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Finnish farmers' climate change perceptions: Towards a psychological understanding of pro-environmental behavior in agriculture

Doctoral Dissertation

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Luke
NATURAL RESOURCES
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Academic dissertation

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Abstract

Jaana Sorvali

Natural Resources Institute Finland and University of Helsinki

Climate change is a global challenge, and solving it requires the combined effort of every nation and sector of life. The land-use sector is a significant source of greenhouse gas emissions but also an important carbon sink. The agricultural sector is obliged to mitigate emissions under the Paris Agreement, thus speeding up the research, policy development, and implementation of mitigation options. In agriculture, farmers' decision making at the farm level is crucial for climate change mitigation and adaptation implementation, which underlines the importance of farmers' perceptions of climate change.

The scientific evidence for climate change is strong, but it has not resulted in public understanding and corresponding action to mitigate climate change. Physical, psychological, and social factors have been suggested as reasons for this imbalance of knowledge and action. As environmental psychology studies the interplay between individuals and the built and natural environment, it can facilitate the rectification of this imbalance through an understanding of the human behavior relevant for climate change, informing responses to climate change and understanding of peoples' thoughts and feelings about climate change that in turn influence their motivations and pro-environmental behavior.

Although farmers' climate change perceptions are already well known, psychological research into this issue remains quite rare. This thesis will extend the theoretical perspective of environmental psychology to agricultural research. Two social psychological theories, the value-belief-norm (VBN) theory by Stern and the theory of basic human values by Schwartz et al. are used to study Finnish farmers' pro-environmental behavior. A new psychological element of the climate change opportunity is also introduced, and its effects on pro-environmental behavior are discussed.

This research is based on two surveys of the Finnish farmer population in 2018 and 2020. Altogether, 4,401 farmers responded to the 2018 survey, with a response rate of 12%. The follow-up survey in 2020 received 2,000 responses, a response rate of 45%. The sample represented the Finnish farmer population quite well in many different demographic and farm-specific aspects for both surveys. Statistical methods were used to analyze the data.

The results of this thesis show that farmers have differing values and perceptions concerning climate change, and they perceive the connected risks and opportunities differently. This understanding is needed by agricultural policy planners and decision makers to draft policy measures that will be accepted and thoroughly implemented by farmers. Finnish farmers have a very high awareness of climate change, a strong notion that action must be taken, and that their actions will have an effect.

The literature on agriculture and climate change has focused mainly on climate change risks and adaptation challenges and options, and less attention has been paid to mitigation or climate change opportunities. Globally, this is very understandable, as climate change risks are already experienced, and quick responses must be made on how to handle those risks. Moreover, discussing the opportunities of such a detrimental phenomenon as climate change can be seen as ethically unjust. Yet the results of this thesis highlight that opportunities are perceived by farmers, and that farmers feel confused because they are expected to simultaneously mitigate climate change and adapt to and benefit from the positive implications of climate change.

Farmers are crucial in climate change mitigation in agriculture, as they are the ones making decisions at the farm level. Farmers' felt possibility to mitigate climate change proved the most important predictor of pro-environmental behavior. Agricultural research and policy should therefore enable the adoption of tangible farm-specific climate change mitigation practices with undeniable environmental benefits that will increase farmers' motivation to mitigate climate change.

Keywords: farmer, agriculture, climate change, psychology, behavior

Tiivistelmä

Jaana Sorvali

Luonnonvarakeskus ja Helsingin yliopisto

Ilmastonmuutos on maailmanlaajuinen haaste, ja sen ratkaiseminen edellyttää kaikkien valtioiden ja sektoreiden yhteistyötä. Maankäyttösektori on merkittävä kasvihuonekaasupäästöjen lähde, mutta myös tärkeä hiilinielu. Maataloussektorilla on Pariisin sopimuksen mukainen velvollisuus vähentää päästöjä, mikä on edesauttanut hillintävaihtoehtojen tutkimusta, politiikan kehittämistä ja toimeenpanoa. Maataloudessa viljelijöiden päätöksenteko maatilatasolla on ratkaisevan tärkeää ilmastonmuutoksen hillinnän ja siihen sopeutumisen toteuttamisen kannalta, mikä korostaa viljelijöiden ilmastokäsitysten merkitystä.

Tieteellinen näyttö ilmastonmuutoksesta on vahvaa, mutta se ei ole johtanut yleiseen ymmärrykseen ja tarvetta vastaaviin toimiin ilmastonmuutoksen hillitsemiseksi. Tiedon ja toiminnan epätasapainon syiksi on esitetty fyysisiä, psykologisia ja sosiaalisia tekijöitä. Koska ympäristöpsykologia tutkii yksilöiden sekä rakennetun ja luonnonympäristön välistä vuorovaikutusta, se voi helpottaa tämän epätasapainon korjaamisessa tuomalla ymmärrystä ilmastonmuutoksen kannalta merkityksellisestä ihmisten käyttäytymisestä, antamalla tietoa ilmastonmuutoksen hillintätoimien tueksi sekä ihmisten ilmastonmuutosta koskevista ajatuksista ja tunteista, jotka puolestaan vaikuttavat heidän motivaatioihinsa ja ympäristömyönteiseen käyttäytymiseen.

Vaikka maanviljelijöiden käsitykset ilmastonmuutoksesta tunnetaan jo hyvin, psykologinen tutkimus aiheesta on vielä melko harvinaista. Tässä tutkielmassa laajennetaan ympäristöpsykologian teoreettista näkökulmaa maatalousalan tutkimukseen. Suomalaisten maanviljelijöiden ympäristömyönteistä käyttäytymistä tutkitaan kahden sosiaalipsykologisen teorian, Sternin arvo-uskomus-normiteorian (VBN-teorian) ja Schwartzin ym. arvoteorian avulla. Lisäksi esitellään uusi psykologinen elementti, ilmastonmuutos mahdollisuutena, ja keskustellaan sen vaikutuksista ympäristömyönteiseen käyttäytymiseen.

Tutkimus perustuu kahteen suomalaiselle viljelijäväestölle suunnattuun kyselytutkimukseen vuosina 2018 ja 2020. Vuoden 2018 kyselyyn vastasi yhteensä 4 401 viljelijää, ja vastausprosentti oli 12 %. Vuoden 2020 seurantakyselyyn saatiin 2 000 vastausta, joten vastausprosentti oli 45 %. Otos edusti suomalaista viljelijäväestöä melko hyvin monien eri demografisten ja tilakohtaisten muuttujien osalta molemmissa kyselyissä. Aineiston analysoinnissa käytettiin tilastollisia menetelmiä.

Tämän tutkielman tulokset osoittavat, että viljelijöillä on toisistaan eroavia arvoja ja käsityksiä ilmastonmuutoksesta ja että he kokevat siihen liittyvät riskit ja mahdollisuudet eri tavoin. Maatalouspolitiikan suunnittelijat ja päätöksentekijät tarvitsevat tätä ymmärrystä, jotta he voivat laatia poliittisia toimenpiteitä, jotka viljelijät hyväksyvät ja jotka ovat siten myös toimeenpantavissa maatilatasolla. Suomalaisilla viljelijöillä on erittäin korkea tietoisuus ilmastonmuutoksesta, vahva käsitys siitä, että toimiin on ryhdyttävä ja että heidän toimillaan on vaikutusta.

Maataloutta ja ilmastonmuutosta käsittelevässä kirjallisuudessa on keskitytty lähinnä ilmastonmuutoksen riskeihin ja siihen sopeutumisen haasteisiin ja vaihtoehtoihin, ja vähemmän huomiota on kiinnitetty ilmastonmuutoksen hillitsemiseen tai sen mukanaan tuomiin mahdollisuuksiin. Maailmanlaajuisesti tämä on ymmärrettävää, sillä ilmastonmuutoksen negatiiviset vaikutukset ovat jo nähtävissä, ja niihin tulee hakea nopeita ratkaisuja. Myös ilmastonmuutoksen kaltaisen haitallisen ilmiön tarjoamista mahdollisuuksista keskustelemista voidaan pitää eettisesti epäoikeudenmukaisena. Tämän tutkielman tulokset kuitenkin korostavat, että viljelijät näkevät riskien lisäksi myös mahdollisuuksia. Tämä on heille hämmentävää, koska heidän odotetaan samanaikaisesti hillitsevän ilmastonmuutosta ja sopeutuvan siihen sekä käyttävän ilmastonmuutoksen positiiviset vaikutukset hyödykseen.

Viljelijät ovat ratkaisevassa asemassa ilmastonmuutoksen hillitsemisessä maataloudessa, koska he tekevät päätökset maatilatasolla. Maatalousyrittäjien kokema mahdollisuus hillitä ilmastonmuutosta osoittautui tärkeimmäksi ympäristöystävällistä käyttäytymistä ennustavaksi tekijäksi. Siksi maataloustutkimuksen ja -politiikan olisi tehtävä mahdolliseksi konkreettisten, kiistattomia ympäristöhyötyjä tuottavien maatilakohtaisten ilmastonmuutoksen hillintäkäytäntöjen käyttöönoton, joiden kautta viljelijöiden motivaatio ilmastotyöhön lisääntyy.

Asiasanat: viljelijä, maatalous, ilmastonmuutos, psykologia, käyttäytyminen

Acknowledgements

"There is nothing like looking, if you want to find something. You certainly usually find something, if you look, but it is not always quite the something you were after."

J.R.R. Tolkien, The Hobbit, or There and Back Again.

This research started based on an interest in climate change, agriculture, and human behavior. Only later down the road did I discover a whole new discipline where my interests seemed to fit perfectly: environmental psychology. Although my academic road from geography and political science, then through agricultural sciences to psychologically oriented research has not seemed straightforward for many, it has been unavoidable for me and evident for those who know me.

My heartfelt thanks go to all my colleagues in all the different institutions that I have been fortunate enough to work with during these years. Thank you to my supervisory team: Juha Helenius, Pasi Rikkonen, Annukka Vainio, Kati Berninger and Markku Löytönen.

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This thesis is dedicated to my family: my children Elisa, Silja and Akseli, but most of all to Jyri, my husband without whom this day or any other day would not have any meaning.

Victoria, Canada 24.4.2023

Jaana Sorvali

List of original publications

This thesis is based on the following publications:

I

Peltonen-Sainio, Pirjo; Sorvali, Jaana and Kaseva, Janne. (2020). Winds of change for farmers: Matches and mismatches between experiences, views and the intention to act. Climate Risk Management, 27. https://doi.org/10.1016/j.crm.-2019.100205

II

Sorvali, Jaana; Kaseva, Janne and Pirjo Peltonen-Sainio (2021). Farmer views on climate change—a longitudinal study of threats, opportunities and action. Climatic Change, 164:50. https://doi.org/10.1007/s10584-021-03020-4

III

Sorvali, Jaana, Kaseva, Janne, Vainio, Annukka, Verkasalo, Markku, and Peltonen-Sainio, Pirjo. (2022). Value priorities of the Finnish farmers – Time to stop thinking of farmers as inherently conservative and traditional. Journal of Community and Applied Social Psychology, 32:2, 212-240. https://doi.org/10.1002/casp.2561

IV

Sorvali, Jaana; Liu, Xing and Janne Kaseva (2022). Climate change opportunities reduce farmers' risk perception: extension of the Value-Belief-Norm theory in the context of Finnish agriculture. Frontiers in Psychology, 13. https://doi.org/10.-3389/-fpsyg.2022.939201

Publications are referred to by their Roman numerals in the thesis.

Authors contribution to the articles

Work has been divided between the co-authors as follows:

Arti-cle	Conceptualization	Methodology	Analysis	Writing: original draft preparation	Writing: review and editing
I	Pirjo Peltonen-Sainio, **Jaana Sorvali**	**Jaana Sorvali**, Pirjo Peltonen-Sainio	Janne Kaseva, Pirjo Peltonen-Sainio	Pirjo Peltonen-Sainio	**Jaana Sorvali,** Janne Kaseva, Pirjo Peltonen-Sainio
II	**Jaana Sorvali**	**Jaana Sorvali**	**Jaana Sorvali,** Janne Kaseva	**Jaana Sorvali**	**Jaana Sorvali,** Janne Kaseva, Pirjo Peltonen-Sainio
III	**Jaana Sorvali**	**Jaana Sorvali,** Markku Verkasalo, Annukka Vainio	Janne Kaseva, **Jaana Sorvali**	**Jaana Sorvali**	**Jaana Sorvali,** Markku Verkasalo, Annukka Vainio, Janne Kaseva, Pirjo Peltonen-Sainio
IV	**Jaana Sorvali**, Xing Liu, Janne Kaseva	**Jaana Sorvali**	Janne Kaseva	**Jaana Sor-vali,** Xing Liu, Janne Kaseva	**Jaana Sorvali,** Janne Kaseva, Xing Liu

Contents

1. Introduction

1.1. Climate change and agriculture

> *"It is difficult to know when issues are real, and when people are just pushing their own ideology (e.g. veganism) or otherwise trying to influence people and their choices using climate change as an argument. It can be used to justify almost anything these days. It is hypocritical to force farmers to go green and at the same time test nuclear weapons and other military activities, send rockets with satellites into space every few days and who knows what else, which cancels out the emission reductions of all Finnish farmers in a minute. It's very difficult to distinguish between arguments that are ideologically motivated and advanced as routine in this ongoing debate on climate change, and what is real."*[1]

The climate has changed rapidly from the pre-industrial era to the current day. Now, the world is roughly 1 °C warmer than in the period between 1850 and 1900. Strong scientific proof supports human action as the cause of accelerated climate change, shows that the pace of warming has accelerated in recent decades, and the warming is two to three times higher in Arctic areas than elsewhere (Allen et al., 2018). Climate change is a global challenge that cannot be solved by any one actor or nation alone. The response to climate change should be collective, drastic, and immediate (UNFCCC, 2021). Even with intense international collaboration and the commitments of nations to international climate change agreements, mitigation actions have yet to curb emission trends globally (IPCC, 2022).

Globally, around 23% of anthropogenic greenhouse gas emissions are estimated to originate from the AFOLU (agriculture, forestry, and other land use) sector. Land is also an important sink of greenhouse gases (IPCC, 2019). In Finland, the emissions from the land-use sector are around 20% of total emissions (Ministry of the Environment, 2017), and the direct emissions from agriculture are around 10% (Figure 1) and have stayed quite stable in the last 10 years. The agricultural sector is obliged to mitigate emissions under the Paris Agreement (European Union, 2018), thus speeding up the research, policy development, and implementation of possible mitigation options. Climate change threatens global food production, especially through land degradation and weakening water

[1] All citations not referenced separately are from 2018 farmer survey and farmers' responses to an open-ended question "Your own comments concerning the impacts of climate change on agriculture".

availability, while at the same time, food demand is rising (IPCC, 2019). Agriculture in northern latitudes will be increasingly challenged by variable weather conditions, extreme weather, and higher risks caused by pests and disease (Peltonen-Sainio et al., 2017). However, a longer growing season and the diversification of crop choices bring opportunities for northern agriculture (Peltonen-Sainio et al., 2009; Peltonen-Sainio & Jauhiainen 2020; Zhao et al., 2022; Peltonen-Sainio et al., 2018; Trnka et al., 2011; Elsgaard et al., 2012).

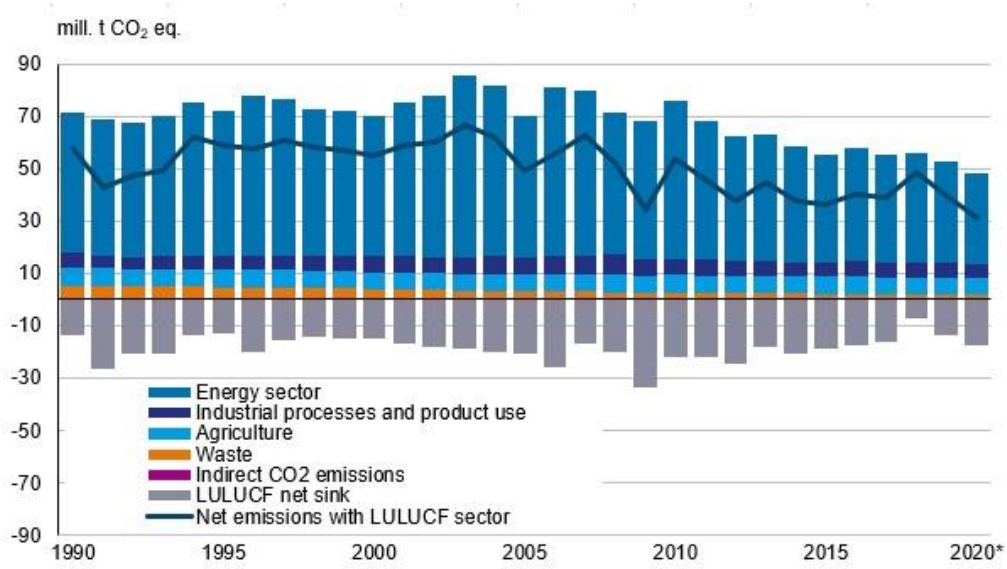

Figure 1. Finland's greenhouse gas emissions and removals by sector and the sum of all sectors, where the net sink of the LULUCF (land use, land-use change, and forestry) sector is deducted from the combined emissions of other sectors. *Based on preliminary data (OSF, 2020).

Finland is in the boreal biogeographical zone, with 73–86%[2] of its land area covered by forests (Korhonen et al., 2021) and 7% by agricultural land (Figure 2) (Natural Resources Institute Finland, 2022a). Although much of the farming has been concentrated in the southern and western parts of the country, there are also productive farms in the northernmost parts of Finland (Kuha et al., 2021). Agricultural production in Finland is geographically specialized. Dairy farms are mainly situated in the east and north, beef production in the west, and cereals in the south (Voutilainen et al., 2012).

[2] Depending on the definition of forestry land (Korhonen et al., 2021).

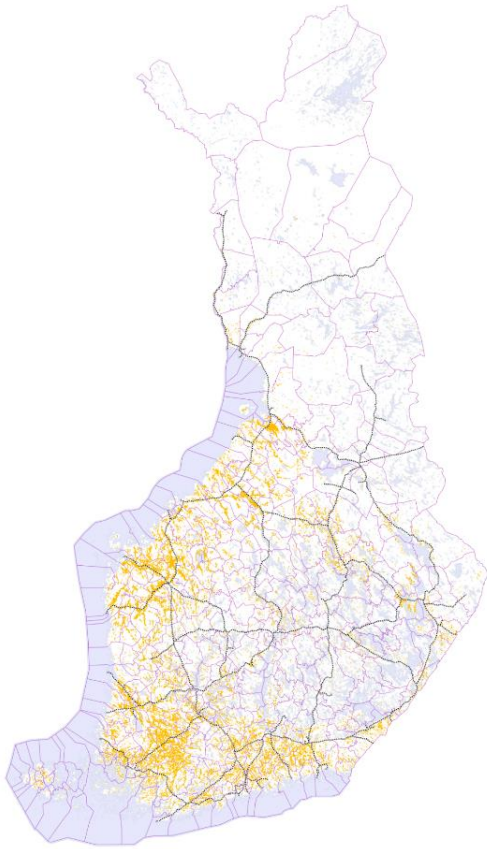

Figure 2. Agricultural land in Finland. Areas under cultivation are marked in yellow (Näsi, 2018).

Agriculture in Finland has undergone a rapid transformation. In 2020, there were fewer than 50,000 agricultural enterprises, while the land area under cultivation stayed the same (Latvala et al., 2021). In 1995, when Finland joined the EU, there were 98,000 farms in Finland (Statistics Finland, 1997). This means that the average farm size has grown over the years, as the land area of farms being abandoned have been bought by neighboring farms. Finnish farms are quite big (51 ha on average) (Natural Resources Institute Finland, 2022b) compared with farms in the European Union (15 ha) (European Commission, 2019) but quite small compared with North America (445 acres; 180 ha in the United States) (USDA, 2022). Almost 70% of farms produce cereals or other arable crops (barley, oats, wheat, rye, potato, sugar beet, turnip rape, rape, peas) and around 25% practice mixed farming with livestock (dairy, beef, pig, poultry), using their arable land mainly for feed crops (Latvala et al., 2021). Around 14% of the agricultural land in Finland is organically farmed (Latvala et al., 2022). Most farms in Finland are family-run farms that are passed to the next generation within the family.

Finnish agricultural producers are ageing. The average age of a farmer was 53 in 2020 (Natural Resources Institute Finland, 2021). Agriculture is strictly regulated by the Common Agricultural Policy (CAP) of the European Union, and it depends heavily on subsidies. Agriculture in Finland suffers from an acute economic crisis, as the level of agricultural income has decreased and has been negative for several years (Latvala et al., 2022), meaning that the profitability of agriculture is poor. Agriculture is therefore ill equipped to handle sudden crises such as the current rise in energy prizes and other production costs.

When planning a new policy that has a major impact on society, from government spending to individuals' lives, such as climate change policy, policy legitimacy becomes important (Capstick et al., 2015; Suchman 1995). Policy legitimacy and the actual willingness to implement practices require the involvement of citizens in policy development processes (Dietz & Stern, 2008). Public opinion on the causes and consequences of climate change reflect how individuals, societies, and decision makers respond to it (Capstick et. al., 2015). Public opinion matters greatly, as negative public opinion of mitigation policy has resulted in the inaction of decision makers in climate policy development (Shwom et al., 2010; Rickards et al., 2014). Social acceptance and social acceptability have been closely linked with research on new policy items such as climate policy practices. The acceptance of the people who would be affected by a policy has been thought to be a validation of that policy's legitimacy. Beliefs in risks and consequences and norms affect policy acceptance (Eriksson et al., 2006; Schuitema et al., 2011). Policies are also evaluated based on trust for the institutions proposing the policy, as well as people's notions of fairness and justice (Eriksson et al., 2006; Dreyer & Walker 2013; Schuitema et al., 2011). Individual behavior is the ultimate driver of the societal change towards low-carbon futures, and to enable the change, peoples' perceptions, and factors influencing their climate-change-related behaviors need to be known (Clayton et al., 2015).

Even with strong scientific consensus concerning climate change and its anthropogenic origin, the acknowledgement of climate change as a threat has not similarly always increased among the general public (Capstick et al., 2015; Weber, 2006; Weber & Stern, 2011). Climate change as a challenge is particularly difficult to understand for several reasons: the risks associated with climate change are very complex and uncertainties are high; there are multiple sources of climate change emissions; and the consequences are often temporally and geographically distant (Böhm & Tanner, 2019). With confusing and sometimes contradictory media communication, there are also obvious impacts on the willingness to implement climate change mitigation and adaptation measures at the grassroots level. In agriculture, farmers' decision making at the farm level is crucial for

climate change mitigation and adaptation implementation, underlining the importance of farmers' perception of climate change.

1.2. Psychology and agriculture

The first observations of the changing climate were made already in 1959, and the first scientific conclusions about the effects of the change in 1979 (Weber & Stern, 2011). Today, more than 60 years after those first observations, the problem is still debated and remains unsolved. Climate change research is deeply rooted in natural sciences and the contribution of the social sciences, not to mention the behavioral sciences, is much more recent. This thesis adopts an environmental psychological perspective on climate change mitigation in agriculture. Let us consider next why this approach is needed, and how it can contribute to solving the problems humankind is facing. How is this perspective relevant for Finnish agricultural research and policy?

Weber and Stern (2011) have suggested physical, psychological, and social factors as reasons scientific evidence has not resulted in public understanding and corresponding action to mitigate climate change. The complexity of climate change makes it difficult to understand, understanding is often based on biased personal experience and biased mental models, driven by affect, values, and worldviews, and knowledge collected from secondary sources (media) that frame their stories based on motivations other than scientific (ibid.). At least in democratic societies, the public understanding of climate change is linked to policy responses, which makes public understanding a key variable in mitigation policy formulation and implementation.

Environmental psychology can help by 1) describing and explaining the human causes of climate change by understanding how and why humans consume or behave otherwise in a way that increases emissions; 2) describing and explaining the human consequences of climate change by understanding how it will affect humans (e.g. quality of life, mental health); 3) describing, explaining, and informing responses to climate change (such interventions and campaigns); and 4) understanding people's thoughts and feelings about climate change that in turn influence their motivations and pro-environmental behavior (Swim et al., 2011).

The research in this thesis focuses on understanding farmers' values and perceptions, affecting their judgement concerning climate change to better enable responses to climate change at the policy level but also at the individual level of farmers. This enables them to better understand the causes of their behavior and makes it possible to change it in a more pro-environmental direction (Nickerson, 2008). To enable effective public interventions in the change towards pro-

environmental behavior, an understanding of the determinants of behavior is needed (van Valkengoed et al., 2022). It is commonly agreed that values form the basis of human behavior (Sagiv et al., 2017). Understanding these values and linking them to communication efforts help to understand the different perspectives people from different backgrounds bring to discussions on climate change mitigation, for example (Dietz, 2013).

Although farmers' climate change perceptions are already quite well known (Karki et al., 2020), rigid psychological research remains quite rare. This thesis will extend the theoretical perspective of environmental psychology to agricultural research. Two social psychological theories, the value-belief-norm (VBN) theory (Stern, 2000) and the theory of basic human values (Schwartz et al., 2012) are used to study Finnish farmers' pro-environmental behavior. A new psychological element of climate change opportunity is also introduced, and its effects on pro-environmental behavior are discussed.

1.3. Aim of the thesis

The overall aim of this thesis is to study the climate change perceptions of Finnish farmers and the psychological factors that influence farmers' pro-environmental, in this case climate-friendly, behavior.

The practical goal for this research is twofold: first, to bring farmer's views into the political decision-making processes currently ongoing in Finland concerning climate change mitigation and adaptation policy; and second, to help the parties of the climate-change-related discussions in agriculture understand each other's views better and build a way towards common, acceptable, and fair solutions.

The academic goal of the thesis has also been twofold: to expand the scope of agricultural and sustainability research into behavioral sciences (and vice versa), and to experiment with and add to the theories of environmental psychology.

The two main research questions for this thesis are:

1) **What are Finnish farmers' values and perceptions of climate change?**
2) **Which psychological elements predict farmers' pro-environmental behavior?**

Answers to these research questions have been sought with the more detailed research questions in each of the articles I–IV (Table 1).

Table 1. Research questions addressed in the articles composing the thesis.

Article	Research questions
I Winds of change for farmers: Matches and mismatches between experiences, views, and the intention to act	1) What is the farmers' awareness of future changes and risks related to climate change? 2) Do farmers have personal experience of the risks related to climate change? 3) What are the farmers' views on the importance of specific agricultural measures that can mitigate and help adapt to climate change? 4) Have the farmers already planned, or are they planning, to implement these measures? 5) Do the views or implementation plans differ based on demographics or practiced farming systems? 6) Are there any mismatches between farmers' views and their intention to act? 7) Based on this knowledge, is it possible to identify hotspots for future knowledge sharing and for the development of policies to encourage efficient changes towards more climate-friendly crop production systems?
II Farmer views on climate change—a longitudinal study of threats, opportunities and action	1) What are Finnish farmers' general views on climate change and its risks and opportunities for agriculture? 2) How do Finnish farmers see their responsibilities and possibilities to mitigate and adapt to climate change in agriculture? 3) Do climate views, perceived responsibility, or the possibility to mitigate and adapt differ based on demographics or practiced farming systems? 4) Has there been any change in any of the above views between 2018 and 2020, and if so, in which farmer groups? 5) Are the different climate views associated with each other, and how? 6) What is the role of personal values in shaping climate change views? 7) What are the implications of farmers' views for future climate action in agriculture?
III Value priorities of the Finnish farmers – Time to stop thinking of farmers as inherently conservative and traditional	1) Can the motivational structure of 19 values as presented in Schwartz's refined theory of basic human values be found among Finnish farmers? 2) What are the value and higher-order value priorities of Finnish farmers? 3) Do these value priorities differ according to demographics or farming choices? We then proceed to ask: 4) How do our results relate to other studies of farmer values? 5) What do our results mean concerning the future transition pathways of agriculture?
IV Climate change opportunities reduce farmers' risk perception: extension of the Value-Belief-Norm theory in the context of Finnish agriculture	1) Do the VBN theory elements form a causal path from pro-environmental value of universalism via climate change belief, risk perception, the felt possibility to mitigate and felt responsibility to mitigate pro-environmental behavior as suggested by Stern et. al. (2000)? 2) Do opportunities have a negative direct effect on risk perception, the felt responsibility to mitigate climate change, and pro-environmental behavior? 3) Are different elements of the VBN theory highlighted in different farmer groups: gender (men/women), age (under 40 years/40 years or older), farming system (organic/conventional), and in different years (2018 and 2020)?

1.4. Structure of the thesis

As the background of the thesis and the aim and research questions are presented in **chapter one**, the rest of the thesis is constructed as follows. **Chapter two** presents the methodology of the thesis by introducing the background and basic principles of environmental psychology. The central terminology and recent findings of environmental psychology regarding climate change are presented. Chapter two continues to introduce the theoretical framework of the thesis, which includes the value-belief-norm (VBN) theory and the basic human values theory. In **chapter three**, the materials and the analysis methods of the thesis are presented. The chapter starts by introducing the theoretical modifications made to the theories presented in the previous chapter and then describes the data collection procedure, respondent profiles, and analysis methods used in the thesis. **Chapter four** presents the results of the thesis: farmers' climate change perceptions and elements of farmers' pro-environmental behavior. This results chapter is organized according to the theoretical construction of the VBN theory. Farmers' values are presented first, followed by climate change belief, personal norms, and pro-environmental behavior. In **chapter five**, the results are discussed in connection with the other relevant literature. Suggestions for further research are also brought forward. In **chapter six**, the research of the thesis is summarized, and the implications of the research for policy development and further use of psychology in agricultural research are discussed. The concluding chapter, **chapter seven** offers recommendations for policy and practice.

2. Methodology and theoretical framework

2.1. Environmental psychology of climate change

Environmental psychology studies the interplay between individuals and the built and natural environment (Steg et al., 2019). The focus of the discipline is to find ways to change people's behavior towards more environmentally friendly practices and simultaneously preserve well-being and quality of life. Environmental psychology is thus connected with the broad concept of sustainability, in which not only environmental but also economic, social, and cultural aspects are considered. An interactive approach to human-environment research, interdisciplinarity, a real-life problem-focused approach, and diversity of methods are the key features of environmental psychology (Steg et al., 2019).

Environmental psychology was recognized as a separate psychological research field in the late 1960s (Nickerson, 2008; Gifford, 2016). Other names, such as ecopsychology, environment and behavior, and conservation psychology have been suggested, but environmental psychology is today widely accepted and recognized (Gifford, 2016). At first the built environment was the focus of the new discipline, and research was directed at homes and public facilities such as school environments. Another focus was the effects of environmental stressors (such as noise, humidity, and air pollution) on human performance and well-being (Nickerson, 2008).

Psychological interest in climate change has grown rapidly since around 2000 (Clayton & Manning, 2018). The research has been practical, offering support and solutions for policy processes and other disciplines engaged in climate change research (Gifford, 2007). Psychological theories and conceptualizations can be used to understand the predictors of human behavior in climate change contexts (Swim et al., 2011). The contribution of psychology and the study of human behavior to climate change research are relevant in at least three domains: 1) studying people's perceptions of climate change; 2) studying the drivers of climate-change-related behavior; and 3) studying how climate change impacts affect human behavior and well-being (Clayton et al., 2015).

Apart from the mainstream psychology that has been described above, a more qualitative approach, based on psychosocial practices, has also been proposed. Stemming from psychotherapy, a definition of climate psychology has been introduced that focuses on the role of emotions and other psychic defenses (Hogget, 2019). This thesis is based on the environmental psychology perspective.

2.1.1. Perceptions of climate change and pro-environmental behavior

Any behavior that has an impact on the environment is considered **environmental behavior** (Gatersleben, 2019). **Pro-environmental behavior** (or environmentally friendly; ecological; conservation behavior) can be defined as either goal-directed – "behavior that consciously seeks to minimize the negative impact of one's actions on the natural and built world" (Kollmuss & Agyeman, 2002) – or non-goal-directed: "behavior that harms the environment as little as possible, or even benefits the environment" (Steg & Vlek, 2002).

The reasons for pro-environmental behavior are complex. Laws, regulations, and economic incentives steer peoples' decisions, but they do not explain all human behavior. Different behaviors can be explained by different factors (Clayton et al., 2015), and behavior is not always influenced solely by conscious factors (Kahneman, 2013). In general, pro-environmental behavior in the context of climate change is guided by beliefs, norms, habits, and routines (Figure 3) (Clayton et al., 2015). One theoretical construct to study the factors contributing to pro-environmental behavior is the value-belief-norm theory (Stern, 2000), used in this research and described in detail in the next chapter. The other dimension, barriers, of pro-environmental behavior is also its own line of interest in environmental psychology and research on barriers for climate action have been accumulating in recent years (Gifford, 2011; Gifford, 2013; Gifford et al., 2018).

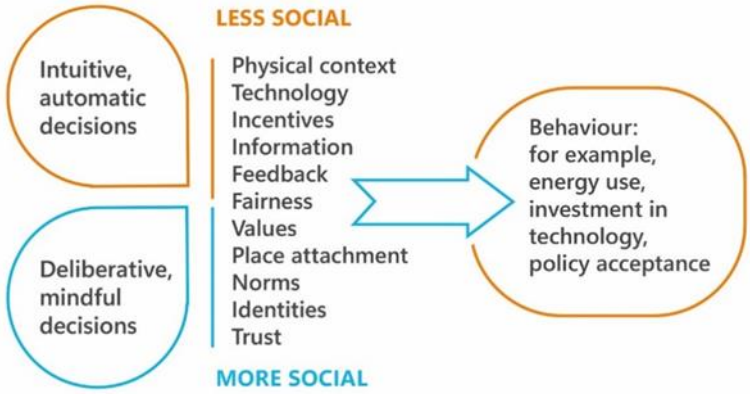

Figure 3. Factors influencing behavior relevant to climate change. Modified from Clayton et al. (2015).

The use and meaning of the term **perception** vary greatly in the literature. Attitude and belief have been used interchangeably with perception in many studies, but a broader definition has been suggested that considers the cognitive, affective, and evaluative representations of climate change, shaped by social interactions and cultural contexts (Whitmarsh & Capstick, 2018; Kahan et al., 2010; Kasperson et al., 1988). Knowledge of climate change, beliefs, attitudes, concerns, affects, and risk perceptions are therefore considered as parts of climate change perception. This broad term is also used in this research as a starting point, but the different factors of which it is comprised will be examined in this research in greater detail. A person's climate change perception is the result of a complex set of factors (Clayton et al., 2015). The direct (personal experience) and indirect (through media and other persons) experience of climate change is moderated by various factors that result in biased perceptions of climate change (Figure 4). Different people therefore tend to have differing perceptions about the same issue, and why climate change mitigation and adaptation are not universally endorsed by everyone.

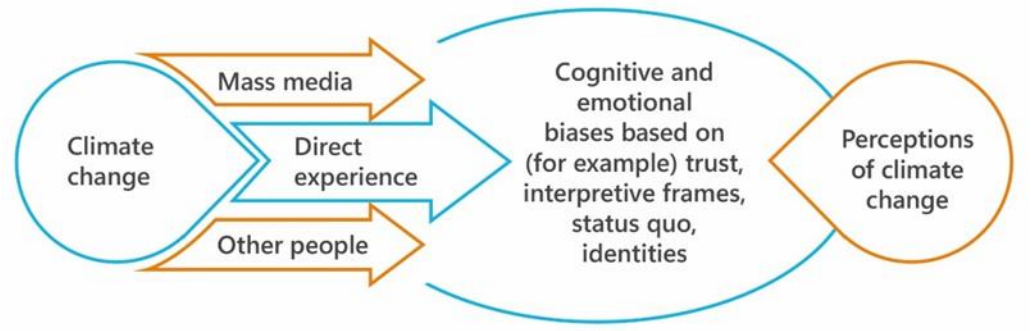

Figure 4. Climate change perception. Modified from Clayton et al. (2015).

In many situations of human decision making, the only method for weighting and assessing uncertain outcomes is intuitive judgement (Tversky & Kahneman, 1983). Human cognition, or the processing of knowledge, operates via **heuristic procedures**, or mental shortcuts, that are essential in quick problem solving but also susceptible to biases (Tversky & Kahneman, 1974). **Cognitive biases** can be defined as faulty mental processes that lead judgements and decisions to violate commonly accepted normative principles (Montibeller & von Winterfeldt, 2015), whereas **motivational biases** are conscious or subconscious distortions of judgements and decisions because of self-interest, social pressures, or organizational context. Judgements are thus influenced by the desirability or undesirability of events, consequences, outcomes, or choices (Montibeller & von Winterfeldt, 2015). Psychological research has identified a multitude of different heuristics and biases (e.g. Gilovich et al., 2002; Montibeller & von Winterfeldt, 2015;

Tversky & Kahneman, 1973; Tversky & Kahneman, 1974; Tversky & Kahneman, 1983), and academic interest has turned to climate change perceptions and biases in the recent years (Luo & Zhao, 2021; Nurse & Grant, 2020). The effect of heuristics and biases on agricultural decision making has not been studied at all.

A cognitive process of **availability heuristics** states that the frequency or probability of an event is judged based on the ease with which similar instances are recalled. This leads to a **retrievability of instances bias** where the occurrence of an event of which we have recent memories or experiences is often overestimated (Tversky & Kahneman, 1974). Personal experience of climate-change-related risk, e.g. a recent heatwave (Howe & Leiserowitz, 2013) or flood (Spence et al., 2011) in a person's immediate neighborhood is connected with an increase in climate change concern and willingness to act. Similarly, a recent experience of a very cold winter might understate the urgency of action to prevent global warming altogether. In this light, it is worthwhile to study personal experiences with risk events connected to climate change to see if such a bias does exist and its effect on climate change views.

Optimism bias means that "people believe that negative events are less likely to happen to them than to others, and they believe that positive events are more likely to happen to them than to others" (Weinstein, 1980). Following this reasoning, this bias positions the negative impacts of climate change to another time, somewhere else, or for someone else to worry about (Böhm & Tanner, 2019). Because of motivational biases such as **motivated reasoning**, where an assessment of a situation is biased towards a person's own beliefs and goals (Montibeller & von Winterfeldt, 2015), the periods or risk incidents that would support climate change are more difficult to remember for people who deny its existence (Böhm & Tanner, 2019).

Affect heuristics are an important part of risk assessment. It can be a state of feeling (or emotions) that people experience (happiness/sadness) or a quality (e.g. goodness or badness) that is associated with a stimulus (Finucane et al., 2000) such as climate change. If an individual has a positive feeling about an activity, the risk is evaluated as smaller, and the benefits greater, and if the feeling is negative, vice versa. In a sense, the emotions work as motivators for biased risk perception. For the climate change context, this would imply that those who worry about or fear climate change impacts also evaluate the costs of mitigation and adaptation less than those who are not worried.

Apart from cognitive, motivational, and emotional biases, **psychological distance** also affects risk perception (Azadi et al., 2019). Psychological distance is the perceived distance of risk impacts and oneself (Böhm & Tanner, 2019). It can be temporal (happening in the distant future), geographical (happening far

away), or social (happening to people very different from oneself). Psychological distance diminishes the perception of risk as incidents happening in the distance are subjectively evaluated as less significant than those closer to oneself (Böhm & Tanner, 2019). Thus, even when climate change risks are thought to be great in some parts of the world, this will not provoke action.

Climate change perception research started in the late 1980s and early 1990s, and it has progressed from a few studies of the shift of public awareness of the physical and scientific aspects of climate change towards multiple and continuous research on how climate change affects people's personal life and changes societies at large (Capstick et al., 2015). Six main conclusions have been drawn from recent research into the general public's perceptions of climate change: 1) awareness and self-reported knowledge have been rising over the decades, and people are reasonably well informed about climate change; 2) people still lack an understanding of the actual sources of emissions and the different sectors' relative contribution to climate change; 3) people underestimate their own contribution to causing climate change and overestimate the role of others; 4) climate skepticism has not waned, even though the scientific evidence and consensus has become unanimous over time; 5) climate change is perceived to produce negative consequences but is not regarded as a priority among competing concerns such as the economy, healthcare, and other social issues; and 6) climate change is not perceived as a personal threat in the developed country context (Whitmarsh & Capstick, 2018).

Climate change opportunities (positive effects of climate change) and their impact on climate-change-related behavior have rarely been studied before in the agricultural or any other context. This is a novelty that is introduced in Articles II and IV of this thesis.

2.1.2. Farmers' climate change perceptions

An initial literature review was conducted at the beginning of the thesis process in 2016 to understand what research had been conducted into farmers' climate change perceptions at that time, when little was published on the subject. For the purposes of the articles in this thesis, the relevant literature has been sought each time separately for their needs. A new systematic literature review was undertaken in 2022 for this thesis. The results have yet to be published separately but are briefly summarized here.

Original journal articles in English were searched for in the Scopus database in October 2022. The search terms were "climate change" AND farmer AND perception OR view. This resulted in 1,358 articles published between 1988 and

2022. Farmers' climate change perceptions have been a growing focus of research for the last decade (Figure 5), with more than 600 original articles published between 2020 and 2022. The single largest contributor to the research has been the United States (241 articles), followed by China (120), the United Kingdom (116), and Australia (114). Finland has contributed 19 articles on the subject, including Articles I, II, and IV of this thesis. Climatic Change, Sustainability, and Climate and Development were the top three publishers of this research. Most of the published articles, 32%, were classified under environmental sciences, 21% under social sciences, and 16% under agricultural and biological sciences. Only three articles were classified under psychology, of which Article IV of this thesis was one.

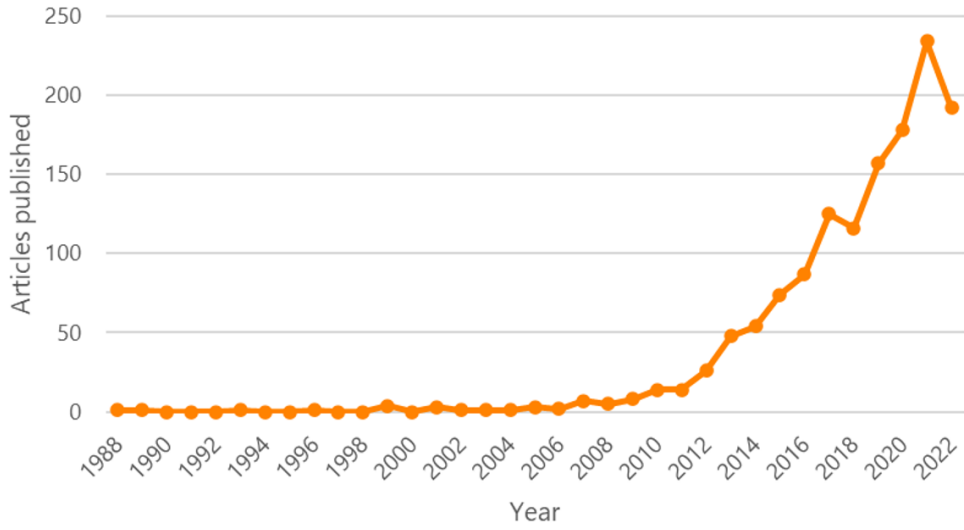

Figure 5. Original research articles published between 1988 and 2022 (end of October 2022) based on the search done with Scopus using the search terms "climate change" AND farmer AND perception OR view.

Farmers' climate change perceptions are very well known throughout the world (Karki et al., 2020; Table 2). In 2022 alone, 53 pieces of research were published on farmers' adaptation strategies (farmers' responses to climate change risks), 41 on their climate change perceptions, and 16 on different water and drought management practices, a distinctive section of the adaptation strategy literature. Most of the literature focuses on adaptation, and mitigation research is scarce. New areas of farmers' climate change perception research are health, inequality, and justice-related research. Psychological research in some form was used in 18 articles.

Table 2. Summary of the farmers' climate change perception literature from January to October 2022 (N=192): themes of the articles; number for each theme; region on which the research focuses; and if psychological research has been applied. Na=information is not available. The full title of each article is presented in Appendix 1: Farmers' climate change perception literature at the end of the thesis.

Theme	Number of articles	Region	Psychology
Adaptation governance and policy	3	Czech Republic, EU, France	0/3
Adaptation strategies	53	Australia, 4 x Bangladesh, Cameroon, 3 x China, Ethiopia, France, 2 x Ghana, 6 x India, Indonesia, 2 x Iran, 2 x Kenya, Mali, Mediterranean region, Nepal, the Netherlands, 3 x Nigeria, 4 x Pakistan, 2 x Romania, Senegal, South Africa, South-eastern Africa, Sub-Saharan Africa, Sweden, Tanzania, Tibet, Tunisia, 2 x Turkey, Uganda, USA, 2 x Vietnam, West Africa	5/53
Agricultural systems	6	2 x Bangladesh, Brazil, France, Kenya, Spain	0/6
Climate impacts	12	Congo, Ethiopia, Europe, India, Indonesia, Iran, Kenya, Lesotho, Nigeria, South Africa, Vietnam (1 x na)	0/12
Climate perceptions	41	Australia, 2 x Bangladesh, 2 x Benin, Brazil, Cameroon, 2 x China, Congo, Côte d'Ivoire, Ecuador, Ethiopia, Finland, Honduras, 6 x India, Indonesia, 2 x Iran, Malawi, 3 x Nepal, Nigeria, Peru, Romania, 2 x South Africa, Spain, Sudan, Tanzania, Turkey, 2 x USA (2 n/a)	6/41
Health	3	Brazil, China, Gambia	0/3
Inequality and justice	6	Ethiopia, Finland, 2 x Ghana, Guatemala, Jamaica	0/6
Innovation and technology adoption	9	2 x Ethiopia, Ethiopia, Ghana, India, New Zealand, Nigeria (3 n/a)	0/9
Land management and farming practices	11	2 x Brazil, Finland, 2 x Ghana, Indonesia, Italy, Kenya, Nepal, South Asia, Turkey	1/11
Mitigation and adaptation strategies	9	China, 3 x Ethiopia, Iran, Nepal, the Netherlands, Philippines, Vietnam	4/9
Mitigation strategies	3	Canada, India, Japan	2/3
Water and drought management	16	Afghanistan, Australia, 3 x Ethiopia, India, Jordan, 2 x Pakistan, South Asia, USA, Uzbekistan, 2 x Vietnam (2 n/a)	0/16
Other (not relevant)	20		

Early research on the farmer- and climate-change-related literature dealt with climate change as one of the possible causes of different risks to agriculture such as perceptions of drought by farmers in the USA (Taylor et al., 1988). Early on,

adaptation strategies for farms in the USA (Lewandrowski & Brazee, 1993) and the economic impacts of climate change on Finnish agriculture (Kettunen, 1996) were also evaluated. Some of the first qualitative research in which farmers were interviewed about their perception of climate change was from China (Hageback et al., 2005) and Canada (Reid et al., 2007), followed by qualitative approach with survey methods in Burkina Faso (Barbier et al., 2009) and the Sahel region in Africa (Mertz et al., 2009). In the following years, research was done mainly in the developing world context. Research in the developed countries started with Australia (Buys et al., 2012), USA (Haden et al., 2012; Arbuckle et al., 2013a; 2013b) and was followed by a multitude of research from all over the world: Chile (Roco et al., 2015); New Zealand (Niles et al., 2016); Italy (Nguyen et al., 2016); Sweden (Asplund, 2016); South Africa (Hitayezu et al., 2017); Bangladesh (Kabir et al., 2017); Nepal (Khanal et al., 2018); Norway (Brobakk, 2018); Peru (Altea, 2020); India (Datta et al., 2022); and Finland (Articles I and II of this thesis).

As previously mentioned, psychological research in the context of agriculture is still quite scarce. Besides the VBN theory used in this thesis, the theory of planned behavior (TPB) (Ajzen 1991) has been widely used to explain pro-environmental behavior. Although rigorous TPB and VBN research is not that common, separate elements from the theories have been used in many studies in the agricultural sector. For example, climate change beliefs and connections between adaptation and mitigation action with Danish (Jørgensen & Termansen, 2016) farmers and climate change beliefs and norms with Scottish (Barnes & Toma, 2012) and German (Eggers et al., 2015; Jantke et al., 2020) farmers. The TPB theory has been used to explain and predict the climate change perceptions of farmers' at least in Thailand (Arunrat et al., 2017), Nigeria (Jellason et al., 2019), for three studies in China (Song & Shi, 2020; Duan et al., 2021; Li et al., 2021), and Vietnam (Nguyen & Drakou, 2021), and in New Zealand (Small & Maseyk, 2022), the theory was used to predict biodiversity drivers in agriculture.

Apart from Article IV of this thesis, four applications of VBN theory in agriculture have been found. In Australia, contextual factors and social-psychological characteristics such as values, attitudes, and norms predicted farmers' pro-environmental land management practices (Price & Leviston, 2014). It was found that farmers' own skills and abilities, environmental constraints, pro-environmental values, and sense of being able to control one's own destiny were the greatest predictors of pro-environmental behavior. According to these results, agricultural change is highly driven by the farmers' individual motivations. In the context of the US, two groups (farmers and non-farmers) were compared, and an explanation was sought through amendments to the VBN theory for the climate-change-related tension between these two groups (Sanderson et al., 2018). Besides values and a pro-environmental worldview, political ideology and

knowledge concerning the local environment was studied as predictors of climate change belief. Although the results showed that climate change belief was rooted in values, the pro-environmental worldview was the strongest predictor of climate change beliefs. A conservative political ideology predicted climate skepticism and increased knowledge about the local environment predicted a more positive relationship with anthropogenic climate change. When the two groups studied shared pro-environmental values, their perceptions of climate change also became unified. This implies that value-based engagement strategies would bring the two groups closer and help ease the tension around climate change issues. Rezaei-Moghaddam et al. (2020) analyzed the pro-environmental behavior of Iranian farmers in the context of clean technology adoption with the VBN theory framework. They found that the farmers' perceived ability to utilize new technology (perceived behavioral control), supporting norms, and education increased the adoption of the proposed technology. Similar to the research of Price & Leviston (2014), Zhang et al. (2020) also compared the predictive power of the VBN theory with the TPB theory. Adaptation behavior, a more self-interest-oriented behavior, was more accurately predicted with the TPB theory. Mitigation behavior was seen as more altruistic, and the value-based VBN theory predicted the pro-environmental behavior for mitigation with Chinese farmers better than the TPB theory.

2.2. Theoretical framework

2.2.1. Value-belief-norm theory

The value-belief-norm (VBN) theory was developed by the social psychologist Paul C. Stern and his colleagues. The most cited version of the theory and the one used as the basis for this research was published in 2000 and has been widely used[3] to explain pro-environmental behavior in different contexts. The theory conceptualizes how certain pro-environmental values, an ecological worldview, an awareness of the negative consequences of environmental risks, a personal ability to act on minimizing the risks and personal norms together form a sequential line of predictors that ultimately lead to an individual's pro-environmental behavior (Figure 6). The rationale behind the theory is that as individuals must restrain their egotistic needs and make short-term sacrifices for the sake of

[3] The article "New environmental theories: Toward a coherent theory of environmentally significant behavior" published in 2000 in the Journal of Social Issues 56 (3): 407–424, had 9,149 citations in Google Scholar on 10.10.2022.

common environmental benefits, there are certain psychological factors that empower this altruistic behavior (Steg et al., 2005). The purpose of the theory is to identify and understand these factors and enable change towards more pro-environmental human behavior (Stern, 2000). The VBN theory was developed based on the combination of the basic human values theory (Schwartz, 1992), the New Environmental Paradigm (NEP) scale (Dunlap & van Liere, 1978), and the Norm Activation Model (NAM) (Schwartz, 1977; Schwartz and Howard, 1981).

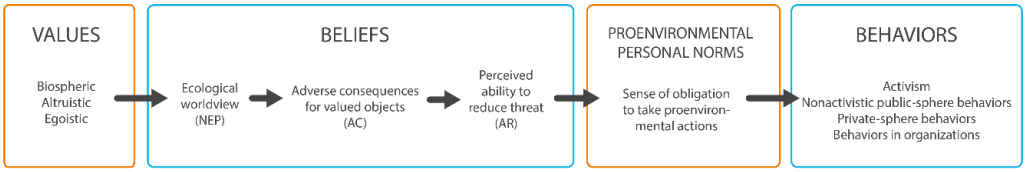

Figure 6. The original VBN theory (Stern, 2000).

Values, or "desirable trans-situational goals, varying in importance, that serve as guiding principles in the life of a person or other social entity" (Rokeach, 1973; Schwartz, 1994) and the development of the basic human values theory will be more thoroughly described in the next chapter. Values and their connection with behavior in general and pro-environmental behavior in particular has been widely debated. It is now commonly accepted that different values predict different kinds of attitudes and behaviors (Sagiv et al., 2017). In general, values do not have a strong direct effect on behavior without other mediating factors, but universalism and benevolence especially have been identified to be closely related to the willingness to act in an environmentally friendly way (Hansla et al., 2008; Schultz et al., 2005; Stern, 2000). These values position the goal of behavior above one's own personal interests to those of others and the non-human word and therefore motivate pro-environmental behavior (Steg et al., 2005). Surprisingly, hedonism is also connected with pro-environmental behavior, but through a different kind of reasoning. Here, the harm of environmental risks and degradation are seen to threaten one's personal needs, and pro-environmental behavior is therefore exercised (Schultz et al., 2005).

The NEP scale was developed as a measure of a pro-environmental worldview or the environmental concern of an individual, and it has been developed further since its publication in 1978. The new version of the scale is constructed of 15 statements covering different aspects of environmental issues and the rights of humans to modify the natural environment (Dunlap et al., 2000). While the values are quite stable and not easily altered (Sagiv et al., 2017), this is not the case with worldviews, which can fluctuate based on new knowledge and life experiences. The direct connection between a worldview and behavior is not typically very strong (Stern, 2000; Steg et al., 2005).

NAM was originally developed to explain any altruistic behavior but has often been applied to environmental contexts. The theory succeeded in explaining pro-environmental behavior with low costs to the individual but not behavior with high costs (of money, time, or other resources) (Stern et al., 1995). In NAM, pro-environmental behavior was the result of one's awareness of negative consequences and understanding that those negative consequences could be reduced by one's own action, which in turn activated the norms enabling the actual behavior (Schwartz, 1977; Schwartz & Howard, 1981).

These three theories were combined as the VBN theory, and the causal chain began with pro-environmental values (biospheric, altruistic, or egotistic), which in turn activate the ecological worldview (NEP), leading to an understanding of the negative impacts (or risks) of an environmental problem to something valued by the person (awareness of consequences, AC), again reinforcing the understanding of one's personal abilities to reduce the threat (perceived ability to reduce threat, AR). This in turn activates the personal norms (PN) needed for pro-environmental behavior (Stern, 2000) (Figure 6). In the original theory, pro-environmental behavior was categorized in four distinct types of behavior: 1) environmental activism; 2) non-activism in the public sphere; 3) non-activism in the private sphere; and 4) other environmentally significant behavior (such as influencing the actions of the organizations to which they belong) (Stern, 2000).

The VBN theory has been widely used to explain pro-environmental behavior in different contexts. A difficulty has arisen due to the vast use of the theory in different disciplines, resulting in incoherent terminology. Even if the VBN theory seems simple, it contains a lot of specialist terminology that needs to be defined. A **belief** can be defined as one's personal knowledge of things. It can be scientifically correct or not. What is important is that the person believes it to be true (Heberlein, 2012). Perception is sometimes used interchangeably with belief or attitude, but it is regarded here as a broader term that includes concern, perceived risk, knowledge, and affect, besides beliefs and attitudes (Whitmarsh & Capstick, 2018). **Awareness of consequences** (awareness of adverse consequences for valued objects) entails the belief that environmental conditions such as climate change threaten something one values (Steg et al., 2005). **Risk perception** has been used interchangeably with awareness of consequences (e.g. Arbuckle et al., 2015). **Risk** is defined as a situation, event, or activity which might lead to uncertain and negative outcomes for something of value (Böhm & Tanner, 2019). The two components of risk are uncertainty and severity. **Environmental risk** (such as climate change risk) entails high complexity and uncertainty and often consequences that are geographically and temporally distant (Böhm & Tanner, 2019). According to the IPCC (2018), climate change risk "refers to the potential for adverse consequences of a climate-related hazard, or of adaptation or mitigation responses to

such a hazard, on lives, livelihoods, health and well-being, ecosystems and species, economic, social and cultural assets, services (including ecosystem services), and infrastructure". **Risk perception** is the subjective judgement of people concerning a risk (IPCC, 2018). Climate-change-related risk perceptions vary internationally (Lee et al., 2015) and change over time (Milfont et al., 2017).

The **perceived ability to reduce threat** (or the felt possibility to perform pro-environmental behavior) that will, for example, reduce the negative impacts of climate change, is related to the term self-efficacy: "a judgement of one's capability to accomplish a certain level of performance" (Bandura, 1986). **Social norms** can be defined as behavioral rules and standards that come with sanctions unless followed (Keizer & Schultz, 2019; Heberlein, 2012). **Personal norms** are standards or rules for one's own behavior (Kallgren et al., 2000).

2.2.2. Theory of basic human values

In 1973, Milton Rokeach, the pioneer of value research, wrote: "the concept of values is the core concept across all the social sciences" and "the main independent variable in the study of social attitudes and behavior" (Rokeach, 1973: preface). **Basic values** are defined as "desirable transsituational goals, varying in importance, that serve as guiding principles in the life of a person or other social entity" (Schwartz, 1994: 21). This goal-oriented definition implies that values serve the interests of social entities, can motivate action, function as standards for judging and justifying action, and are acquired through socialization and learning experiences (Schwartz, 1994).

The early development of the theory of basic human values (Schwartz & Bilsky, 1987; Schwartz & Bilsky, 1990) is built on three universal human requirements which form a prerequisite for all human existence: the needs of individuals as biological organisms; the requisites of coordinated social interaction and survival; and the welfare needs of groups (Schwartz & Bilsky, 1987). Taking the Rokeach value survey (Rokeach, 1973) as its starting point, the early version of the theory defined seven motivational domains of values that were organized dynamically in relation to each other. The data were gathered from schoolteachers in Israel and college students in Germany (Schwartz & Bilsky, 1987). In the second phase of the theory development, the universality was studied in more detail with data from Australia, Finland, Hong Kong, Spain, and the USA. This time, the data were gathered from students or teachers, with the exception of the USA, where a representative sample of adults was used, and Finland, where adult residents of a small coastal village were studied. Apart from Hong Kong, the same seven motivational domains were confirmed as in the earlier study (Schwartz & Bilsky, 1990).

The basic structure of the ten motivational values in the current theory was published by Schwartz in 1992. With data from 20 different countries (including Finland), three new values (tradition, stimulation, and power) that had not been included in the previous theory were studied further; one new value (spirituality) was introduced and tested for the first time, and four values (enjoyment, maturity, prosocial, and security) were redefined and fine-tuned. Ultimately, spirituality did not prove to be universal by nature and was therefore omitted from the theory (Schwartz et al., 1992). The 1992 article presented the first continuum model of ten values, with four higher order values (openness to change, conservation, self-enhancement, and self-transcendence) and their bipolar dimensions.

The newest revision of the theory is constructed around 19 values into which six of the ten original values (self-direction, power, security, conformity, universalism, and benevolence) were divided, and two new values (humility and face) were introduced (Schwartz et al., 2012) (Table 3).

Table 3. The definitions of the 19 basic human values (Schwartz et al., 2012).

Value (abbr.)	Conceptual definition in terms of motivational goals
Self-direction-thought (SDT)	Freedom to cultivate one's own ideas and abilities
Self-direction-action (SDA)	Freedom to determine one's own actions
Stimulation (ST)	Excitement, novelty, and change
Hedonism (HE)	Pleasure and sensuous gratification
Achievement (AC)	Success according to social standards
Power-dominance (POD)	Power through exercising control over people
Power-resources (POR)	Power through control of material and social resources
Face (FAC)	Security and power through maintaining one's public image and avoiding humiliation
Security-personal (SEP)	Safety in one's immediate environment
Security-societal (SES)	Safety and stability in the wider society
Tradition (TRA)	Maintaining and preserving cultural, family, or religious traditions
Conformity-rules (COR)	Compliance with rules, laws, and formal obligations
Conformity-interpersonal (COI)	Avoidance of upsetting or harming other people
Humility (HUM)	Recognising one's insignificance in the larger scheme of things
Benevolence-dependability (BED)	Being a reliable and trustworthy member of the ingroup
Benevolence-caring (BEC)	Devotion to the welfare of ingroup members
Universalism-concern (UNC)	Commitment to equality, justice, and protection for all people
Universalism-nature (UNN)	Preservation of the natural environment
Universalism-tolerance (UNT)	Acceptance and understanding of those who are different from oneself

The circular continuum structure was kept (Figure 7), and it presents compatible and conflicting motivations at the same time: the adjacent values complement and the opposite values conflict with each other. Nineteen basic human values can be computed into four higher-order values, which are: 1) openness to change; 2) self-enhancement; 3) conservation; and 4) self-transcendence. The higher-order values are separated between values of more personal focus vs more social focus, and along the lines of self-protection vs self-growth (Schwartz et al., 2012). Based on the renewed theory, it is possible to measure values in more detail with the 19 values, but still also to combine the values and measure the 10 original and four higher-order values (Schwartz. et al., 2017). In this thesis (Articles III and IV), the renewed theory with 19 values is used.

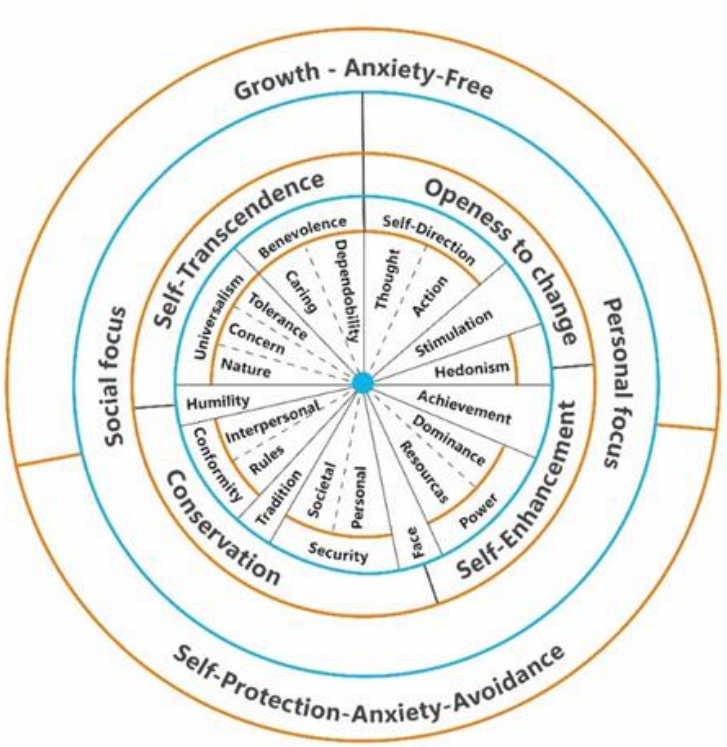

Figure 7. The circular continuum of the 19 values (Schwartz et al., 2012).

The Schwartz theory of basic human values has been widely tested and used especially in psychological and social psychological research, and it has resulted in hundreds of articles on value relations to different characteristics, personality traits, behaviors, attitudes, and opinions (Maio, 2017; Schwartz et al., 2012). From quite early on, the theory of basic human values has spawned research into

values and their connectedness to other traits in human behavior, such as environmental concern (Hansla et al., 2008; Schultz et al., 2005).

Value research in Finland has long traditions with Schwartz's theory of basic human values (Helkama, 2018; Koivula, 2008; Puohiniemi, 2006). The theory is less common in the agricultural context, but there are some examples. Dobricki (2011) studied the value structures and profiles of a small sample of Swiss farmers, compared the four higher-order values of Switzerland's general population to those of farmers, and found them to be different. Baur et al. (2016) broadened the study to cover six additional countries, also making general remarks on Finland. Article III of this thesis was the first study of farmers' values with the renewed theory of 19 basic human values. As stated above, values are a key element in VBN theory in determining pro-environmental behavior.

3. Materials and methods

3.1. Theoretical development

For the purposes of the research presented in this thesis, modifications were made to the original VBN theory to enable research specifically in the climate change context, to take advantage of the new findings in the recent literature, and to study the opportunity aspect of Finnish farmers' climate change perceptions (IV: Figure 1). The original VBN theory (Stern, 2000) used a version of Schwartz's basic human values theory with biospheric, altruistic, and egotistic values. As a more detailed version of the basic human values theory had been developed since the VBN theory was launched, the new version was also used in this research. Universalism values correspond to the old biospheric values, benevolence values to the old altruistic values, and hedonism to the old egotistic values. As the results of Article II showed that universalism had the strongest connections to the VBN theory elements and the value of achievement to climate change opportunities, these two values were introduced as part of the research in Article IV.

The original VBN theory used the NEP scale to measure general environmental attitudes, but for the purposes of more climate-change-specific research, new instruments were needed. Climate change belief was therefore introduced following the research by Arbuckle et al. (2015). The scale distinguishes between the causes of climate change: whether climate change is of natural or of anthropogenic origin.

Studying self-reported behavioral intention as a predictor for actual behavior has been criticized in the agricultural context (Niles et al., 2016), but for this research, the measures for actual mitigation behavior were not possible to obtain as there are no sufficient documented data on mitigation action undertaken by farmers in Finland. Therefore, the measure of pro-environmental behavior was farmers self-reported intention to mitigate (see Table 4).

As research on climate change opportunities is still scarce, no description for the term was available in the literature. Climate change opportunities were thus defined in Article IV as "Direct opportunities caused by global warming (e.g. the possibility to extend agricultural production to more northern areas because of the rise in average temperatures) and as indirect opportunities where an action becomes beneficial because of the need to adapt to or mitigate climate change (e.g. development of new technology)." The absence of previous research also meant that the instruments for measuring climate change opportunities had to be developed specifically for this research.

3.2. Farmer surveys

The data collection was conducted in an EU-Life funded project "Optimizing agricultural land use to mitigate climate change" (OPAL-Life), which ran from 2015 until 2022. The project aimed for climate change mitigation in agriculture in an environmentally, economically, and socially sustainable way. Collaboration with farmers was a crucial part of the project, and the project's outcomes were developed with them. The project had a network of 20 pilot farms, and the basis for the surveys described below was collaboratively developed based on farmers' feedback. Close collaboration with farmers strived for an understanding of farmer perspectives right from the planning phase onwards. Surveys were tested with a sample audience before being sent to the actual respondents. There was close collaboration with the newspaper *Maaseudun tulevaisuus* (the name means "the rural future"), the main newspaper in the rural areas, to remind and encourage the farmers to answer the surveys.

Two surveys of the Finnish farmer population were conducted, the first in the spring of 2018 and the follow-up survey in the spring of 2020. The first survey of 2018 was sent to all Finnish farmers with an email address in the current Finnish Food Authority (the then Finnish Agency for Rural Affairs) database, a total of 38,091 farmers. The surveys were designed to enable research based on the VBN theory and basic human values theory described in the previous chapter. The survey consisted of demographic and farm-specific questions, structured statements, and open-ended questions. Altogether, the 2018 questionnaire had 11 demographic and farm-specific questions, 11 structured questions, with 275 statements and two open-ended questions. The 2020 questionnaire had the same demographic and farm-specific questions as the previous survey, 13 structured questions with 117 statements and two open-ended questions. The 2020 survey had an additional part for farmers with peatlands, and this consisted of six structured questions with 41 statements, one open-ended question, and five choice experiment questions. Both surveys could be answered in Finnish and in Swedish, Finland's official languages. It was obligatory to answer all the questions, so there were no missing data. Some of the background variables connected to the farms were combined with the 2018 survey data from the Finnish Food Authority database with the farm identification code. This succeeded quite well, but due to some minor problems, all the background variables and farm-specific questions were included in the 2020 survey.

Apart from the climate-change-related questions used for this thesis (Table 4), the 2018 survey included questions concerning mitigation practices, mitigation policy, trust in climate change information providers, and the future of Finnish agriculture. The 2020 survey included questions about agricultural water management, organic production, peatland management, and investment, which are also not part of this thesis. These data are published in articles not included in this thesis, and some are still unpublished and will be used in forthcoming articles.

Altogether, 4,401 farmers responded to the 2018 survey, and the response rate was thus 12%. The follow-up survey of 2020 was sent to those farmers who had responded to the first survey. Altogether, 2,000 responses were received, making the response rate 45%.

Table 4. Themes, survey years, questions, response scales, number of statements, examples of statements, and the article where the data have been used.

Theme	Survey year(s)	Question	Response scale	Number and examples of the statements	Used in article
Climate change: personal experience of risk	2018	Have you experienced changes on your farm or in your region in the 2000s?	1=Not at all 2=Rarely 3=Occasionally 4=Frequently 5=All the time	11 statements - Increased need to control plant diseases - Increased damages caused by drought	I
Climate change: personal experience of opportunity	2018	Have you experienced changes on your farm or in your region in the 2000s?	1=Not at all 2=Rarely 3=Occasionally 4=Frequently 5=All the time	11 statements - Expansion of the area under autumn sown crops and cultivars - Increasing opportunities for autumn sowing	I
Climate change: importance of mitigation and adaptation practices	2018, 2020	Do you consider the following measures to be important or unimportant?	1=Unimportant 2=Quite unimportant 3=Neither important nor unimportant 4=Quite important 5=Important	23 statements - Taking care of the basic soil conditions - Diversifying crop rotations	I
Climate change: current and future mitigation and adaptation behaviour	2018	Have you already implemented any of the measures, or do you plan to do so on your farm?	1=Implemented already 2=I will in next growing season 3=I will within the next 2–5 years 4=I will but after 6 years at the earliest 5=I'm not going to implement any 6=Does not concern my farm	23 statements, same as above	I
Climate change: risk awareness and knowledge of emission sources in agriculture	2018, 2020	What do you think about the following statements?	1=Fully disagree 2=Disagree 3=Neither agree nor disagree 4=Agree 5=Fully agree	20 statements - Pressure caused by pests will increase in the forthcoming years - Peat soils cause less emissions than mineral soils	I

Theme	Survey year(s)	Question	Response scale	Number and examples of the statements	Used in article
Climate change: perception of impacts on agriculture	2018, 2020	What do you think about the following statements?	1=Fully disagree 2=Disagree 3=Neither agree nor disagree 4=Agree 5=Fully agree	9 statements - Climate change is a great threat to agriculture in Finland - Climate change creates new possibilities for Finnish agriculture	II, IV
Climate change: perception of farmer responsibility and possibility to act	2018, 2020	What do you think about the following statements?	1=Fully disagree 2=Disagree 3=Neither agree nor disagree 4=Agree 5=Fully agree	18 statements - I have to reduce climate emissions from my own farm - Practices made by the farmers can mitigate climate change in Finland	II, IV
Climate change belief	2018, 2020	Choose a statement that best describes your opinion	1=Climate change is not occurring 2=Not sufficient evidence to know whether climate change is occurring 3=Climate change is occurring, caused mainly by natural changes 4=Climate change is occurring, and it's caused equally by natural and human activities 5=Climate change is occurring, and it's mostly caused by human activities.		II, IV
Values	2018	Different types of people are described briefly below. Read every description and consider how similar you are to each person described.	1=Not at all like me 2=Fairly different from me 3=Slightly different from me 4=Slightly similar to me 5=Fairly like me 6=Very like me	57 statements - It is important to him/her to take risks that make life exciting - It is important to him/her to take part in activities to defend nature	II, III, IV
Climate change: mitigation intention	2020	I will reduce climate emissions from my farm	1= No matter what 2=Only if other sectors commit to climate change mitigation 3=Only if I receive compensation 4=I will not mitigate climate change		IV

3.3. Demographics of the survey respondents

Although the response rate for the 2018 survey was 12%, the sample represented the Finnish farmer population quite well in many different demographic and farm-specific aspects for both surveys (II: Appendix 1). In 2018, 13% (N=569) of the respondents were female, and 87% (N=3,831) were male. As 12% and 88% was the respective gender balance in the total Finnish farmer population, the survey sample represented the genders well.

The age of the respondents varied between 18 and 78, and the average respondent age was 51. The biggest respondent age group was 51–70-year-olds (52%) (Figure 8). The second biggest respondent group, the 30–50-year-old group, was slightly overrepresented in the survey sample (sample 42%, total 36%). For education, the biggest respondent group was farmers with vocational (or secondary) schooling as their highest level of education, 65% (Figure 9), which is also the biggest group in the total Finnish farmer population. Farmers with university degrees were the second biggest respondent group (26%), and farmers with comprehensive (or primary) schooling were the third biggest respondent group (7%). The survey sample was a little biased towards farmers with vocational schooling in the expense of farmers with comprehensive schooling, as the total percentage of farmers with comprehensive schooling is 18%.

Cereal farmers were the biggest group (43%, N=1,893) to answer the survey (Figure 10), followed by dairy production (19%, N=804). The "other" group was the third biggest group (11%, N=486), and it consisted of sheep and horse farms, bee farming, silviculture, land renting, landscape management, agricultural services for other farmers, and tourism. There were some difficulties with the farm-type data, as the information was not sought from the farmers in the 2018 survey but collected from the registry data. As the registry data were from 2016, there were not always corresponding farm-type data for all respondents. This accounts for the quite large "not known" group (5%, N=204) in the data. For the follow-up survey in 2020, farm-type information was sought in the survey. The respondents covered all 16 administrative regions (II: Appendix 1) and were representative of the NUTS 2003–2006 regions in Finland (Figure 11).

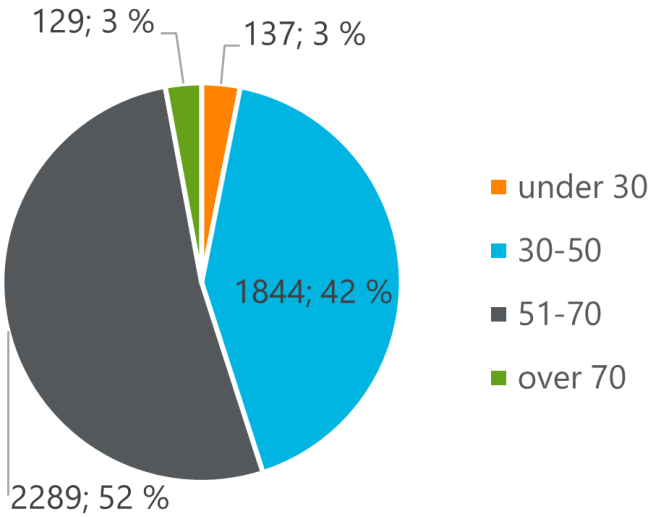

Figure 8. Distribution of respondents by age in 2018 survey.

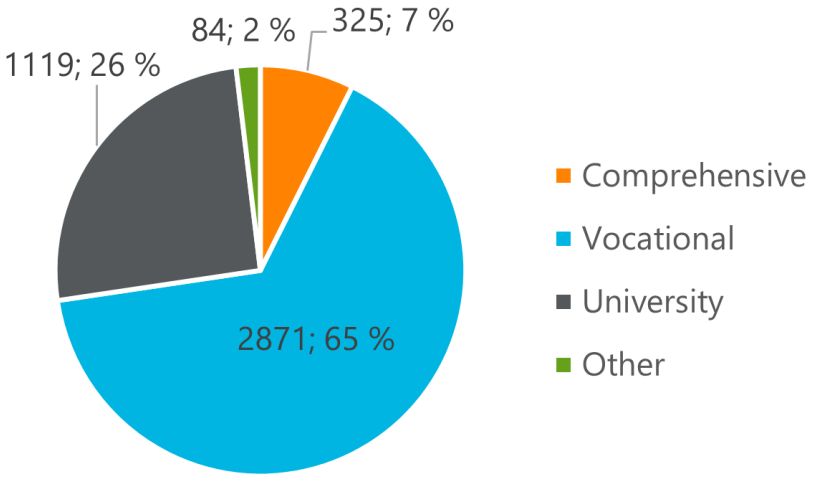

Figure 9. Distribution of respondents by education in 2018 survey.

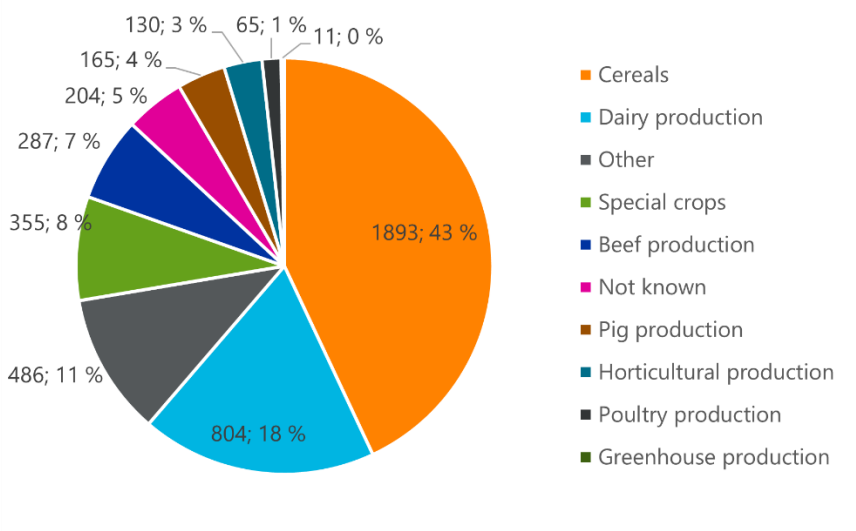

Figure 10. Distribution of respondents by farm type in 2018 survey.

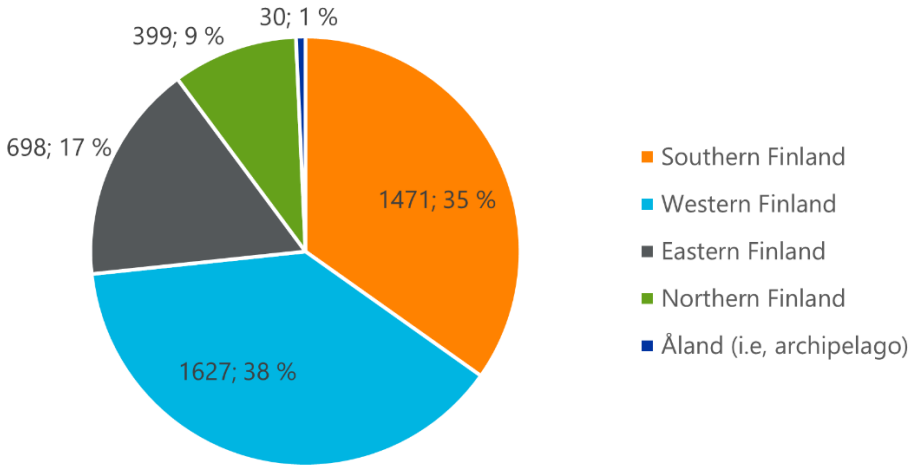

Figure 11. Distribution of respondents by region in 2018 survey.

Of the respondents, 15% (N=657) were organic producers, and 85% (N=3,743) were conventional producers. Organic producers were slightly overrepresented in the sample, as 10% of farmers in Finland are organic farmers. The average farm size of the respondents was 51 hectares. The distribution of the farm size in the sample corresponded to the total distribution of the Finnish farm size. The biggest respondent group was farms under 30 hectares (41%, N=1,792), and the smallest were farms of 100 or more hectares of agricultural land (15%, N=679).

Information about farm revenue was also sought, and the smallest revenue class of under 20,000 euros/year was greatly underrepresented in the sample. While 50% of all Finnish farms belong to this class, the survey sample had only 20% of these small-income farms. In the analysis, the farm size was mostly used as a background variable instead of farm revenue. The administrative type of the farm was also sought in the survey, and the biggest group was family farms (84%, N=3,707), followed by agricultural alliance (in Finnish "*maatalousyhtymä*") (10%, N=433). This distribution closely followed the Finnish general distribution.

The background variable distributions in the 2018 survey were compared to all Finnish farmers, and no significant representativeness distortions were found for age, gender, farm size, farming system (organic/conventional), farm organization, farm type, and the geographical distribution of respondents. As already mentioned, the farmers in the 2018 sample had more vocational schooling than the total of Finnish farmers, and the comprehensive education group was slightly underrepresented. In financial revenue, the lowest class of under 20,000 euros/year was significantly underrepresented in our sample, but as stated above, it was not used in many analyses. University-educated farmers were overrepresented in the 2020 data compared to the 2018 data, and younger farmers were underrepresented, but there were otherwise no distortions in the two datasets.

The distributions of respondents for different demographics and other variables vary slightly in the different articles presented in this thesis because different classifications have been made for different articles, and the data have been cleaned separately for every article. This means some respondents were excluded from the data in question if they had not responded to the statements on which the article focused, for example. If this was done, it is reported separately in each article.

3.4. Statistical analysis

As there were no missing data in the surveys, the need for data cleaning was minimal. For Article III, following the previous research, a total of 241 respondents was omitted from the analyses because they had responded to at least 35 statements out of 57 with the same scale value, or they had used two or fewer scale values when responding (McQuilkin et al., 2016), indicating that the responses were not genuine. The analysis was therefore conducted for 4,160 respondents in Article III. The response scale was also corrected for scale bias, as instructed by the developer of the theory (Schwartz, 2016). Demographic and other farm-specific variables were classified according to previous studies, but minor changes were made according to the needs of the different sub-articles (Table 5). Only binary background variables were used in Article IV to compare the

different models for the predictors of pro-environmental behavior because the analysis would have otherwise become too complicated, without significant benefits.

Table 5. Background variable classifications used in the articles in the thesis.

Article	Gender	Age (years)	Education	Farming System	Farm size (ha)	Revenue (thousand euros/year)	Farm type*	Region
I	female, male	≤30, 31–50, 51–70, >70	comprehensive, vocational, university, other	organic, conventional	<30, 30–49, 50–99, ≥100	not used	crop, pig, poultry, cattle, horse/ sheep	16 ELY Centres of Finland
II	female, male	≤30, 31–50, 51–70, >70	comprehensive, vocational, university, other	organic, conventional	<30, 30–49, 50–99, ≥100	not used	cereals, special crops, horticulture, greenhouse, dairy, beef, pig, poultry, other	southern, western, eastern, northern, Åland
III	female, male	≤30, 31–50, 51–70, >70	comprehensive, vocational, university	organic, conventional	<50, 50–99, 100–149, ≥150	<20, 20–50, 50–100, 100–300, 300–500, 500–1,000, >1,000	cereals, special crops, horticulture, greenhouse, dairy, beef, pig, poultry	southern, western, eastern, northern
IV	female, male	<40, ≥40	not used	organic, conventional	not used	not used	not used	not used

* Crop farms include all types of crop farms (i.e. cereal farms, special crop farms, horticulture farms, and greenhouse production). Cattle farms include both beef and dairy production.

Besides the descriptive statistics (frequency, mean, and standard deviation) of the survey items, parametric statistical methods were mostly used to analyze the data for the articles in the thesis (Table 6). Statistical differences between the different background variable groups were studied with an independent samples t-test and one-way analysis of variance (ANOVA). In the latter case, when more than two groups were studied, Tukey's honest significance difference (HSD) test was used to test which groups differed from each other. The Hedges' g measure was used in Article III for an effect size evaluation of the group differences. The covariation of different background variables was also studied in connection with farmers' values (III: Appendix 7).

Sum variables for similar survey questions were formed in Articles II, III, and IV. Cronbach's alpha was then used to test the internal consistency of these sum variables. Correlation analysis was performed in Article II (parametric Pearson's r) and Article IV (non-parametric Spearman's rho). In Article III, multidimensional scaling (MDS) was used to analyze the structural distances between the 19 value variables. Several models were produced, and the most suitable was chosen based on the badness-of-fit criterion (BOC).

Table 6. Summary of the analysis and analysis methods used in the articles in the thesis.

Article	Analysis	Analysis methods
I	Statistical differences in group means	One-way analysis of variance (ANOVA)
	Statistical differences in group means, post-hoc test for more than two groups	Tukey's HSD test
II	Statistical differences in group means, two groups	Independent samples t-test
	Statistical differences in group means	One-way analysis of variance (ANOVA)
	Statistical differences in group means, post-hoc test for more than two groups	Tukey's HSD test
	Internal consistency of sum variables	Cronbach's alpha
	Combined variability of different variables	Pearson's r
III	Internal consistency of sum variables	Cronbach's alpha
	Structural distances between variables	Multidimensional scaling (MDS)
	Divergence of the total residuals from real values (model estimation for MDS)	Badness-of-fit-criterion (BOC)
	Structure test of four higher-order values	Confirmatory factor analysis (CFA)
	Goodness-of-fit of the CFA models	Root Mean Square Error of Approximation (RMSEA), Standardised Root Mean Square Residual (SRMR), Comparative Fit Index (CFI), and Chi-square test
	Statistical differences in group means	One-way analysis of variance (ANOVA)
	Statistical differences in group means, post-hoc test for more than two groups	Tukey's HSD test
	Effect size evaluation	Hedges' g
IV	Internal consistency of sum variables	Cronbach's alpha
	Combined variability of different variables (non-parametric)	Spearman's rho
	Relations between the sum variables	Path model
	Estimation technique	Maximum likelihood (ML) estimation
	Model evaluation	Lagrange's multiplier test
	Statistical differences	Chi-square test
	Goodness-of-fit of the path models	Root Mean Square Error of Approximation (RMSEA), Standardised Root Mean Square Residual (SRMR), Comparative Fit Index (CFI), and Chi-square test

Confirmatory factor analysis (CFA) was used in Article III, and path analysis for Article IV, to confirm the model structures needed for further analysis. Especially, the alternative CFA models were compared with the Chi-square test, but in both cases, Root Mean Square Error of Approximation (RMSEA), Standardized Root Mean Square Residual (SRMR), and Comparative Fit Index (CFI) were also used to evaluate the models' goodness-of-fit. The path model of Article IV was conducted with the maximum likelihood (ML) estimation method, and Lagrange's multiplier test was used to evaluate the possibilities to improve the model fit.

The survey data consist mostly of ordinal 5-point Likert scale questions, and there is a constant debate about whether parametric methods should be used in this case. For example, ANOVA and therefore the HSD test assume observations to be normally distributed and groups to have equal variances. The risk of violating these assumptions was evaluated as quite small due to the large sample sizes of the data (N=4,401 and N=2,000), but the assumptions were also studied through residual plots. Moreover, the differences between the parametric and non-parametric tests for the 5-point Likert items has often been found to be negligible (de Winter & Dodou, 2010). The analyses were done using the SAS Enterprise Guide 7.1 and 7.15 software packages (SAS Institute Inc., Cary, NC, USA) and IBM SPSS Statistics for Windows, version 25 (IBM Corp., Armonk, N.Y., USA).

4. Results

The results section of the thesis follows the VBN theory model created in Article IV (IV: Figure 2). All the articles in the thesis have discussed one or more of the factors contributing to pro-environmental behavior from various angles, and the factors developed further into a theoretical model in Article IV were then dealt with together in this thesis.

4.1. Farmers' values

4.1.1. Basic human values of Finnish farmers

In the VBN theory, values form the basis for pro-environmental behavior (Stern 2000). In this thesis, farmers' values were studied separately (Article III), but also as independent variables explaining pro-environmental behavior in Articles II and IV.

The structure of the basic human values theory enabled a study of farmers' values at three different levels: 1) as 4 higher-order values; 2) as 10 basic values; and 3) as 19 basic values (Figure 7, Table 3). With four higher-order values, self-transcendence values that highlight care and respect for others scored highest (Figure 12). Conservation, a more traditional set of values, was the second most important higher-order value, followed closely by openness to change. Openness to change values highlight self-determination and action. Self-enhancement, which focuses on power and achievement, scored significantly lower than the other three (III). With the 10-value model, benevolence scored highest, followed by security and self-direction (III: Figure 3a). With the 19-value model, which was used as a basis for research in this thesis, security-societal rose above benevolence values and was the most important singular value for Finnish farmers (III: Figure 3b), followed by the benevolence and self-direction values.

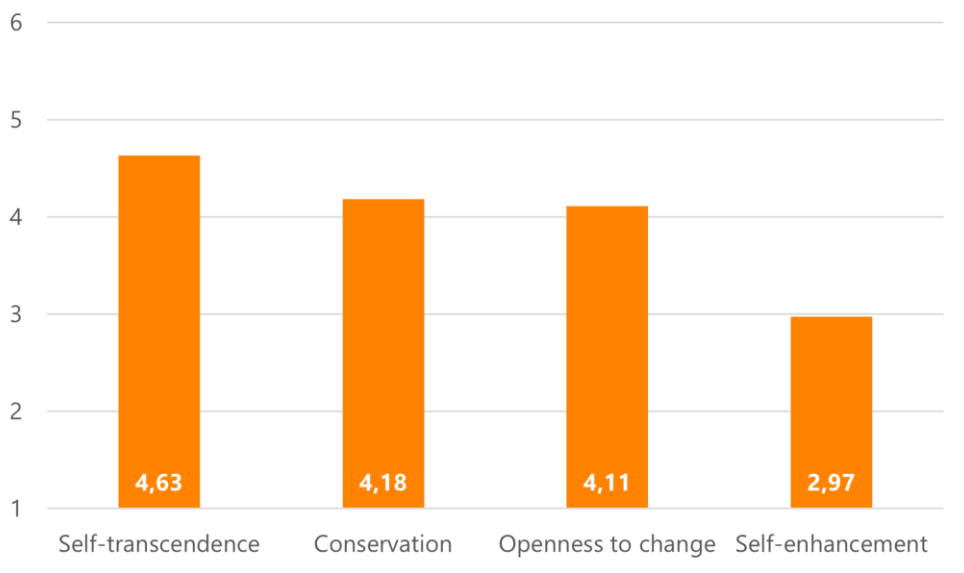

Figure 12. Farmers' mean values, using the four higher-order value model. Respondents were presented with a short description of 57 characteristics and asked: how like you is this person? A response scale from 1 to 6 was used (1 = "Not at all like me"; 6 = "Very much like me").

4.1.2. Differing value profiles

Differences between farmer groups were studied for gender, age, education, farming method (organic/conventional), revenue, farm size, and region. The results showed that value profiles differed between groups defined by the background variables, and only a few of the values can be said to be shared similarly by all groups (III). One of those shared values was security-societal, which varied only a little with demographic variables or farming choices. This value, which highlights national security and the internal safety of the state, was the most important value for all Finnish farmers. Face and benevolence-dependability were also quite similarly rated across all farmers (ibid.).

The overall variance in different values varied greatly for different demographic variables and farming choices. For gender, there were no statistically significant differences with tradition, security-societal, and humility, but in all the other values, men and women differed in their scores (III: Figure 4a). The biggest differences were with the three universalism values, in which women scored higher than men. On the other hand, both self-direction values and power were rated more highly by men than women.

The variance in hedonism was explained by age but less by other demographic variables. The biggest age differences in hedonism were between the youngest (≤30 years) and oldest (≥71 years) age groups (III: Figure 4a). Achievement and power values were scored higher by the younger farmers, and tradition by the older ones. The older farmers also rated universalism values, especially universalism-nature, higher than the younger farmers. Overall, age had the most explanatory power among the studied background variables.

University educated farmers placed more emphasis on openness to change and self-enhancement values than on conservation values. Self-transcendence values were less dependent on education level. The biggest differences in education were between university and comprehensive levels. Organic and conventional farmers did not have differences in so many values as the genders (16/19) and age groups (15/19). Only 12 out of the total of 19 values showed statistically significant differences. The most notable differences were with the universalism values, which were rated more highly by organic farmers (III). Revenue also affected farmers' values, and the biggest differences were found between the opposing ends of the groups (less than 20,000 euros and more than 1 million euros). Achievement and power were rated more highly by the biggest revenue groups, and universalism-nature and universalism-concern were rated more highly by small revenue farms. A similar trend was visible with different farm sizes. Region and farm type were both more weakly associated with values than the other demographic and farm-specific variables (III).

4.2. Farmers' climate change perceptions

4.2.1. Belief in the causes of climate change

> *"Climate change is real, but what contributes to it is unclear. The information is there, but it is fragmented and illogical. It is clear that we humans are rapidly destroying our own habitat, but it cannot all be the fault of farmers."*

There is not much climate skepticism among Finnish farmers, and climate change is accepted as a real phenomenon. Only 33 respondents (1%) responded that climate change was not occurring, and 95 respondents (2%) doubted it was because of a lack of evidence (Figure 13) (II). Despite this common understanding of the phenomenon itself, there was disagreement concerning the cause of climate change. Half the respondents believed climate change to be the result of both human activities and natural factors, and 33% believed that natural factors were the sole cause. A third of the respondents believed climate change

was caused by humans alone. The belief in anthropogenic climate change had slightly declined two years later according to the follow-up survey (N = 2,000, mean = 4.06, SD = 0.78) (ibid.).

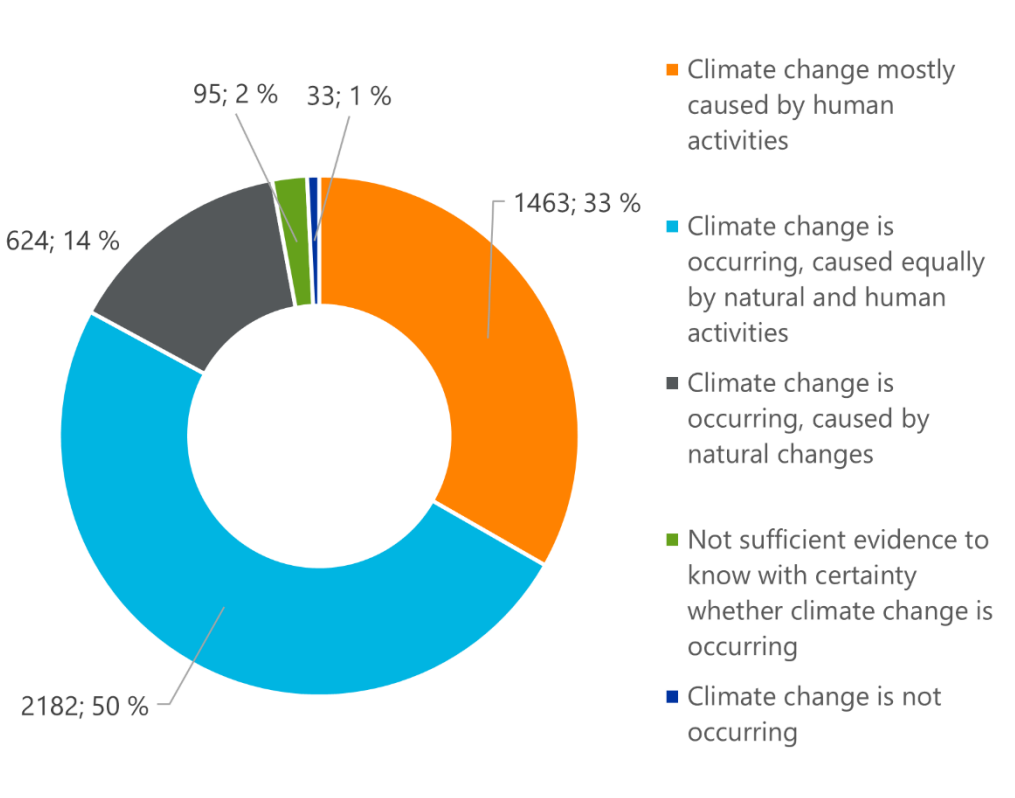

Figure 13. Finnish farmers' belief in the causes of climate change in 2018 (N = 4,397, mean = 4.13, SD = 0.73). Respondents were asked to "choose a statement that best describes your opinion".

The anthropogenic origin of climate change was more supported by women, older farmers, university-educated farmers, organic farmers, farmers with smaller farms, and farmers from the eastern and southern parts of Finland and from Åland (II). Climate change belief became more negative between 2018 and 2020 in almost all the different classes inside the groups, but not all changes were statistically significant (ibid.).

4.2.2. Risk perception

> *"During the last 20 years, we've seen the coldest, warmest, driest, and wettest years on record. Something is happening to our environment."*

At a general level, 74% of the Finnish farmers acknowledge climate change to be a threat to global agriculture. However, only a third of the farmers considered climate change a threat to agriculture in Finland, while another third disagreed with the statement (II). These results did not change between 2018 and 2020. Men and conventional farmers regarded both the national and global threat as less serious than did women and organic farmers. For the global threat, no other differences between different groups were found. Younger farmers and farmers with smaller farms regarded the threat to Finnish agriculture as less severe. Education, farm type, or region did not differentiate between the threat of climate change to Finnish agriculture (ibid.).

Farmers did recognize that most of the effects of climate change related to agriculture would become more severe in the future (I: Figure 1). Milder winters, more frequent heavy rains, pressure from diseases, pests, floods, and weeds were expected to become more common in the future. Soil erosion, drought, and nutrient leaching were not that commonly expected to have more effects in the forthcoming years (I).

Personal experiences of climate change risks to agriculture were not felt constantly (I: Figure 2). The farmers were asked to reflect on whether they had observed some changes in the climate in the 2000s in their close surroundings, and those observed most often were damage caused by wild animals, increased yield variation, and damage by heavy rains (I). Risks caused by flooding or drought were observed quite rarely (ibid.).

4.2.3. Climate change opportunities

> *"We need more information about what can be done at farm level to help the climate. However, food production in the north will play an increasingly important role in feeding the world's population in the future, and this must not be risked by wrong or hasty decisions. Measures must focus more on those areas that research shows contribute most to climate change. In other words, let's not stop livestock farming in Finland or grassland cultivation in peatlands unless it's really necessary on the global scale."*

Many Finnish farmers think climate change brings opportunities to Finnish agriculture (III: Figure 2). At a personal level, the opportunities were not seen to be so great, but 59% of the respondents thought that Finland's position as an

important food producer would increase, 52% thought that there would be new opportunities for Finnish agriculture, and 42% thought that yields would increase in Finland due to climate change (II). In the 2020 follow-up survey, farmers felt even more positive towards the climate change possibilities than in 2018 (ibid.). Generally, men and farmers with higher education regarded the opportunities more positively, and there were no differences between age groups (ibid.).

Farmers' personal experiences of climate change opportunities were highest with respect to the lengthening of the growing season (34% responded often or all the time), novel crops and cultivars (33%), and the cultivation of later maturing cultivars (32%) (I: Figure 2). There were also some signs of higher yields and an earlier onset of crop growth, as they were observed by some 20% of respondents. Autumn sowing was not yet very popular, and earlier maturation of yields was noted by only 8% of the respondents (I).

4.2.4. Possibility to perform pro-environmental behavior

> *"Farmers receive very conflicting information about climate change and their opportunities to influence the change through their own actions. For example, more grass should be grown, but there should be no animals (ruminants) that use the grass crop. Vegetation cover should be increased, but at the same time, this will increase plant diseases and pests. Direct sowing will be reduced if the use of glyphosate or similar total herbicides is banned."*

Farmers' perception of their possibilities to mitigate climate change at farm level were very positive (II: Figure 4). Most of the respondents (65%) agreed that farmers could mitigate climate emissions with farming practices. They also felt that their own farming choices influenced climate emissions (54%). More uncertainty was seen concerning their own possibility to mitigate on their own farm (40% agreed; 22% disagreed). Between 2018 and 2020, farmers' perception of their possibilities to mitigate became more positive (II).

Again, there were differences between the perceptions of the different genders. Women regarded the mitigation possibilities to be bigger than men did. Farmers with higher education and organic farmers thought the same (II). Farm size and region differentiated the perceptions only moderately, and age and farm type were not relevant at all (ibid.).

Although adaptation was not studied in this thesis with the VBN theory, adaptation perceptions were also investigated (I, II). The farmers did not consider their adaptation possibilities to be as high as their mitigation possibilities (II). As with mitigation, personal abilities were regarded as much lower than general ones.

Men, young farmers, organic farmers, highly educated, and large farm owners thought their adaptation possibilities were bigger than their counterparts'. As with mitigation, no differences were found between farm types or different regions. Farmers' views became more negative concerning their perceptions of the possibility to adapt in the follow-up survey, but most of the differences were not statistically significant (ibid.).

4.2.5. Responsibility for pro-environmental behavior

> *"I actively follow the debate and the positions taken on this issue, and it's frustrating when not enough is done to change things. There is starting to be enough information and means to make a difference. So why is Finland not leading the way? We Finns are simply watching what others are doing. Politics is frustrating."*

> *"The climate is changing anyway due to nature's own processes. Excessive conservation efforts in Finland in the name of climate protection are tantamount to nothing. In countries with large populations, actions will have some effect. Finland does not need to set an example when we have enough restrictions anyway, and our methods are clean from the perspective of the environment compared to any other farming culture in the world."*

Much uncertainty prevailed when farmers responded to the normative statements concerning their responsibility to mitigate climate change (II). Almost 50% of the farmers believed the agricultural sector should participate in mitigation efforts, and the same number of farmers thought that mitigation was farmers' responsibility. When questions were asked about personal responsibility, the number was significantly lower (34%) (ibid.). Sectoral and personal responsibility did not alter between the two years studied. Responses to the statement "climate change is farmers' responsibility" declined markedly between 2018 and 2020. This decline was deemed to be caused largely by the slightly different formulation of the statement between the years: the statement was presented as a negation in 2018, and the answers were rotated for analysis (ibid.).

Women, slightly older, and university-educated farmers, organic producers, smaller farm owners, horticultural producers, and farmers from Åland supported more climate change mitigation responsibility than the other groups (II). Farm types did not differ as to personal and farmer responsibility statements.

Responsibility for climate change adaptation was higher than for mitigation (II). Perceptions differed between the different groups almost in reverse to that of mitigation. Men and large farm owners supported adaptation responsibility much more than women and smaller farm owners. The adaptation statements

did not differ with age. Adaptation responsibility was regarded more negatively in all the groups in 2020 than in 2018 (ibid.).

4.3. Farmers' pro-environmental behavior

4.3.1. Model for all Finnish farmers

According to the VBN theory and other research, values of universalism are especially connected to pro-environmental behavior (Stern, 2000; Hansla et al., 2008; Schultz et al., 2005). For the Finnish farmers, all universalism values, but especially universalism-nature, had direct positive connections to climate change perception variables that concerned climate change belief and mitigation. Of all the basic human values, achievement had the highest – though still low – correlation to climate change opportunity (II). Based on this preliminary study of the correlations of the basic human values to other climate perception items, universalism and achievement were studied more thoroughly.

The VBN theory fitted the study of pro-environmental behavior with Finnish farmers (IV) well. The basic model was built with the 2020 survey responses and then compared with the 2018 data. Separate models were also built for women and men, farmers under and over 40, and organic and conventional farmers to enable comparisons between the different farmer groups. There were only a few non-significant connections in the model: from achievement to responsibility and to pro-environmental behavior; from opportunity to responsibility; and from risk perception to pro-environmental behavior (IV: Figure 2; Table 2). This indicates that achievement values are not directly related to pro-environmental personal norms or pro-environmental behavior, and that the notion of climate change opportunities is not directly related to pro-environmental personal norms either. Risk perception was not directly related to pro-environmental behavior, a result that was surprising as such (IV). Nevertheless, there were connections between these elements, but they had to be mediated via other elements (ibid.).

Universalism proved to have a statistically significant direct positive effect on pro-environmental behavior and all the other elements studied except for achievement and opportunity, which was expected. The effect of universalism on risk perception was stronger when it was mediated by climate change belief (IV: Figure 2), indicating that belief in the anthropogenic origins of climate change does matter for pro-environmental behavior. Mediated connections from universalism to felt possibility to mitigate climate emissions (via climate change belief, opportunity, and risk perception) were stronger than the direct connection. Moreover, the connections with felt responsibility for climate change mitigation

and pro-environmental behavior were stronger when mediated via other elements (IV). This indicates that while the value of universalism does have an impact on farmers' pro-environmental behavior, the other elements of the VBN theory make the connection and impact stronger. On the other hand, the value of achievement had a negative effect on climate change belief and was positively connected to felt opportunities of climate change (IV). This means that farmers with high scores for achievement question the anthropogenic origins of climate change and believe more in the opportunities that climate change will bring to Finnish agriculture.

Climate change belief had a positive direct effect on farmers' felt responsibility for mitigation and on pro-environmental behavior, but the connections were significantly higher when mediated via the possibility element (IV: Figure 2). This tells us that even if the notion of anthropogenic climate change does motivate farmers on its own, a high understanding that they actually can mitigate makes the effect even stronger. Risk perception had a direct effect on farmers' notion of mitigation possibility and the felt responsibility for mitigation but surprisingly not on pro-environmental behavior. The felt possibility to mitigate had a direct effect on both responsibility and pro-environmental behavior, and the effect of possibility on pro-environmental behavior alone was quite large, and responsibility's mediating effect was not very big (IV). This indicates that the felt possibility to contribute to pro-environmental behavior is very important for Finnish farmers and thus the highest predictor of farmers' pro-environmental action, at least in the climate change mitigation context.

The new element introduced to the VBN theory context, climate change opportunity, had a strong negative connection to risk perception, which indicates that climate change opportunities decrease the belief in climate change risks to agriculture. At the same time, opportunity was positively connected to the possibility to mitigate climate change, which was a quite unexpected result (IV). Opportunity had a direct connection with pro-environmental behavior, but it was negative. This can be understood as farmers' unwillingness to mitigate something that is thought to bring benefits (ibid.).

4.3.2. Differences between groups

As men, conventional farmers and farmers over 40 were the dominant groups in the whole data (89%, 82%, and 84% of the sample respectively), their models did not differ significantly from the basic model presented above. The model for 2018 had some structural differences from the basic model of 2020, but no significant differences were otherwise found between the years (IV: Table 2; Appendix 1).

For the model of women, changes were found compared to the basic model. Two of the positive relations in the basic model, from achievement to responsibility and from opportunity to pro-environmental behavior, became negative, but these connections were statistically non-significant in both models (IV). Many relations that were statistically significant in the basic model lost their significance in the model for women: from achievement to climate change belief and opportunity, from universalism to risk perception and pro-environmental behavior. As a result, the value of achievement was dropped from the model altogether, and universalism had less direct prediction power than it did in the basic model. This indicates that achievement values may not influence women's environmental behavior, not even as the basis for climate change opportunities (ibid.). Many relations became stronger for the women's model compared to the basic one: climate change belief to opportunity, opportunity to risk perception, risk perception to possibility, and possibility to pro-environmental behavior (IV). The connection between possibility to mitigate and pro-environmental behavior is particularly important, and a strong path of predictors was formed directly from values (universalism), via the possibility to mitigate, to pro-environmental behavior. This means that women farmers, who have a strong universalism value base and know their mitigation options (how to mitigate), might also perform these mitigation actions (ibid.).

For young (under 40) farmers, some relations changed from negative to positive (achievement to responsibility and to pro-environmental behavior) and from positive to negative (opportunity to responsibility), but none of these connections was statistically significant in the basic model or in the model for young farmers (IV). As in the model for women, statistical significance was lost from value-based relations (achievement to climate change belief, and universalism to responsibility and to pro-environmental behavior). In contrast with women, achievement in the model continued to be a predictor of climate change opportunity (ibid.). The model for young farmers followed the original VBN theory model most of all the different models studied, as personal norms were also much more strongly involved in predicting pro-environmental behavior.

With organic farmers, some connections also lost their statistical significance: achievement to climate change belief, universalism to responsibility and to pro-environmental behavior compared to the basic model for all farmers (IV). Interestingly, the connection from responsibility to pro-environmental behavior also lost its statistical significance, indicating that personal norms did not predict pro-environmental behavior with organic farmers at all. Although this seems difficult to explain, the connections that become stronger in this model may explain this discrepancy. As the relation from universalism to climate change belief is almost twice as strong as in the basic model (organic: $\beta=0.457^{***}$; basic model:

β=0.269***), and the connection from climate change belief to pro-environmental behavior was much stronger (organic: β=0.294***; basic model: β=0.160***), this indicates that values and strong belief in the anthropogenic origin of climate change alone can explain much of organic farmers' pro-environmental behavior (ibid.: Table 2).

4.3.3. Development of the VBN theory

According to the results from the analysis presented above, modifications to the original VBN theory are proposed. This model includes climate change opportunities as a new element of the theoretical model. The modified model assumes that the possible consequences of climate change can also be opportunities as well as risks. Opportunities can be either direct or undirect. Direct opportunities in agriculture can be a longer growing season, the possibility to utilize new farming methods, and a higher profit for farmers because of them. Indirect opportunities in agriculture could include new profit models due to mitigation policy (such as carbon farming and payments from carbon sequestering).

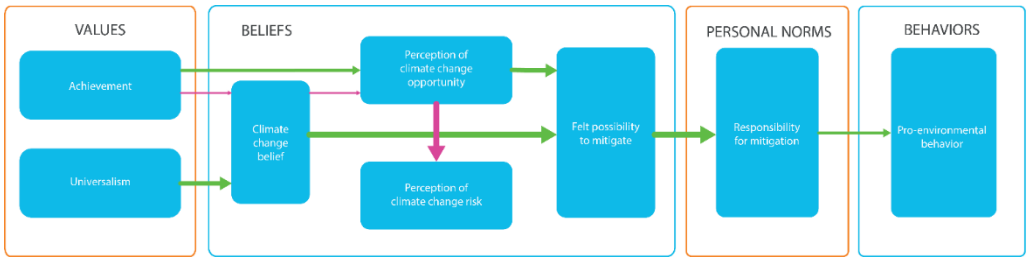

Figure 14. Theoretical model of pro-environmental behavior in agriculture. Green arrows indicate a positive, and pink arrows a negative, correlation.

In the modified VBN theory, the effects of opportunities that farmers recognize as consequences of climate change are considered (Figure 14). Besides universalism values that form the basis for explaining pro-environmental values, achievement is needed to explain the basis for opportunities. Achievement values mediated by strong perception of climate change opportunities reduce risk perception significantly, which would not be visible in the research based only on the original VBN theory. Interestingly, perception of climate change opportunities plays a dual role in explaining pro-environmental behavior in the climate change context. Although it reduces risk perception, opportunities also have a positive effect on farmers' felt possibility to influence mitigation in agriculture and as a consequence, on pro-environmental behavior. There seems to be a dual logic for the functioning of climate change opportunities that needs to be studied further.

5. Discussion

In this thesis, two main research questions were presented:

1) What are Finnish farmers' values and perceptions of climate change?
2) Which psychological elements predict farmers' pro-environmental behavior?

Answers to these questions were sought by using the theoretical framework and methodologies of environmental psychology.

5.1. Finnish farmers' values and climate change perceptions

Finnish farmers' values were studied with the theory of basic human values (Schwartz, 1992) and its revised version, in which basic human values are constituted of 19 values (Schwartz et al., 2012). The circular continuum of values was confirmed, except for security-societal, which deviated from its original place in the theoretical model (III). This was not a unique finding, as Koivula (2008) also found that security values were placed against the original theory in her research on Finnish workplace values. Security values have also been proved to move on the motivational continuum in other country contexts (Schwartz et al., 2001), suggesting the volatility of the value structure in the face of powerful historical events. Security values have a strong protective function (Schwartz et al., 2012) which is activated in the face of a threat (Helkama, 2018). During our data collection, such threatening events had been discussed widely in the media and may explain these findings (III). The security values are therefore a means to preserve the benevolence and self-direction values to which they were closely connected and are more part of the national identity of the farmers than personal values (III, Helkama, 2018; Maio, 2019). Values were surveyed simultaneously with climate-change-related risks, which were also heavily discussed in the media at that time (Lyytimäki, 2020). This may also have affected the highlighting of the security-societal value in Finnish farmers' minds (III).

Security-societal was also found to be the most important value for Finnish farmers, regardless of their demographic or farm-related background (III). Benevolence and security have been found to be the top guiding value principles for different groups in Finland (Karppinen & Korhonen, 2013; Koivula, 2008; Puohiniemi, 2006), and internationally, benevolence, self-direction, and universalism (Schwartz & Bardi, 2001). Conservation values and especially tradition have been highlighted in previous research to be the premier values in

motivating farmer behavior (Baur et al., 2016; Dobricki, 2011; Gasson, 1973; Silvasti, 2003). This was challenged by the research in this thesis, as more detailed research with 19 values showed that it was in fact societal security which raised the importance of conservation values, and not the traditional aspects of the value theory (III).

The results of this thesis follow the previous literature regarding gender differences (e.g. Schwartz & Rubel, 2005). For women, the self-transcendence values of universalism were more important, whereas self-enhancement values were for men (III). The differences were highlighted with universalism-nature, showing that purely environmental values are much more rooted in the value structure of women than that of men. Unsurprisingly, the differences between the youngest and oldest age groups were biggest. In the younger farmers' life, individualistic hedonism values play an important part, whereas older farmers' attention has become more socially focused than on traditional values (III), a result that is also consistent with general communities (Robinson, 2013). More highly educated people have been found to place more importance on openness to change and self-enhancement values than less educated people (Verkasalo et al. 2009), and the same was true for farmers (III). There were also some differences between the different revenue and farm-size groups, but farm type or region was not especially significant (ibid.). Although the results show that not all farmers have an exactly similar value base, similarities can also be found. The most important value for farmers, societal-security, as well as face and benevolence-dependability, was quite similarly rated across all the studied groups.

In general, climate change skepticism is not very common in farmer communities (e.g. Brobakk, 2018), and this was also confirmed for Finnish farmers. There was still differing views about the cause of climate change, as only 33% of farmers thought climate change was caused by human activity alone (II). Risks originating from climate change for Finnish agriculture were not seen as such a huge threat, at least compared to those for global agriculture (II). Farmers did recognize that some of the risks of climate change would become more severe in the future (I). These included milder winters, heavy precipitation, and flooding, which are expected to increase in Finland (Lehtonen et al., 2014; Peltonen-Sainio et al., 2018). Some of the risks were not expected to become more severe in the future at all, and personal experience of the risks was quite limited for farmers (I). This is an important finding and is discussed further in the next chapter. Farmers saw their possibilities to mitigate in general as quite good (II).

Finnish farmers found that opportunities were also related to climate change in the agricultural context (II). Farmers have already utilized some of the opportunities such as expanding the use of novel crops (Peltonen-Sainio & Jauhiainen,

2020). The opportunity aspect has been found in previous research around the world, especially in the US (Niles et al., 2013; Takahashi et al., 2016). Although the simultaneous presence of risks and opportunities can be confusing for farmers, they still thought the agricultural sector must take responsibility for mitigation (ibid.). Following the principles of psychological distance, the felt responsibility was reduced the closer the responsibility was to the personal level. As reported in previous research (Arbuckle et al., 2013a; Haden et al., 2012), adaptation and mitigation were also thought of very differently in Finnish farmers' thinking (II). Adaptation responsibility was thought of more in positive terms. This may be explained by the fact that adaptation measures are basically good land management measures that help maintain the soil in good growing condition, whereas mitigation measures are new and are seen as extra work (ibid.).

In general terms, women, more highly educated farmers, small farm owners, and organic producers saw climate change as a human-caused problem, were more concerned about climate change threats, and supported more mitigation action than the other groups (II). Men, moor poorly educated farmers, bigger farm owners, and conventional producers were more positive about climate change opportunities for Finnish agriculture and felt they were more equipped to adapt to the risks. A similar effect of gender variation has also been noted in previous research. Liu et al. (2014) found that women farmers supported anthropogenic origins of climate change more than men. In other sectors, women are also more positive towards climate change mitigation than men (Jansson & Dorrepaal, 2015). Explanations have been sought from gender role differences and social development, where women are more concerned about impacts on others and the environment. Similar explanations can be thought to be the basis of women's inclination towards more environmental values, as presented earlier in this thesis (III). Higher education helps explain the many aspects of a difficult problem such as climate change, and this may explain the differences between the different education levels. The effect of education in farmer communities has not been unanimous in the literature (Eggers et al., 2015; Jørgensen & Termansen, 2016; Liu et al., 2014; Brobakk, 2018). Values may also explain the differences between organic and conventional farmers (II, III), and similar results have also been found in other countries (Jantke et al., 2020). The connection with farm size and climate change perception may be due to different farming orientations between small and large farms (II). Differences in Finland were often found between farms of ≥100 hectares and the rest, which indicates a more business-like approach to farming. The owners of larger farms were also less inclined towards environmental values than owners of smaller farms (III). The age of the farmer was one of the most interesting demographic variables of the study. Following the results from Jørgensen & Termansen (2016), the youngest farmers were more skeptical about climate change and its risks. They also felt less responsibility to mitigate climate

change than middle-aged farmers (II). Concerning adaptation, the youngest farmers believed most in their possibilities to adapt to the changes. In the light of research that highlights young people's climate change anxiety in general terms (Piispa & Myllyniemi, 2019), this finding with farmers is very surprising. The explanation may lie in the fact that younger farmers have been living amidst constant change all their lives, whereas older farmers still remember the "good old days", when everything was more predictable (II).

Interesting changes did occur in the farmers' climate change perceptions between the two surveys in 2018 and 2020. Farmers' opportunity perceptions and possibilities to mitigate climate change had become more positive (II). Farmers' belief in the anthropogenic origin of climate change became more negative, as did their views on responsibility to mitigate and adapt to climate change, but the mitigation result is highly uncertain due to the research design change described earlier (ibid.). Before the first survey in 2018, climate change issues in agriculture were little discussed in the Finnish media. Shortly after the first survey, climate-change-related media coverage rose significantly (Lyytimäki, 2020), and new topics such as carbon farming and economic incentives surfaced to the public agenda (Lehtonen et al., 2020). It seems obvious that farmers' perceptions were influenced by these discussions, and this may explain the growth of interest in climate change opportunities and possibilities to mitigate (II). Farmers also felt they were blamed for causing climate change, and a counter reaction may have been caused by this within the farming community, which would explain the negative change in mitigation responsibility perceptions (ibid.). Concerning adaptation, responsibility for precipitation risk prevention had become more negative in 2020 (II). This was one of the main risks previously identified by the farmers (I). The change in views may be explained by natural events surrounding the two surveys. The summer before the first survey was very wet, and the two subsequent summers were very dry. The first survey was therefore introduced against the background of heavy rain, and the second survey against one of drought. It can be claimed that the shift in year-to-year weather caused the shift in farmers' perception (II). This is a good example of the retrievability of instances bias, where conclusions are drawn based on the closest example that comes to a person's mind (Tversky & Kahneman, 1974).

5.2. Predictors of Finnish farmers' pro-environmental behavior

Following the theoretical guidelines of the VBN theory (Stern, 2000), it was possible to find plausible predictors of Finnish farmers' pro-environmental behavior in the climate change context. A causal path from values to pro-environmental behavior was found, and the basic model for all Finnish farmers based on the 2020 survey data was able to predict 30% of pro-environmental behavior among the farming community, and the models for different groups reached prediction levels of 29–40% (IV).

Pro-environmental behavior is rooted in pro-environmental values with Finnish farmers. This was proved, as universalism had both direct and indirect positive effects on all VBN theory elements (IV). The direct effect was shown to extend to even pro-environmental behavior, as was also shown with Australian farmers (Price et al., 2014). Surprisingly, in the models for women, organic, and younger farmers, the direct effect of universalism did not extend to pro-environmental behavior, indicating that within these groups, a certain value base alone was alone insufficient to motivate pro-environmental behavior (IV). This result was also found with US farmers (Sanderson et al., 2018). The connection between values and pro-environmental behavior seems to be constructed somewhat differently with different farmer groups with different backgrounds (IV). Universalism's strongest direct connection was with the felt possibility to mitigate agricultural emissions. This indicates that pro-environmental values activate farmers to consider if and how climate change could be addressed and find ways to mitigate these risks (IV). Although universalism also had a direct explanatory power, the connections were stronger when mediated via other theory elements (ibid.), as the VBN theory suggests (Stern, 2000).

Achievement, an individualistic self-enhancement value in the basic human values theory of Schwartz et al. (2012), had a negative relation to climate change belief (IV), as also reported in previous research (Schultz et al., 2005). Achievement had a direct positive connection with opportunity but not with any other variables (IV). This means that a strong emphasis on achievement values reduces belief in human-caused climate change and increases the perception of climate change opportunities. In the model for women, the connections with achievement were not statistically significant for any of the other variables studied. This indicates that achievement values do not influence environmental behavior for women, not even as the basis for the perception of climate change opportunities (ibid.).

The effect of universalism on risk perception was stronger when it was mediated by a belief in climate change (IV: Figure 2), which indicates that belief in the anthropogenic origins of climate change does matter for pro-environmental behavior. Belief in the anthropogenic origins of climate change had a strong direct effect on risk perception and the felt possibility to mitigate climate change. This connection has been repeatedly found in previous research, including in the agricultural sector (e.g. Niles et al., 2013; Arbuckle et al., 2013a; Arbuckle et al., 2013b; Asplund, 2016) and is based on the idea that people can fix problems that they have themselves created (Böhm & Tanner, 2019). On the other hand, belief in the many other causes of climate change besides human action gives way to attributional ambiguity, a bias that releases people from responsibility, as many additional explanations for the risk can be found.

The role of risk perception has varied in the literature. Some studies have found risk perception an important predictor of pro-environmental behavior; others have found its role more secondary (Arbuckle et al., 2014; Arbuckle et al., 2015; Saylor Mase et al., 2017; Lane et al., 2019). While risk perception did act as a mediator for the other VBN theory elements, its direct effects were considerably smaller than expected (IV). Surprisingly, there was no direct effect from risk perception to pro-environmental behavior based on the research with Finnish farmers (IV). Our results for risk perception (I, II, and IV) confirm that the risks associated with climate change are not related to farmers' everyday experiences that would lead to pro-environmental behavior (Weber, 2006; Leiserowitz, 2006; Haden et al., 2012) in the Finnish agricultural context.

The low importance of risk perception can also be explained by its connection to opportunities. It seems that the very strong negative effect of climate change opportunities on risk perception indicates that the prospects of opportunities leave behind the possible risks that may occur in the future. Here, biases and heuristics may also be relevant. Because of optimism bias, people tend to believe that positive events are more likely to happen to themselves, and negative events to others (Weinstein, 1980). On the other hand, affect heuristics have an impact through positive feelings (such as prospective opportunities), which results in risks being evaluated as smaller than they actually are (Finucane et al., 2000). Farmers who believe strongly that climate change will bring opportunities to themselves or to Finnish agriculture therefore do not see the connected risks. Another explanation may be "techno-optimism", where coping with risks seem easy through new technology that will eventually become available (Gardezi & Arbuckle, 2020). Hence, there is no need for specific, proactive, and potentially expensive mitigation or adaptation. There was a negative direct effect from climate change opportunities to pro-environmental behavior (IV), which also highlights the unwillingness to mitigate something that might bring benefits.

One of the most surprising findings of the thesis is the strong positive connection from climate change opportunities to the felt possibility to mitigate climate change (IV). What could explain the connection between farmers believing in climate change opportunities and simultaneously believing in their possibilities to mitigate? The discussion in Finland around climate change and agriculture in the last couple of years has focused on the possibilities of agriculture and farmers to mitigate climate change and the support offered to farmers for doing so (e.g. subsidies for carbon farming). From this perspective, the opportunities of climate change stem from the mitigation possibility that the farmers have and not from the direct effects of climate change (ibid.).

Felt possibility to mitigate climate change was the single strongest predictor of pro-environmental behavior in all other farmer groups studied except young farmers (IV). As with the results of Price and Leviston (2014), it seems a very important incentive for Finnish farmers to know that one can perform pro-environmental behavior in practice (ibid.). These findings support Stern's (2000) hypothesis, where the more important behavior is in terms of its environmental impact, the less behavior depends on attitudinal variables such as climate change belief or risk perception.

Although it was possible to extract a modified new VBN theory construction that summarizes the results of this thesis and considers the effects of climate change opportunities (Figure 14), it is noteworthy that there were significant differences between the different models for different groups such as women, organic farmers, and young farmers (IV). Throughout the thesis, these differing values and perceptions have been highlighted, and they should be considered when applying the results in practice.

6. Conclusions

"If I could even evolve a theory that explain them satisfactorily, my amour propre would not suffer so much." (Hercule Poirot to Captain Hastings).

Agatha Christie. Lord Edgeware Dies.

Research based on environmental psychology can give new and important perspectives for the research aimed at the transition to low-carbon societies (Swim et al., 2011; Clayton et al., 2015). The VBN theory (Stern, 2000) built on the basic human values theory (Schwartz et al., 2012) has been widely used to study the predictors of pro-environmental behavior and has also been the basis for agricultural research (e.g. Price & Leviston, 2014; Sanderson et al., 2018). Although climate change opportunities have been presented in the media and discussed widely in Finland (II; Peltonen-Sainio et al., 2009; Peltonen-Sainio & Jauhiainen, 2020; Peltonen-Sainio et al., 2018) and other boreal countries (Trnka et al., 2011; Elsgaard et al., 2012; King et al., 2018; Unc et al., 2021; Zhao et al., 2022), the effect of these opportunities on pro-environmental action have not been studied. In this research, a new element of climate change opportunities was introduced to the VBN theory structure to better understand its impact on the pro-environmental behavior of Finnish farmers.

The modified model assumes that the possible consequences of climate change can also be opportunities, as well as risks. Opportunities can be either direct or indirect. Achievement values were introduced as the basis for opportunities, which in turn reduced risk perception significantly. Interestingly, the perception of climate change opportunities played a dual role in explaining pro-environmental behavior in the climate change context, as it was also positively connected with the felt possibility of climate change mitigation. The theoretical model is suitable for conceptualizing connections and phenomena that would be otherwise difficult to understand. At the same time, it must be noted that too much simplicity hides important differences, as presented in this thesis concerning different farmer groups.

The results of this thesis showed that Finnish farmers are not one group with homogenous values and perceptions of climate change. The understanding of this facilitates research to find solutions applicable to different kinds of farmers, whether they have a more traditional way of thinking about agricultural production as a continuation of their family legacy and the old ways, or whether they are willing to experiment and try all the new findings that the latest agricultural research has to offer (Figure 15).

Figure 15. Caricatures of the Finnish farmers' value profiles, published in *Maaseudun tulevaisuus* (The Rural Future) newspaper on 11.10.2021 in the newspaper story covering the results of Article III (drawing by Timo Filpus, Maaseudun tulevaisuus, 2021).

The literature on agriculture and climate change has focused mainly on the climate change risks and adaptation challenges and options, and less attention has been paid to mitigation or climate change opportunities. Globally, this is very understandable, as climate change risks are already being experienced, and quick responses must be made to handle those risks. Moreover, discussing the opportunities of such a detrimental phenomenon as climate change can be seen as ethically unjust. Yet the research of this thesis has highlighted that opportunities are perceived by farmers (II), and that farmers feel confused because they are expected to simultaneously mitigate climate change and adapt to and benefit from the positive impacts of climate change, such as better opportunities for diverse crop choices and a longer growing season (Kaukoranta & Hakala, 2008; Peltonen-Sainio & Jauhiainen, 2020). The opportunity perspective must therefore be included in climate change research.

The number of farms is declining rapidly all over Europe, and farms have become much larger (Eurostat, 2018). The same structural change has taken place and is ongoing in Finland (Natural Resources Institute Finland, 2022b). The average age

of farmers is quite high in Finland, and a generational change must happen quite soon. The younger generation of farmers is likely to be more highly educated than the preceding generations. The highly educated young farmers of the future, with large farms producing high revenues, indicate an even greater shift from conservation values to values of openness to change. For a sector facing pressures to regenerate and adapt to new demands, this seems promising from the economic perspective, but what does it mean from the environmental perspective?

Farmers are crucial to climate change mitigation in agriculture, as they are the ones making decisions at the farm level. Farmers' felt possibility to mitigate climate change proved the most important predictor of pro-environmental behavior. Future efforts of agricultural research and policy should therefore focus on bringing these tangible farm-level mitigation practices with undeniable environmental benefits to the surface. This is the most effective way to generate the change to low-carbon agriculture.

The research in this thesis was based on longitudinal data which studied farmers' perceptions in 2018 and again in 2020. This made it possible to observe that farmers respond to public discussion and emerging new ideas and policy by adjusting their views. As societies are constantly changing, it is important to have timely knowledge about farmers preferences and perceptions. To continue the longitudinal aspect, a third farmer survey has already been made in 2022 and forth is planned for 2024.

This research has prompted many new questions that have yet to be answered. This thesis has only started the research on climate change opportunities and their impact on pro-environmental behavior in the climate change context. The dual role of opportunity in reducing risk perception while increasing the felt possibility to mitigate especially needs more research. Research in this thesis focused on farmers' mitigation behavior as a form of pro-environmental behavior but was only able to examine farmers' mitigation intentions. The next phase is to define what measures could be used to research their actual behavior also beyond self-reported behavior, e.g. from registry data on farm level mitigation activities. This might be easier in the future with the new CAP regulations. The VBN theory and the new modification can be used in the more detailed agricultural context, such as for understanding farmers' perceptions of and responses for mitigation in peatlands in Finland and this research is already on-going. The drivers of climate change adaptation in agriculture differ from mitigation and are therefore predictors of adaptation, and the connections between climate change opportunities and adaptation behavior should be studied further.

More research should focus on studying the differences between farmer groups and these groups' barriers and predictors of pro-environmental behavior. Young farmers should be a special focus, as they will be the actors responsible for the future development of agriculture, and little is known about their perceptions and desires for the future. The role of bias and heuristics was only lightly touched on in this thesis, and their effects on the understanding of climate change and associated perceptions will need considerably more work. The role of emotions as an important predictor of pro-environmental behavior has recently emerged in the literature concerning risk perception and decision making under uncertainty (Brosch, 2021). This will also be relevant in the context of agriculture and climate change mitigation, as there has been much discussion about blame and the sense of guilt, which is at the core of emotion research. Farming is not just an occupation but is more a lifestyle rooted in traditions, so understanding the emotions involved may also help predict pro-environmental behavior better. The literature on the fair distribution of climate change mitigation and the adaptation burden and farmers' views on climate justice has started to emerge, and this may also contribute to the VBN theoretical framework.

Psychology is a quantitative discipline by its nature, and the research methods used in environmental psychology come from this family. When the first survey that was used as a data collection method for the research in this thesis was launched, farmers reached out and made personal contact to state their opinions and concerns about climate change and agriculture. This lasted for many days and dumbfounded the researchers. The results of this interest in communicating their thoughts and feelings was also visible in the survey's open-ended responses. The farmers produced more than 400 written pages in which they reasoned, argued, and justified their answers to the structured statements. Some of them are shown in the results section of this thesis as quotations. As the quotations show, many thoughts can be found behind the answers to the structured statements. Environmental psychology research would hugely benefit from qualitative methods and the deeper understanding they would bring to research on pro-environmental behavior.

7. Recommendations

Based on the research in this thesis, the following recommendations for policy development are offered:

1) As farmers are not a unified group with similar values, perceptions, and motivations for pro-environmental action, the **variability of mitigation and adaptation measures should also be offered and supported.** This variation of measures will ensure that policy will be accepted and thoroughly implemented by farmers.

2) The same **variability should apply to the climate-change-related communication, knowledge sharing, and education of farmers**, as different farmers place an emphasis on differing elements of climate change perceptions. For some farmers, communicating climate change risks can be effective, while others would be more motivated by understanding the benefits of their mitigation actions.

3) **Discussion of climate change opportunities should not be avoided but openly embraced**. Farmers have perceived climate change opportunities and see the possibilities for Finnish agriculture. This will be a cause of confusion and conflict if it is not properly addressed. Farmers are expected to simultaneously mitigate climate change and adapt to and benefit from the positive implications of climate change. An open discussion and thorough understanding of climate change opportunities would help solve this bias and prepare our farmers and policy instruments for the future opportunities.

4) Agricultural research and policy should **prompt tangible climate change mitigation practices that are easily applicable at farm level and have proven environmental benefits**. Farmers' felt possibility to mitigate climate change proved the most important predictor of pro-environmental behavior. These practical measures and other farmers' experiences will increase farmers' motivation to mitigate climate change.

5) As farmers are the best specialists in their own field of work, **farmers with different backgrounds should be invited to participate in the planning of the policy processes** alongside other specialists, policymakers, and researchers. This would bring openness to policy processes, an understanding of the day-to-day challenges of farmers, and an increase in the acceptance of finalized policy among them.

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Appendix 1: Farmers' climate change perception literature

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