempel: återvinning, vissa metoder för jordbrukshantering, användning av kollektivtrafik osv.)

1. Aldrig
2. Sällan
3. Ibland
4. Ofta
5. Alltid
6. Vet inte

Note: This question was asked for each of the names provided in the name generator above. Question matches the corresponding question of the ego.

Three Section Version: Not asked

Appendix 2: Informal Survey Distribution

Facebook Groups in SWWA

- Pacific Northwest Small Farm, Garden and Homesteading
- Cowlitz Co Farm to Table
- Clark Food and Farm Network Classifieds and Discussion
- Western Washington Farming and Gardening
- Permaculture Swap - Washington State
- Clark County Farm to Table
- Friendly Mini Farmers of the Northwest
- Hobby Farms
- PNW Farm Swap
- Washington Ag Chat

Facebook Groups in Skåne

- Småbrukare och framtidens lantbrukare
- Jordbrukarna
- Jordbruksredskap förr och nu.
- Permakultur & Skogsträdgårdsodling i Praktiken – Omställning
- Permaculture Sweden
- Biodlare i Skåne
- Nordiskt nätverk för regenerativt lantbruk
- Lantbrukaren
- Lantbrukare i Skåne
- Odling
- Hemmaodlat

Lists of Farms in SWWA

Table 13. Lists of farms in SWWA used to identify potential survey respondents for direct distribution.

List	Farms	Source
Eat Local First Food and Farm Finder	103	(*WA Food & Farm Finder*, 2020)
EatWild Pastured Products Directory	3	(*Pastured Products Directory – Washington*, 2021)
Local Harvest Website	46	(*Family Farms*, n.d.)
Tilth Alliance 2020 Farm Guide	1	(Tilth Alliance, 2020)
Community Farmland Trust's 2020 Farm Map	72	(Community Farm Land Trust, 2020)
Olympia Farmers Market	33	(Olympia Farmers Market, 2020)
Cowlitz Community Farmers Market	3	(Cowlitz Community Farmers Market, 2021)
Vancouver Farmers Market	24	(Boldt, 2021)
Lewis County Farm Guide	25	(Discover Lewis County et al., 2020)
Discover Lewis County	2	(Discover Lewis County, n.d.)
Wahkiakum Food and Farm Network Farm Map	13	(Backman, 2020)
2020 Mason County Farm Fresh Guide	12	(Carman, 2020)

Appendix 3: Interview Topics

Interviews were semi-structured and lasted about one hour. The questions below, or slight variations on them, were used to guide the conversation and ensure the same core ideas were discussed by each interviewee. Additional questions included follow ups and questions specific to projects the interviewee was personally involved in.

1. Who does your organization work with? What types of farmers?
2. How do you begin working with a farmer?
3. How are interactions generally structured? Classes, one-on-one farm visits, etc.?
4. Are farmers generally excited to work with you? On what topics?
5. How much of a focus is climate change and related issues for your organization?
6. What impacts of climate change have you seen or heard about from farmers?
7. What, if anything, are farmers doing to adapt to climate change? What should they be doing?
8. How do you talk to farmers about climate change and related issues? Is this a difficult conversation?
9. What other organizations do farmers work with or talk to when making farm management decisions?

Appendix 4: Survey Data

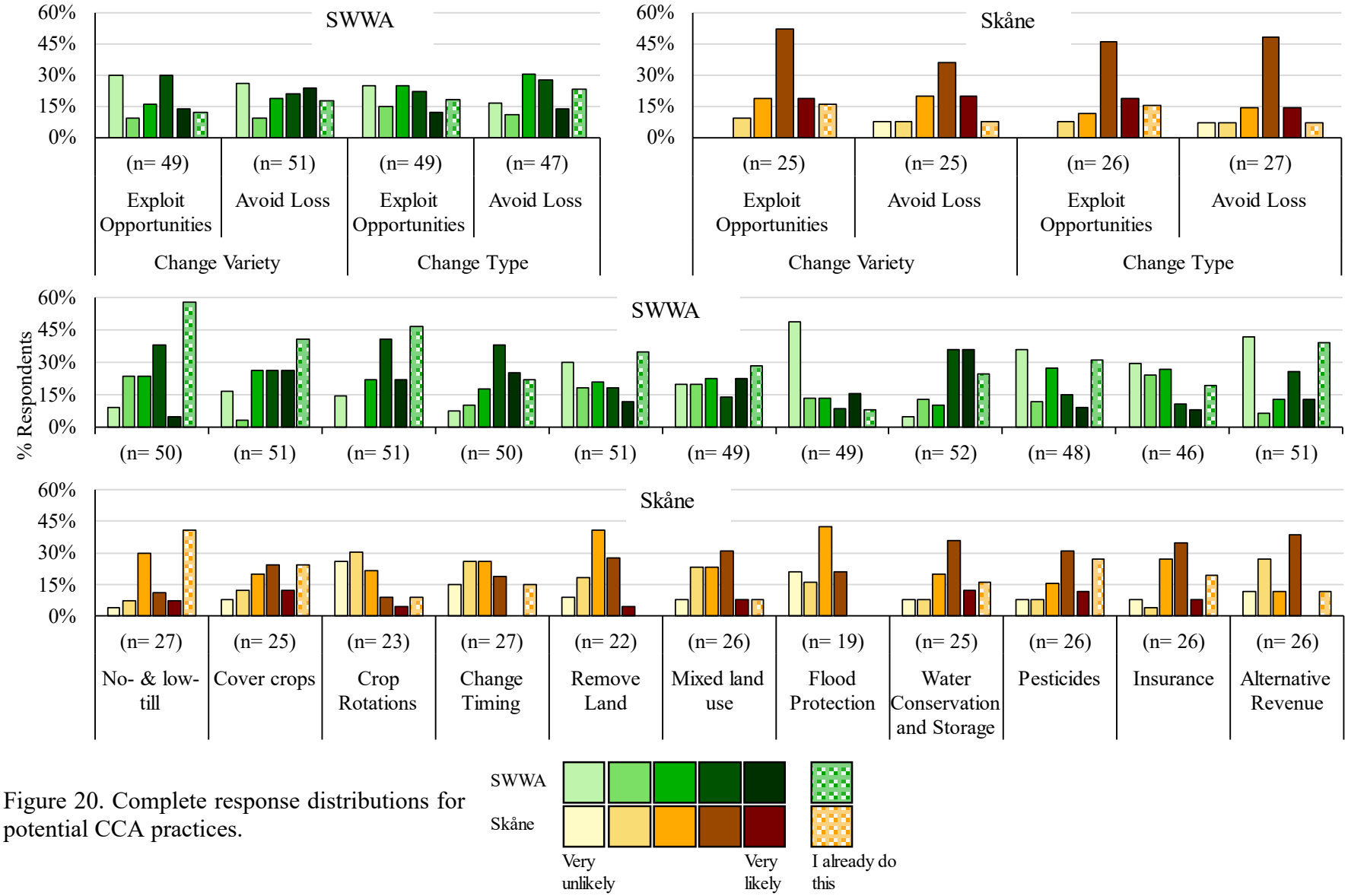

Figure 20. Complete response distributions for potential CCA practices.

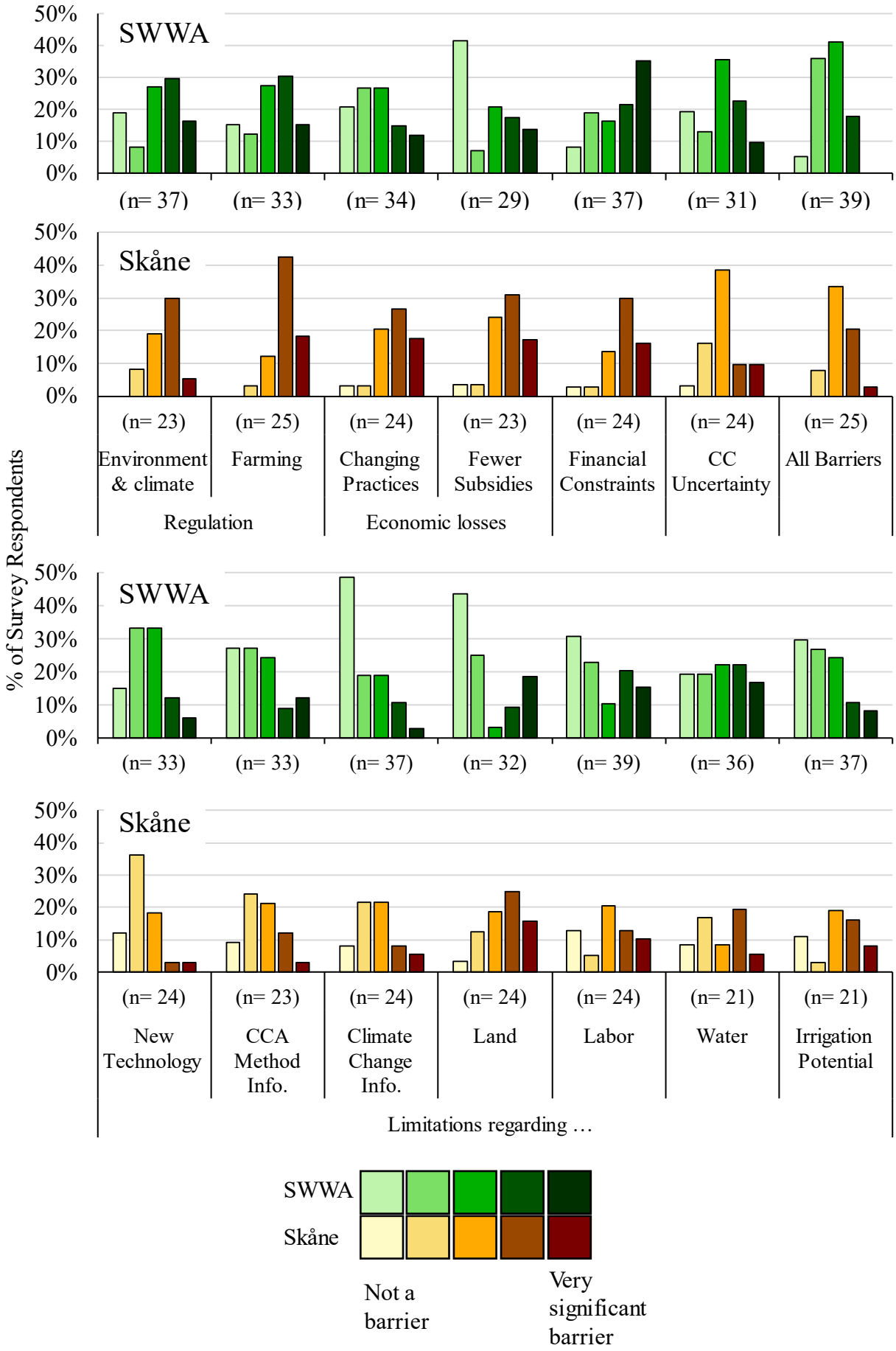

Figure 21. Complete response distribution for potential barriers to CCA.