

An ethnographic perspective on the perception and impacts of climate change on agriculture and its future:

The case of the region of La Rioja, Spain

Quinten A. Harskamp

Global Responsibility and Leadership, Rijksuniversiteit Groningen

Capstone Thesis

PhD Nick Q. Emlen

5th of June, 2024

Abstract

In this paper the perceptions on climate and climate change of farmers in La Rioja (Spain) were researched. Additionally, the perspectives on the adaptation to and mitigation of climate change were discussed. All these different findings have been combined in order to understand the different interactions between the different themes. In the end, three different flows of thought have been identified. The first one pointing out that climate can affect crops negatively, resulting in climate change seen as destructive and stressing the need for well-adjusted and affordable solutions. Secondly, that it is beneficial to know upcoming climate and as this cannot be done so easily anymore, climate is seen as uncertain due to climate change and farmers identify the usefulness of diversification of crops. Lastly, agriculture is seen as heavily dependent on weather and as crops are failing, it is concluded that the system is out of equilibrium and stressing the need to have Nature-friendly solutions and local consumption. Additionally, future directions for agriculture as well as for our society have been pointed out in order to ensure a more positive and sustainable future. It is regarded important to improve our connection to Nature, reduce environmental inequalities, commit globally to mitigating and create greater support and recognition for farmers. Finally, this paper wants to point out the importance of including local perspectives of farmers and to recognize their expertise on the topic of climate change.

Contents

Introduction.....	2
Methodology.....	4
Literature review	4
Fieldwork in Arnedo, Calahorra and Nalda (La Rioja, Spain)	4
Participant recruitment	4
Informal conversation and in-depth interviews	5
Ethical considerations.....	5
Literature review	6
Importance of local perception and experience	6
Climate change perceptions.....	7
Results.....	9
The meaning of climate in agriculture.....	9
Climate and agricultural crops.....	9
Climate and agricultural work	10
Feeling for climate.....	11
Climate change and agriculture	12
The perception of climate change by farmers.....	12
The impacts of climate change on agriculture.....	16
Adaptation to climate change	18
Mitigation of climate change.....	20
The future of agriculture.....	22
Discussion	24
Interpretations and implications	24
Limitations.....	27
Future research	27
Conclusion	28
Appendices.....	29
Appendix 1: Interview Guide	29
Appendix 2: Additional information on the culture of agriculture and its connection to Nature	30
References.....	33

Introduction

In this paper the perception and impacts of climate change on agriculture will be explored as well as the future of agriculture as climate change is becoming more and more apparent. Climate change has been defined by the World Meteorological Organization as the following: “*changes in the state of the climate that can be identified by changes in the average and/or the variability of its properties and that persists for an extended period, typically decades or longer.*” (2024a). Agriculture is a sector that is highly vulnerable¹ to climate change as the climate has a big influence on the harvest. Changing temperatures and precipitation are having the greatest impact on agriculture and cause problems regarding water availability, pests, diseases and extreme weather events. Also on the long-term it is seen that climate change has a negative influence on agriculture. The sensitivity to climate change is not clear due to geographical differences in rainfall, temperature, crops and their systems, soils and management practices (Alam & Rukhsana, 2023). This demonstrates the need for local perspectives on the issue of climate change in the agricultural sector. In parts of the Mediterranean region it is found that higher temperatures, made worse by droughts, is affecting the yields in a negative way (Mbow et al., 2019). It is to be expected that the extent of the impacts of climate change will surpass the adaptive capacity of many European farmers. The country of Spain is seen as one of the most vulnerable countries due to its geographical location, characteristics and seen in the results of model predictions and studies. This will especially affect the agriculture as water availability will become more and more of a problem. Next to this, a shortening of the vegetative cycle, an increase in plagues, an increased risk of heatwaves and floods and a decrease in yield and its quality can be expected (Vargas-Amelin & Pindado, 2014). Because of all these climate change impacts influencing agriculture, it is important to understand the perspectives of the farmers. As already mentioned, every location has its own characteristics and way of doing agriculture and because of this it is important to give attention to the local perspectives present on this topic.

Before diving into the content of this paper, it is important to clarify the difference between ‘climate’ and ‘weather’ in order to avoid confusion. The official definition of climate by the World Meteorological Organization is the following: “*the average weather conditions for a particular location over a long period of time, ranging from months to thousands or millions of years.*” (2024b). As this paper will talk about the perceptions of climate change of the farmers, the period of time is closely corresponding to the lifetime of the participant (see their age group in

¹ Vulnerability in terms of climate change can be understood as the following: “The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes.” (IPCC, 2001, p. 995).

Participant recruitment), but this will be made clear in the results. The definition for weather is the following one: “the state of the atmosphere at a particular time, as defined by the various meteorological elements, including temperature, precipitation, atmospheric pressure, wind and humidity.” (World Meteorological Organization , 2023). As the paper focuses more on the long-term events that are happening, weather is less discussed, however, sometimes certain events are pointed out and it would be named as weather.

To dive into the content of this paper, this paper will discuss the local perceptions and impacts of climate change on agriculture in order to get a good understanding of what climate change means in agriculture. Firstly, this will be done by drawing upon different literature of various places in the world to see how perceptions of climate change are shaped and why these perceptions are important. Secondly, the results of an ethnographic fieldwork in the northern region of La Rioja in Spain will be presented to get an in-depth understanding of how farmers experience climate change in this specific location. These results will complement the current literature with more insights of perceptions and impacts of climate change as well as how the future of agriculture is viewed by farmers. Just as important, the purpose of this paper is also to make clear the importance and value in these perspectives and to see these perspectives not just as an opinion, but as a real expertise. By drawing upon the local expertise of the farmers that participated in the fieldwork, the following questions will be answered:

1. How is climate and climate change perceived by small-holder farmers?
2. How does climate change impact the livelihoods of small-holder farmers in agriculture?
3. How do small-holder farmers view adaptation to and mitigation of climate change as well as the future of agriculture?

The paper itself will be structured the following. Firstly, the methodology of the literature review and the fieldwork will be explained. Secondly, a literature review will be presented in order to get a clear understanding of the importance of local perspectives and to get to know different perceptions of climate change that have been researched. Thirdly, the results of the ethnographic fieldwork in the region of La Rioja will be presented to give a clear perspective of climate change seen by the farmers of the region. These results will similarly focus on the perception of climate and climate change. Additionally, it will focus on the impacts of climate change experienced by small-holder farmers and how they view adaptation to and mitigation of climate change. Lastly, as the future of agriculture can be seen as quite uncertain, the farmers’ vision on the future of agriculture will be presented. Fourthly, a discussion will allow for comparison between the findings of the literature review and the fieldwork results as well as a deeper analysis of the fieldwork results using a model. At last a conclusion will be given, summarizing the main points.

Methodology

Literature review

A literature review has been done on the importance of including local perspectives regarding climate. The biggest part of the literature review focuses on ethnographic findings on the perceptions of climate change by farmers. The online resources of the university called ‘SmartCat’ and ‘Google Scholar’ have been utilized and the following keywords have been used in combinations in order to find the literature:

Keywords: ‘*climate change*’, ‘*perception*’, ‘*agriculture*’, ‘*ethnography*’, ‘*farmers*’

Fieldwork in Arnedo, Calahorra and Nalda (La Rioja, Spain)

The results have been collected by undertaking an ethnographic research in La Rioja in Spain. During fieldwork in April (2024) I have talked to farmers in order to get a clear perspective from them on climate change.

Participant recruitment

The first few days of the fieldwork were used to orientate in the area and get contacts as I did not have many connections in the area. As my accommodation was in a rural, almost abandoned, village and distant from other places, it was difficult to get into contact with farmers and their perspectives by just walking around. However, by talking to different people who have a broad network, especially regarding farmers, I got into contact with three farmers whom I could visit. During my time in this part of the region of La Rioja, I also got to know of an organization focused on sustainable development and ecological farming in Nalda by someone with a very direct connection. The promising network of this organization consisting of farmers made me decide to also pay a visit to Nalda. They were very helpful and I got to talk to two members of the organization and one farmer who worked part-time for the organization. I also paid a visit to a farmer in Nalda that was part of their network and contacted by them. In the results I have kept the different participants distinct as I consider it to be important to know from whom the different statements are coming as there are some significant differences between the participants in age group or occupation in farming. See below in Table 1 the key characteristics of the participants.

	Gender	Age group	Occupation	Location
Participant 1	Male	Middle-aged	Ecological farmer	Arnedo
Participant 2	Male	Middle-aged	Conventional farmer	Arnedo
Participant 3	Male	Middle-aged	Ecological farmer	Calahorra
Participant 4	Male	Middle-aged	Employee at an organization focused on sustainable development and involved with ecological farming	Nalda
Participant 5	Male	Young	Ecological farmer at the same organization	Nalda
Participant 6	Female	Senior	Volunteer at an organization focused on sustainable development and involved with ecological farming	Nalda
Participant 7	Male	Senior	Former ecological farmer	Nalda

Table 1: Key characteristics of the participants.

Informal conversation and in-depth interviews

For all the participants I talked to them informally and in this way I got to know their situation, especially visiting the different farmlands were useful to clearly understand their work. I also conducted an interview with all of them of which I recorded the audio. I have listened back to these audio files after the fieldwork in order to extract the most important information as well as some quotes clearly explaining some themes. The interview questions of the interview can be found in *Appendix 1*, however, it is important to note that these were leading questions as the way of conducting the interview was flexible. Sometimes some questions were not asked, as they might not have been applicable, or sometimes other follow-up questions have been asked. The interview guide was used as a guide in order to get the conversation starting on the designated topics. During the fieldwork, as already mentioned, I visited the different farms of the participants and next to conducting the interview, we also had informal conversations regarding the topics. After having done the visits I wrote down some important notes. Afterwards, back at home the notes, memories and the selection of information per participant were organized in different themes in order to get a clear overview of all the fieldwork results. These were then written down in the different chapters. Below are photos (Fig. 1, 2, 3 and 4) of various visited farms during fieldwork.

Ethical considerations

The fieldwork of this research has been approved by the Ethics Committee of Campus Fryslân. The participants have been informed of the aim of my visit and have signed an informed consent. During the fieldwork, an informal and comfortable atmosphere was created to let the participants feel comfortable. It was also very clear that the participants were eager to share their perspectives and knowledge with me.



Fig. 1: Vineyard of farmer 1.



Fig. 2: Pear orchard of farmer 3.



Fig. 3: Olive orchard of farmer 2.



Fig. 4: Farmland of organization of participant 4, 5 and 6.

Literature review

In this literature review, the importance of local perceptions and experiences in examining climate change impacts will be pointed out. The main part of the literature review will consist of literature on different perceptions of climate change by small-scale farmers in various places of the world.

Importance of local perception and experience

If we want to understand how people experience climate change, comprehending the local perceptions of climate change and the environment is important. In the end, the structure of making decisions regarding agriculture and climate (change) cannot be seen separate from the culturally constituted ways of seeing, knowing and valuing the world (Vedwan & Rhoades, 2001). Both Hamal et al. (2022) and Ogra et al. (2020) argue that the inclusion of local perceptions is useful in constructing risk management strategies. In the study of King et al. (2008) it is shown how valuable and insightful local knowledge on weather and climate change can be and thus they argue for its inclusion into the knowledge infrastructures. Due to climate change continuing to exist and thus a need for adaptation strategies, it is also important to know how farmers have handled the occurrence of climate variability and climate change (Mertz et al., 2008). According to a study of Kloprogge and Van Der Sluijs (2006), the incorporation of local knowledge and perspective enhances the quality of the assessment on climate change. All in all, it comes down to the following: *“Only local people can explain how climate change becomes manifest locally and how it is evaluated, interpreted and handled by the affected people. While local observations cannot substitute for scientific measurements and models, they are important supplements, detailing local phenomena and perceptions and giving insight into local concerns.”* (Byg & Salick, 2009, p. 165-166).

Climate change perceptions

In the study of Vedwan and Rhoades (2001) the perception of climate change of the farmers was very clearly shaped by the traditional calendar in place. As can be seen in Table 2 (Vedwan & Rhoades, 2001, p. 112), the farmers have a description of an ideal type of weather per month and the present weather is compared to this. The authors also point out that these ideals of weather heavily correspond to the ideal annual apple growth cycle. As the apple growth is of high importance, when thinking about weather deviations, they mentioned the impacts on the yield or performance of the apple. Another interesting insight from this study is the fact that participants were constructed their deviation of weather on the weather maximums present in a year. In other words, the climate change perception was based on, for example, a snow maximum that was high during a year and thus a high snow average was perceived, while the snow average might have decreased during this certain year. Another study done by Vedwan (2006) in the same region presents additional information on the perceptions of the apple farmers. He points out the importance of mountain “specificities”, encompassing, for example, the existence of niches, marginality and the distinct mountain physiography, in shaping the perception of climate change. Due to the traditional subsistence based on agriculture, the mountain “specificities” form the cultural notions of risk and vulnerability, which then constructs their perception of climate change (see Fig. 5 (Vedwan, 2006, p. 10)). One clear example of this is the mentioning of the change in altitude of where apples can be grown due to climate change; lower parts of the valley are not suitable anymore to grow apples. Due to this, traditional crops are not cultivated in the same regions and this was clearly experienced. A participant explained that a certain corn is now produced by people in a region whom were supplied by them before. A difference in color of chilli was also noted as they now turn red instead of staying green at altitudes. Additionally, the farmers mentioned that apple belt also moved 30 kilometers towards the north in 50 years. Vedwan makes clear that the farmers are of the opinion that the environment is not in a balance anymore seen from the shifts in the environment and also the social connections to it. He also makes clear that the well-agreed upon experience of a ‘displaced weather cycle’ creates a linkage between

Local term	Approximate period	Description (ideal)	Description (present)
Magh	Jan 15–Feb 15	Cold with snow fall	Some rain and snow
Falgun	Feb 15–Mar 15	Less cold with snow	Rain
Chaitra	Mar 15–Apr 15	Rain, snow rare	Some rain and snow
Baisakh	Apr 15–May 15	No rain, clear skies (paddy, dal and corn sown)	Dry with some rain
Jeth	May 15–Jun 15	Hot (paddy, dal and corn sown)	Dry
Asadh	Jun 15–Jul 15	Hot (until June 30), pre-monsoon rain	Hot and dry
Sawan	Jul 15–Aug 15	Rain	Hot and rainy
Bhadra	Aug 15–Sep 15	Rain (until Aug 30, apple harvest), dry	Predominantly rainy season (stock of drying grass for fodder)
Ashwin	Sep 15–Oct 15	Clear (corn, dal harvest; wheat, barley sown)	First half rainy and second half dry
Kartik	Oct 15–Nov 15	Mostly clear (paddy harvest), shorter days	Same as ideal
Mangsir	Nov 15–Dec 15	Snowfall, drying fir leaves and wood for fuel	Same as ideal
Paush	Dec 15–Jan 15	Maximum cold with snow	Very little snow

Source: Field interview

Table 2: Traditional calendar of the apple farmers.

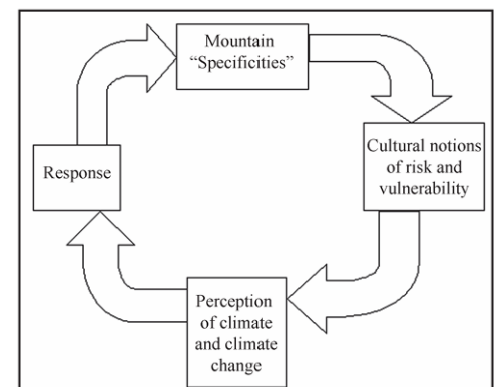


Fig. 5: Conceptual model of apple-grower-environment relationship.

recent perceptions of climate change and the traditional ecological knowledge that has been there for a long time. In the end, the farmers experience different weather, as one points out that it was normally raining during rainy season, but that the situation now is very much topsy-turvy.

In a study done by Mertz et al. (2008) they found that extreme weather and events having a negative effects on yield and its corresponding year were very well memorized by the participants. The participants also identified mostly negative impacts due to climate change and were related to two main factors, in this case strong winds and excessive rain. From the study of Debela et al. (2015) it is also clear that a big part of the farmers (58%) are considerably worried about the future of agriculture due to negative climate change effects. The other big part (29%) of the participants were worried about the unpredictability of the weather and 5% were worried about more extreme weather events. Interestingly, 8% were of the opinion that the climate would be more advantageous to the agriculture. In this study it was also found that extreme events play a big role in affecting the perceptions of farmers towards climate change and its impacts. Another interesting outcome of this study was the uncertainty that was felt regarding the future of their livelihoods (in ten years), the reason being for this the uncertainty present in the future climate. Something that all farmers agreed upon was the reliance of the future on how well the climate will serve their livestock production, which is dependent on precipitation. Additionally, all the farmers associated a reduction in agricultural production to climate change and also regarded this as a significant risk to their agriculture-based subsistence.

As ethnographic findings of perceptions of climate and climate change are lacking in the region of the north of Spain, my research will focus on this area to fill this research gap. Additionally, the research will also include the impacts of climate change as well as how the farmers envision the future in order to create a clear future direction for the agricultural sector.

Results

In this part of the paper the results found during the fieldwork will be presented. The results have been divided in different sections in order to have a more clear distinction between the different themes. However, it is important to keep in mind that the different themes are interlinked and are thus sometimes difficult to be seen separately. The three different themes that will be covered are the following: *The meaning of climate in agriculture*, *Climate change and agriculture* and *The future of agriculture*. As it was part of the fieldwork, but not the focus of the paper, findings on the culture of agriculture and its connection to Nature can be read in *Appendix 2*.

The meaning of climate in agriculture

In this chapter the meaning of climate in the agricultural sector will be explained by using the findings of the fieldwork. Discussing the meaning of climate before diving into climate change is important in order to get a better understanding of the impacts of climate change. Next to this, it is interesting to get to know more about the importance of climate, while having climate change more or less out of the picture. This chapter consists of three different sections: *Climate and agricultural crops*, *Climate and agricultural work* and *Feeling for climate*.

Climate and agricultural crops

When I talked to the different farmers and people heavily involved in agriculture, one thing was directly clear: **climate** has a **direct effect on the crops** being cultivated by farmers. Participant 1 mentioned the following: “*The climate and the soil define the agriculture*.”. Next to this, participant 3 made clear that agriculture is outside and thus climate is a part of it. These two findings make very clear the direct effect it has and how it defines agriculture. Participant 2 made very clear that if the climate does not accompany the crops, it can cause **destruction of the crops** and thus it can cause you to have less harvest as a farmer. The participants also explained different types of weather and their effects on a crop. An example being storms during summer, which are very dangerous to crops as they bring hail and they can destroy the whole harvest. Farmer 7 made clear that hot weather during my time of visit (April) means the following: “*Right now, the heat we are having is not good for the plants, because they are very tender. They are now growing, they are sprouting and this heat is suffocating them, it is too hot*.”. This makes clear that certain types of climate are certainly not beneficial to crops during every part of the year. Farmer 2 mentioned that rain is not per se good during every period of the year, during the end of the growing season (September) this is not the case. Participant 4 also mentioned that in (organic) farming the **temporality** is very

important as it decides which crop can grow when (e.g. tomatoes during summer and zucchinis during winter). This also affects the corresponding actions of farmers that are tied to the seasons. One very clear example is the harvesting of crops that is tied to these different seasons and can thus be affected. Not only the type of climate and when this climate takes place is important, also whether there is a balance. Participant 2 mentioned that: “*An unbalanced climate unbalances everything, it also unbalances the wine a bit.*”. In wine this can affect the sugar degree, the alcohol percentage and the pH value.

Climate and agricultural work

As already mentioned, climate is very important in daily agricultural work and affects it directly. Participant 1 pointed out that they cannot plant crops when it freezes and thus the climate directly **decides an action** that cannot be taken. Another farmer (2) let me know that he was waiting for rain in order to start planting new olive trees and as there was no rain, he could not do so. He also let me know that it is **beneficial to know** the climate that is coming and that he will act directly on this information. He, for example, would, depending on the (good or bad) climate that is forecasted for the upcoming season, cut more or less branches from his trees. Would the climate be not so beneficial to his trees, he would cut off 2 out of 4 branches of the grape vine or keep 50 branches of his almond tree instead of 150 branches (when having good climate). Participant 4 also mentioned this advantage you have when knowing the climate and the importance of acting upon this:

“If here, for example, it depends on what season of the year you are in, they (the climate conditions) can be very important if you know, for example, that it is going to hail, that hail is going to fall and it can save a fruit harvest (to know it coming). If you also see that your land needs water and you have to reserve water from irrigation, because rainwater arrives is also interesting and important, you are not going to water if you have rain nearby.”

Depending on the weather that is forecasted and thus known, a farmer will act in a certain way, for example, not watering his plants. Regarding rain it is also important to keep in mind when having irrigation systems (flood irrigation in the case of this farmer), that the amount of days the farmers have access to irrigation water is dependent on the precipitation. Participant 7 explained that this changes the way farmers should **plan their working days** as they should use their opportunity to irrigate when there are only a few days it is possible (due to the low amount of precipitation).

Feeling for climate

As farmers are heavily affected by the climate, I was interested in getting to know whether they have an intuition for the climate. It was interesting to hear that, although some participants being of a relatively older generation, they all do not have a feeling for the climate as would have been present in generations before them. One participant (4) for example mentioned that his father knew to predict the climate quite well: *“Yes, it depends, there are farmers who have that instinct and know how to prevent. For example, my father, if I see a cloud there in the background, he tells you it's going to rain tomorrow and it will rain tomorrow or today.”*

In general I got the impression that they all do have a **certain level of feeling** for the climate due to their experience of the past with different phenomena, but that they all feel this **could** definitely **be improved**. Participant 2 mentioned that he knows the cloud patterns whether they would bring water, but this is not all the time correct. During my visit he could for example see from the sky that it most probably would not rain that day. Someone (1) else also pointed out that in general it is **always difficult to predict** the climate, but now with climate change it is even more difficult. Participant 2 said that looking at the weather forecasts is part of his daily life as he at least checks it twice a day. This indicates the **high importance of forecasts** on them as it is important for them to know the upcoming weather. Two participants also mentioned that they do know particular people or groups of people who do have this strong connection and feeling of the forthcoming climate. Participant 3 let me know about a group of people called “cabañuelas”, whom make predictions at specific times of the year, based on for example clouds or volume of bird passage, and get to quite accurate forecasts of the coming climate. He let me know he does not do this himself and this again stresses the extent to which the farmers I talked to, have this type of knowledge or intuition. Another participant (4) mentioned that they do not have people with these instincts in their organization, but they do protect these people and their knowledge in their projects. He explains their instincts as the following: *“Today, for example, those clouds, the shape they have if they enter through this mountain through the other mountain on the other side implies that there will still be a very strong wind or that there will be hail. Or suddenly they do notice hot air, they already know that a storm is coming very quickly.”* Aside from these acquaintances, overall, the participants themselves did make it clear to me that they do not have this in-depth knowledge and intuition.

Climate change and agriculture

In this chapter the topic of climate change and its position in agriculture will be discussed. Firstly, the concept of climate change has been discussed with the farmers in order to get an understanding how they perceive climate change, but also how they themselves created this perception, by what kind of experiences. Secondly, the impacts of climate change will be discussed in-depth in order to get a clear understanding of how farmers are affected by climate change. Towards the end, the implementation of adaptation to climate change will be discussed as well as the direction of mitigation in the agricultural sector. This chapter thus consists of four different sections: *The perception of climate change by farmers*, *The impacts of climate change on farmers*, *Adaptation to climate change* and *Mitigation of climate change*.

The perception of climate change by farmers

A term as climate change is quite a broad term and thus can be perceived in many different ways. Due to this it is interesting to see how farmers view climate change, what do they highlight and where does this perception come from. In the following paragraphs this will become clear by discussing different themes that came up the most when talking to the different participants.

The most clear and outstanding perception that was very clearly defining climate change is the presence of **higher temperatures**. The occurrence of higher temperatures was something that came back during every conversation and it can also be found in other parts of this paper as it is a very clear experience among the farmers linked to the concept of climate change. The best way for me to understand this was to be there outside as, during my fieldwork, it was extremely warm for the period of the year (April). This was clearly said by farmer 7 when I was in the field with him: *“Well, here the climate has changed a lot, it's been hotter. Right now it's almost a summer day, it's 22 degrees and very hot.”*. It was very clear that experiencing these high temperatures is not normal for them compared to how the climate was when they were younger. Participant 2 referred back to the Easter Weekend (31st of March and 1st of April) before my visit in which it was around 26 till 30 degrees Celsius. He made clear to me that this was unimaginable ten years ago and they are now getting more used to it, but for him it is still not normal to have these temperatures. The high temperatures are not only experienced specifically during summer, two farmers also made the same note on how they were surprised and could notice the increase in temperature during the winter by the change in clothing: *“And in winter before it was cold and it was really cold with a lot of frost with snowfall with rain. And now in winter there were days when we were wearing short sleeves, we were just*

wearing a t-shirt in the field and before I didn't see that or I didn't realize it, because I didn't see it. I didn't see it and I spent my whole life in the countryside, nothing but with my father in the countryside all my life, you didn't see those things.” (farmer 2). Participant 4 also made clear to me the difference in cold during the winters as there is no snow during the winter and records of high temperatures have been broken during the most recent winter. Also a difference between the night temperatures have been recognized by farmer 7 to which he commented that he would have liked colder nights. He also makes clear that winters should be a period of bad weather and of being at home in the warmth. All in all, it is very clear among the farmers that I talked to that there is no doubt about higher temperatures taking place in the region and this being connected to the concept of climate change: “*Mainly here, what I have noticed most about climate change is the rise in temperature, without a doubt it gets much hotter and hotter...*” (participant 5).

Climate change was many times seen as something causing our system to be **out of equilibrium**, creating **instability**, **high variability** and having **climate extremes**. Farmer 1 mentioned that a lot of things are changing quickly; a lot of climate records are being broken, ultimately low as well as high temperature records. He drew the conclusion that the system is not in equilibrium and that this is not well for agriculture as it needs a constant climate. The stable conditions are being lost and this makes it more and more difficult to be a farmer. Participant 2 also points out the high variability as in his experience the weather now has not been as stable as it has been when he was younger. He said the following:

“The perception I have of climate change is that it rains less, that it is hot, that it is suddenly getting hotter like this week ago, for example, that it has risen to almost 20 and many degrees and suddenly today 15 degrees or 12 degrees, tomorrow 15 (degrees) and the day after tomorrow 25 (degrees) again. It has always been cold, it has been hot, but I didn't see it, I think, like this, before it was less exaggerated than now...”

As can be read here, during my week of fieldwork, it was clear to notice how there were extremes in the weather, especially the hot temperatures. This clearly defines climate change for farmers and an experience like the one I had, really shapes their perception, especially over a longer period of time. Farmer 7 pointed out the same lack of an equilibrium in which he pointed out the fact that it can be warmer somewhere if there would be more rain and it would not be a problem. However, there is no rain now and thus there is no equilibrium present anymore. He makes this absence of a balance more clear by the following, in which he also points out the climate extremes that are a result of this imbalance:

“So you see that it rains less and when it rains, it rains harder, stormy and bad, because I remember when I was young that during these spring months it did start to rain and maybe it started raining slowly, maybe three days here, and now not, everything at the same time. It rains in half an hour and the water of those three days fell on you in half an hour, of course, then it does nothing but harm.”

Experiencing these **climate extremes** was also evident in the perception of participant 6, in which she explained the following: *“Climate change also affects us, it affects us in the form of drought or it affects us in the form of torrential rains that arrive, or winds or storms, storms with hail, because they can also cause us a lot of problems. And everyone says that there have always been these atmospheric phenomena, but now they are closer in time and they are more repetitive and more serious.”*. This variability is also clearly experienced by farmer 3 in which he explains that the seasons were much clearer when he started with agriculture 40 years ago. He gives the example of the winters back then in which it was cold with sometimes one warmer day, but it was cold. The most important point to what this leads is that the seasons were more clear: *“the seasons were much more marked”*. In the end, the lack of an equilibrium causes high variability and climate extremes, which then causes there to be **unclear seasons** as they are not as marked as before. This is not only experienced through the farmers’ their own experiences, but also through the experiences of them with their plants. This is very clearly explained by farmer 3:

“Mainly, what we are detecting the most, above all, is the issue of water scarcity, the sudden changes from very strong in very short periods of time from rising temperatures to having strong drops. Ofcourse, the plants, in the end, that type of stress, they suffer it as living beings that they are, and they are having more problems due to diseases, more problems to develop and production problems.”

Being part of this quote is the next big topic that arose when talking about climate change during the conversations with the farmers: the **lack of rain**. The lack of rain is similarly a substantial part of the perception of farmer 2 as can be read in his [quote](#) before, especially as it is the first thing mentioned. Farmer 7 touches upon the lower amount of precipitation in his [quote](#) and especially the invariability of the precipitation patterns. He also made clear that he visually recognizes the lack of rain by the absence of certain crops on places where they were seen by him before. As the lack of rain becomes very clear through the impacts it has, more perspectives will be given in the next section.

Another very interesting perception of climate change was one that was told by two farmers as they see climate change as a **fever**. They mentioned that people may always be saying that it is just one degrees Celsius

warmer and that this is not that big of a change. The farmers let me know that if you compare this to a fever, one degrees Celsius warmer in our body also has big effects on our well-being: we are sick. Both farmers see this phenomenon happening in their plants as they are not feeling well all the time and it is clear to them that Nature is sick.

As climate change can mean different effects in different areas, it is a complicated issue, but some farmers also let me know that there is **uncertainty** and **unclarity** around climate change. Farmer 2 let me know that he also is aware of the different cycles worldwide present and these affecting our climate. He was not sure whether, for example, the cycle of El Niño and La Niña is a cycle we are currently in. This uncertainty is also found in his estimation of when the climate change really began in the region of which he says it is since four or five years. However, he also gave ten years ago as an option since it is difficult to say for him with all the different climate cycles present. Participant 3 was of the opinion that the last eight till ten years there has been change and especially the last five years there has been a strong presence of increased and decreased temperatures. He, however, also experiences some unclarity regarding climate change as he also heard about another theory different from the official one of the Intergovernmental Panel on Climate Change (which stress upon a strong increase in temperatures). This theory describes the fact that we will enter an ice age and after a certain amount of time we will see a drop in temperatures. These two perspectives show the uncertainty that is felt surrounding climate change, but one thing is for sure, there is a clear change happening and ongoing: *“I don't know how much we are able to predict or assure where climate change is going to go, but we are in a sure change.”* (participant 3).

The impacts of climate change on agriculture

As I now have presented the perception of climate change by the farmers, it is important to see more into detail where their perception comes from. As the topics are intertwined, in this section some perceptions will also be more clearly explained or complemented. The main focus of this section of the chapter is to clearly lay out the direct effects on farmers that climate change has on their business.

An issue caused by climate change that was often mentioned is the **early flowering** taking place in different plants. Farmer 1 explained that flowering should happen normally during the middle of April or even a week later, a bit after the time period I was doing the fieldwork. During the fieldwork I have already seen a lot of flowers in the different plants, while it should not have been necessarily the case. This is also what he told me, flowering is happening earlier now, which causes problems when there is a late frost in April. This creates a situation in which the flowers get frozen and destroyed, which then leads to a yearly harvest being lost. Participant 2 also explained this to me with an example in which his trees get flowers at the 25th of March (earlier than normal) and it then freezes on the 15th of April, this would mean a whole harvest gone for him. It is important to note here that it depends on the plant variety when it is normal to bloom. Farmer 5, for example, mentioned a plant with a normal blooming time of mid-March, now developing earlier and as well having the same problem of frost. This problem of early flowering is clearly causing big problems for farmers when losing their whole harvest and this is thus a clear example of the devastating impacts of climate change on farmers.

As already discussed in the section before, a lack of rain and its high variability is taking place due to climate change and it is causing substantial **irrigation problems** for farmers. As there is either a lot of rain at places or almost no rain at all, it is causing a poor situation for farmers: *“Where it rains, it rains a lot, which is bad for agriculture. Where it does not rain, it rains nothing at all, and this as well is bad for agriculture.”* (farmer 1). In the region of La Rioja they are in the situation in which there is a serious shortage of water for the agricultural sector to be functioning properly. Farmer 2 explained to me the devastating effects the lack of rain can cause to him. He could lose his vines in the future if there is less than half of the normal amount of the precipitation due to climate change. He also told me that his farms did not get any rain while some other regions did get precipitation. It is normal that there is a difference between regions, but it is becoming a desert with the absence of rain. He is waiting for a sufficient amount of rain to plant new olive trees to extend his farm, but he cannot do so and this causes him to be disappointed and frustrated: *“But I’m tired of looking at the sky all day and they say, it’s going to rain, it’s going to rain, it’s going to rain and here it’s not raining.”*. The lack of rainwater is clearly destructive to farmers,

participant 4 also makes this point clear by sharing his experience of farmers in his region: *“Last year there was a very, very, very important drought in La Rioja and in Spain, which prevented many farmers from not having irrigation in the summer and that is devastating more than anything...”*. One of the farmers in his region, participant 5, made also clear that the aquifers and reservoirs are not full due to the lack of rain and this is causing a lot of irrigation problems. Farmer 7 makes clear what these irrigation problems exactly entail. He explained that due to the lower availability of water, there are more strict rules on the irrigation water usage. Before, he could (flood) irrigate whenever he wanted to do so, now there are strict periods of around fifteen days he can do so. It is important to keep in mind that this really becomes an inconvenience as farmers now should plan differently to wisely make use of the period of having water available. As already discussed as part of the perception of climate change, farmer 7 sees a difference in crops that are possible to be cultivated in certain areas. The drought caused by the lack of precipitation results into certain crops being impossible to be planted and thus heavily affecting the business of farmers.

Another problem that was discussed multiple times during fieldwork was the presence of **stress** and **plagues** with climate change as malefactor. Due to the high variability and high temperatures, also seen as a fever as discussed before, the plants endure a serious amount of stress: *“Now, for example, in the pear tree, what we are seeing is that the changes are so sudden and, above all, the increase in temperature leads to stress that results in wood diseases or bad vegetation and much more.”* (participant 3). Farmer 3 explained to me that the stress of plants now causes the farmers to experience more problems with a vascular fungi: a fungi getting into the circulation of the trees and causing them to dry up. He explains the situation as the following: *“They use more energy to try to withstand this change in temperatures than to generate defenses against what is attacking them.”*. Farmer 2 explained that the plagues need to be fought against every twenty days, which he believes is due to the lack of good cold, but he mentions that it could also be due to the tree varieties. Another aspect to this is the increased amount of reproduction cycles of insects due to the higher temperatures, mentioned by farmer 3. Participant 7 acknowledged this same issue and he also pointed out the dilemma of whether to use pesticides and contaminate or to let the bugs eat the plants. Before, this problem was not really present as the situation was more equated. Another interesting issue not taking place before, is the presence of more wildlife, think about roe deer, deer, wild boars and rabbits, destroying the crops. Farmer 2 experienced this problem, which was not present before. He did not see these animals before and he thinks it is due to climate change, as it could also be due to a planned reintroduction, reducing the

amount of water and food present up in the mountains. If they come close to the agricultural fields they can destroy half a vineyard.

Adaptation to climate change

As has become clear by the different perspectives of the participants, there are a lot of different impacts on agriculture due to climate change and they are devastating to their subsistence. These impacts create a situation where adaptations are required in order to cope with these effects. In this section the viewpoint of farmers towards adaptation will be presented.

During my conversations with the farmers, it became clear that there may be adaptations present on the market, but they might not be possible for everyone to purchase. Farmer 2, for example, could not have an irrigation system on his land at the moment, which means a drought can have devastating effects for him. The role of money is a big part of this as it is a big investment to put these adaptations into place. The use of **drip irrigation** is preferable by farmer 5, however, it costs them a lot of money to install such a system and there is also a system in place and thus they continue to use their system of flood irrigation. Another perspective brought forward by farmer 3 is the capacity of using certain adaptations and technologies. He explains that an irrigation program telling precisely when to irrigate or an accurate forecast of an upcoming drought are not of much use when the farmer does not have the means to do anything with it: *“I mean that, knowing, for example, that in three or four days we are going to have an increase in temperatures, it's good because you can foresee it, but you also have to have the means to be able to alleviate that problem. If you don't have them, it's like if they are going to tell you that you are going to die in three or four days, you know it, but you have no solution.”*. This point really makes clear that adaptations in agriculture should be **well-adjusted** to the needs of the farmers as well as **affordable**. Farmer 1 made the same point clear to me and he added to this that the additional expenditure is cheaper to do so for big enterprises than for small family businesses.

“People change with climate change, people also have to adapt. If now, for example, it doesn't rain, then here people will have to find a way to survive with other products, other things will have to be done in a different style of agriculture.” (participant 7). Although the struggles surrounding implementing adaptations, adaptation is necessary as the impacts of climate change are so influential for agriculture and thus farmers are slowly changing their way of doing agriculture, as can also be in the quote read above. As I talked to different ecological farmers and farmers taking a less conventional approach to farming, adaptations in this direction came up during

conversations. The use of **vegetative cover** was something coming up multiple times as it is beneficial to different climate change impacts. Interestingly, due to these benefits it is also done by conventional farmers as a response to climate change: *“Many farmers who have trees like olive trees, vineyards, are beginning to leave vegetative covers on their farms, on their orchards, to maintain the water and the fertility of their soil and not cultivate it ... and without meaning to, they are also doing organic farming.”* (participant 4). The implementation of vegetative cover can thus keep more moisture in the soil as it blocks the sun. Two farmers actually showed me this on their farms and I could very clearly feel and see the moisture inside of the soil with the vegetative cover, while the exposed soil was dry. Vegetative cover can also help in reducing the impacts of erosion as less soil can be taken along as farmer 1 mentioned to me. Farmer 2 actually mentioned to me the problems he faced with erosion as he does not farm ecologically, neither do his neighbors, causing a lot of soil to be moved towards his fields and also his soil being moved away. Although the use of vegetative cover might sound quite straightforward there are lot of different factors and so could vegetative cover also compete with the crops as farmer 1 brought up. Farmer 3 explained to me the whole idea behind his way of, in his words, **rational farming** in which he is more connected to Nature. He explained to me that the vegetative cover after some time decompresses the soil and creates a better structure and better drainage. During winter having more vegetative cover generates organic matter, which in the end is beneficial to the crops when they start to grow after winter. He made clear to me that he prefers to let the Nature do its work to a certain extent in a sense that certain herbs or plants pop up depending on the needs of the soil. At the same time he does try to create a favorable balance for the crops by cutting the herbs and other plants during summer when his crops benefit from having less competition. Another perspective brought up by farmer 1 was the **diversification of crops** on a farm. He mentioned that farmers are much more affected by climate change when only being specialized on just one crop. Having a diverse crop range is a relatively easy way to adapting to climate change. Having six different types of crops and two or three types of crops fail for a year due to climate extremes, would still leave you with three or four types of crops to harvest. These different ways of farming are usually not necessarily seen as an adaptation to climate change, but it can most definitely be seen in this way as explained by the participants.

Next to this different way of farming, also some other more straightforward methods of adapting to climate change were mentioned during the fieldwork. One of the adaptations that were seen by the participants being used in the sector, however, not necessarily by themselves, were the use of **pesticides** on a regular basis. The other one was a system of **candles** and **ventilators** in order to prevent frost on the flowers, however, farmer 1 also mentioned

the extensivity of purchasing and using this system. A more accessible option that was discussed was the use of **different varieties** of the crops being harvested now. This would mean, for example, different types of almond tree varieties that are more withstanding to the heat instead of the cold. It could also be beneficial having varieties that flower later as they would not have the problem of frozen flowers.

Mitigation of climate change

The need for adaptations can also make us wonder whether some mitigation is needed in the sector in order to decrease the severity of climate change. The farmers' perspective on mitigation will be explained in the following section.

“We see the relationship that agricultural practices have in climate change and we see the relationship that climate change has in how agriculture is going, it is a direct relationship.” (participant 6)

As can be read in the quote, agriculture itself is very much connected to climate change and thus it is also valuable to see how mitigation can take place in this sector. Similarly as the responses to adaptation, the participants focusing themselves on ecological farming, saw a different way of farming as a form of mitigating the climate crisis. Farmer 1 referred to the conventional way of farming emitting high amounts by opening up the soil and using chemical fertilizers. The **ecological way of farming** would be avoiding these emissions and be more climate-friendly. Again, **vegetative cover** would allow more carbon to be absorbed into the soil. Farmer 3 also made clear that the organic, ecological or biodynamic way of farming tries to **limit the number of inputs** and in this sense tries to alleviate the carbon dioxide emissions by, for example, avoiding energy for production of additional agricultural products. Working with **mycorrhizae** is also a way to capture as much carbon dioxide as explained by participant 4. Participant 6, part of the same organization, mentions that the agricultural sector as a whole is emitting more carbon than it absorbs. They are trying to do the opposite, partly with mycorrhizae and replanting aromatic plants and young trees to function as **carbon sinks**, to have a negative carbon footprint. She also told me that they are working on promoting a law in Spain surrounding **soil improvement**, as this is not being taken serious while the soil in the end absorbs carbon, which is important against the problem of climate change.

As I talked to farmer 3, he also pointed out a different perspective on mitigation as he made clear that the responsibility is not only on farmers to mitigate. He pointed out that **local consumption** should become very important when thinking about food consumption: *“For example, here in Calahorra, I am producing cherries, well, part of my cherries are sold here in Calahorra, the route is nothing, the ones from the farm go for a kilometer and*

they are there. I am not polluting.”. He sees a lot of exotic fruits being offered in the supermarkets coming from the continent of South America and this brings along a lot of pollution for transportation. Consuming local fruits or vegetables in that sense have a big impact of reducing pollution and should become more of a standard to create a more sustainable agricultural infrastructure. Another perspective that became clear by talking to him was the **limited contribution** of the **agricultural sector** to climate change. He explained to me that this became very clear when the COVID-19 pandemic took place and all different polluting sectors closed down except the one of agriculture. There were clear signs of reduction in pollution, a clear example being the ozone hole recovery. This happened while the agricultural sector was still up and running and he then also said: *“An airplane is capable of emitting much more carbon than a lot of hectares that were cultivated.”*. The restrictions that are put upon farmers are from his perspective not fair as other sectors are having much more contribution to pollution.

The future of agriculture

As we have talked about the stress put upon the agricultural sector due to climate change, it is interesting to see how farmers imagine the future. As climate change is making it more difficult for small-scale farmers to continue to exist, their business is slowly being lost. Next to this, farmers also made clear to me that they are struggling with other aspects, sometimes more powerful than the impacts of climate change. In this chapter these two aspects will be discussed in order to get a clear image on how small-scale farmers imagine their future in these times of uncertainty.

As my fieldwork was focused on the impacts of climate change and how this would affect the future of agriculture, it was interesting to get to know by listening to the farmers that there are actually other factors putting a lot of stress on them. Something that clearly concerned the participants was the way how society is structured nowadays. Farmer 1 had a very clear perspective on this: “...*many farms are abandoned and passed into the hands of large capitals, so that is influencing much more than climate change today. Maybe tomorrow climate change affects more, but today it is more the **capitalist exploitative mentality** that does not think about anything other than money.*”. Farmer 7 also pointed out the **disadvantaged position of small-holder farmers** as companies can produce for low prices and everyone is looking for these low prices. He and farmer 2 both mentioned that big amounts of subsidies go to these companies compared to small-scale farmers. Additionally, farmer 2 mentioned that there are no just prices anymore. He said off the top of his head that farmers were paid 40% of the final price of a product in the past and that this has now lowered to around 7%. Another factor, due to the capitalistic culture, is the technological advancement being more and more part of the agricultural sector. Farmer 3 made clear that he was not convinced that this is a way to alleviate climate change, but for economic interest. Coming back to the structure in place, the problem of a high level of bureaucracy was also brought forward. Interestingly, this is also very much in connection to climate change. Farmer 2 explained about more and more restrictions for water being present due to climate change, however, more restrictions targeted on the people that have the least (small-scale farmers). In the future this might cause them to find a different way of living out of necessity. Farmer 3 also pointed out that the agricultural sector is the last in line for water resources, especially when a water shortage is happening, they are the ones being disproportionately affected. Farmer 5 also made clear this **unequal distribution of burdens** as he explained that small-holder farmers could be farming very sustainably, but in the end the innocent still get to end up paying for the sins of the guilty (the big agricultural industries). The distrust in the system is also present surrounding the 2030 Agenda for Sustainable Development of the United Nations. Participant 6 told me about the

fact that farmers are not believing in this agenda. Regarding this agenda, participant 4 explained to me that the climate summits taking place do not represent any hope to him as they do not reach an agreement.

More specifically on climate change, as it is becoming more and more apparent, a **high level of worry** was present when talking to the participants. There is worry for the agriculture in the far future as farmer 1 imagines the future to be very difficult. Participant 6 shares this concern as she also stressed the point that it is a going to be a problem for the current generation and the ones that follow and not generations in the far future. On this note, she specifically is troubled whether crops can still be cultivated in the north of Spain. Farmer 7 was very clearly negative on the topic of climate change in the future: *“We’re already late. Always change if it is in time, but we don’t get it anymore, climate change is already above us, we are not going to change it anymore.”*. As the farmers face the consequences of climate change regularly, this worry of climate change is highly present and makes them wonder whether the necessary resources for agriculture will still be there in the future.

Next to having concerns, the participants I talked to also had a very clear perspective on how they imagine a better future in agriculture. Both participant 4 and 6 pointed out that it is very important to **have hope** in order to strive towards a better future. Participant 4 mentioned that giving all the time anxiety to people will not help to get people working on this. Participant 6 pointed out to be satisfied with little results and start doing things: *“Here we say: ‘Don’t worry, get busy.’. I’m busy making sure that many things that may be in my power can be changed.”*. She gave the example of reforesting with a considerable low amount of 1,500 trees and she wants to make clear by these activities that there are solutions and hope, in order to make people eco-resilient in this way. When talking to the participants the perspective of having a **different connection to Nature** was something important for the future, to have a symbiotic relationship with her, to coexist. Participant 6 also said the following to make clear the need to reconnect with Nature: *“A young man or woman who puts some aromatics on the balcony is revolutionary.”*. Participant 4 also made clear that besides small actions, bigger actions is needed, which are the ones that cost more and thus might be more challenging. Farmer 5 also pointed out that this symbiotic relationship with Nature is a **commitment for us all** and it is important to take this serious: *“It is a commitment for all of us, because if we destroy ourselves and screw up the planet, what are we going to have for the next generations?”*. Committing to a Nature-friendly way of farming is important to the farmers and **local production** is also important on this topic. Creating a society in which we use less resources is also significant to farmer 3, both in the agricultural sector as well in the whole society. This broader perspective of taking care as a society of our surroundings and our impact was expressed by multiple participants and they made clear that we all should be part of acting more sustainable.

Discussion

As a lot results have been presented above, the different interactions will now be presented and especially the implications, this will be done by explaining a model based on the one of Vedwan (2006). Additionally, some results that are corresponding to the literature review will also be pointed while explaining this model. In the end, the different limitations of this study will be discussed as well as the future direction that could be taken in this research area by giving some recommendations.

Interpretations and implications

From the fieldwork it got very clear that the participating farmers have a very strong connection to the climate as well as to their plants. As they have a high awareness of their surroundings, due to the importance for their work, their perception of climate and climate change is greatly based on their day-to-day experience and even more so by the effects it has on their plants. It is interesting to see that this aligns well with the idea and influence of mountain “specificities” discussed in the article of Vedwan (2006), in which apple farmers strongly form their perception by their connection to the environment. It is interesting to reflect a bit more on this conceptual model of Vedwan, as the model itself can be used to connect the different findings of the fieldwork with each other. In Figure 6 a model similar to Vedwan’s model can be seen in which the different research findings have been processed and slight adjustments have been done to the model. Unfortunately, my research has not dived too much into the different “specificities” of the agricultural environments, also partly due to the fact that the different farmers had their farm on slightly different types of locations. Nonetheless, it was very clear that the different farmers were very

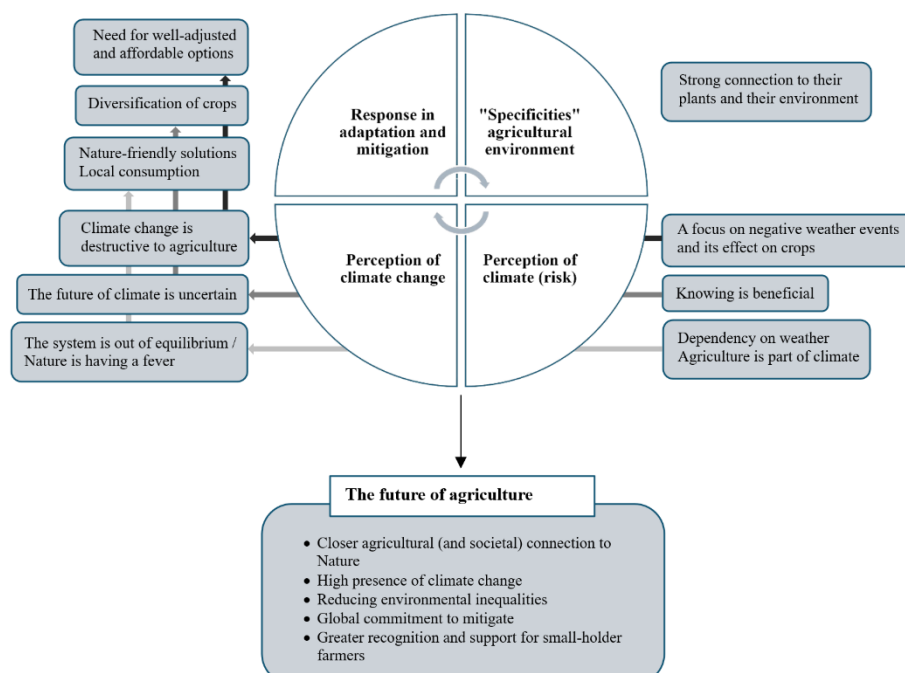


Fig. 6: Model of the fieldwork of the farmers in La Rioja, Spain based on the model of Vedwan (2006, p. 10).

knowledgeable on the environment of their farm(s). As my research focused on the perception of climate (risk) and climate change and their responses to it in terms of adaptation and mitigation, I will focus myself on these three elements of the model. Additionally, after having done the fieldwork and analyzing the interviews, I am under the impression that these different aspects in the end give results to a broad picture of the future of agriculture, especially how the farmers envision it to be. As I have identified three different flows of thought regarding climate change, I will explain them from top to bottom (black to light grey):

1. A substantial part of the farmers' perception of the climate and its risk is connected to how the different types of weather **affect** their **crops**, especially **negatively**. While farmers did not associate extreme weather events to specific years as in the study of Mertz et al. (2008), these extreme events do play a big role in the perceptions, similar as in the study of Debela et al. (2015). As they know the "specificities" of their agricultural lands, they made clear to me the different notions of climate risk, for example: warmer temperatures in early spring, torrential rain, long-term droughts. From the findings it could be said that the farmers have some sort of calendar (in their minds) of weather that would be damaging to their crops during certain periods, this would be the opposite idea of the ideal weather calendar discussed in the study of Vedwan and Rhoades (2001). These weather events occurring more and more and affecting their crops negatively were clearly part of the perception of climate change, which is that **climate change** mainly has **negative, destructive effects**, as was also seen in the study by Mertz et al. (2008). Additionally, the disappearance of certain crops in specific locations due to the negative effects of climate change was also experienced, just as the farmers did in the study of Vedwan (2006). As the farmers are struggling more and more with these problems they were of the opinion that they need **well-adjusted** and **affordable solutions** to climate change as this is currently not the case.
2. As the farmers made clear to me that it is **beneficial** to **know** the upcoming climate, this also explains why the farmers bring forward the **uncertainty** they are experiencing by climate change, as was also experienced by the participants in the study of Debela et al. (2015). As it is important to know the upcoming weather and as this is not possible anymore, this is something immediately perceived. As uncertainty is playing more and more a role in the field of agriculture, farmers point out that **diversification of crops** is a useful tool in order to reduce vulnerability and be more certain to end up with a sufficient amount of harvest.

3. The crops of farmers are explained by the farmers as highly **dependent** on the **weather**, as also pointed out in the research of Debela et al. (2015), and thus being **part** of a **climate system** (Nature). As the farmers are now experiencing that their plants are having stress and sometimes failing to grow, the conclusion that is drawn by the farmers is that climate change signify a system that is **out of equilibrium**, also described as ‘topsy turvy’ by farmers in the study of Vedwan (2006). Or as two farmers described it as **Nature is having a fever**. Due to this perspective, the farmers made clear that it is important to have more **Nature-friendly solutions** in order to get back to an equilibrium. Additionally, the importance of **consuming locally** is related to this perspective as it would help to mitigate the climate crisis and create a more balanced system.

These different aspects along with other findings of the fieldwork result in different desires and perspectives on the future. Firstly, the fieldwork made very clear that the farmers are looking forward to an improved and more present **connection to Nature** in agriculture as well as in society. It was also very clear by the perceptions of the farmers that **climate change is there to stay** and thus will be part of the future. Due to these current impacts of climate change and the future ones that will follow, participants also mentioned the differences in opportunities between small-holder farmers and big agricultural industries. The small-holder farmers have difficulties sustaining themselves, trying to farm in a sustainable way, while they are suffering from the environmental inequalities caused by polluting agricultural businesses. This indicates a need to **reduce** these **environmental inequalities**. At the same time this points out the need to **commit globally** to reduce the impacts of climate change, especially by **mitigating**. Finally, the results found during fieldwork also advocate for **greater recognition** of small-holder farmers, in terms of expertise as also shown in the study of Byg & Salick (2009) and as important actors in the production system as well their effort of mitigating climate change. Finally, it is made clear that there needs to be **improved support** for the farmers in order to make it possible to also in the future have a subsistence based on agriculture.

Limitations

As every research this research also has several limitations which are important to keep in mind. A clear limitation of the fieldwork was the limited time possible to do the research as I only could spend 1.5 weeks due to university classes. Another clear limitation of the fieldwork is the fact that I spoke to mostly farmers focusing on ecological agriculture or a similar type of agriculture and less to farmers conventionally farming. It is also important to mention that all the interactions and interviews were done in Spanish, while my Spanish proficiency is competent, I might have not picked up on something that would have been clear in a more proficient language. Lastly, as an ethnographer, it is also important to point out the positionality as researcher which can have an influence on the outcomes.

Future research

Having done this research, new perspectives and insights were brought up and with this comes future directions of research. One interesting research that could be done is to see the perspectives of people working in industrial agriculture businesses, to see how they look upon climate change and its future. Additionally, it would be of significance to have a study consisting of a greater number of farmers working in a conventional way of agriculture in order to see more clearly their perspective. Secondly, as the fieldwork was only done at one specific moment, it would be interesting to have a research consisting of multiple field visits in order to see the effects of climate change over several years. Finally, as the topic unexpectedly arose during my research, it would be interesting to have a more in-depth research on the effects of the capitalistic society on small-holder farmers as it was seen as detrimental to their subsistence.

Conclusion

In this research the importance of including the local perception on climate and climate change has been pointed out. The fieldwork has made clear the different perceptions that are present by farmers in the region of La Rioja in Spain. The main perceptions being that climate change is destructive to agriculture, causing an uncertain future of the climate and causing the system to be out of equilibrium. These perspectives are highly important as climate change is becoming more and more apparent due to the fact that farmers are having more and more problems. The main problems occurring because of climate change are irrigation problems, problems with early flowering and an increased amount of stress and plagues. Due to these impacts, there are critical concerns from the farmers when imagining the future of agriculture. The results of this fieldwork identified different directions that are important for the farmers to ensure a more promising future. The farmers pointed out the importance of improving our connection to Nature, the need to reduce environmental inequalities, commit globally to mitigate climate change and to increase support for and recognition of small-holder farmers. Next to the need to as society work on these different aspects, it is also crucial to realize that the local experience and knowledge of farmers and their corresponding concerns are important to be researched as it helps envisioning a more positive and sustainable future of a very important sector in our society.

Appendices

Appendix 1: Interview Guide

Interview Questions Preguntas de entrevista

What does climate mean for you in agricultural terms?

Que significa la clima para usted en términos de agricultura?

How important is it for you to know the upcoming climate conditions?

¿Qué importancia tiene para usted conocer las próximas condiciones climáticas?

Do you have an instinct for the upcoming climate?

¿Usted tiene instinto para el clima que se avecina?

Are there specific signs that help you predict the climate?

¿Existen señales específicas que le ayuden a predecir el clima?

What is your definition of climate change?

Como usted significa el cambio climático?

How would you describe it if someone asks you to explain?

¿Cómo lo describiría si alguien le pidiera que se explicara?

Do you think climate change means something different to other people? For example in the region of La Rioja?

Usted cree que el cambio climático significa algo diferente para otras personas? Por ejemplo en la región de La Rioja?

What is your perception of climate change?

Cual es su percepción del cambio climático?

Do you experience climate change yourself when working on agriculture?

¿Experimenta usted mismo el cambio climático cuando trabaja en la agricultura?

Do you think others experience climate change a lot in the region of La Rioja?

Usted cree que otras personas experimentan el cambio climático mucho en la región de La Rioja?

Do you think climate change is currently a problem, especially for agriculture in the region?

Usted piensa que el cambio climático es actualmente un problema ahora, especialmente para la agricultura de la región?

Do you think climate change will be a (bigger) problem in the future for agriculture?

¿Usted cree que el cambio climático será un problema (mayor) en el futuro para la agricultura?

Are you actively busy with climate change on a weekly basis?

Usted esta ocupado con el cambio climático semanalmente?

Is it more difficult for you now to predict the climate due to climate change?

¿Le resulta más difícil ahora predecir el clima debido al cambio climático?

If not explained: How is your perception formed of climate change?

Si no se explica: ¿Cómo se forma su percepción del cambio climático?

Does your perception on climate change have an effect on your behaviour?

¿Su percepción sobre el cambio climático tiene algún efecto en su comportamiento?

Do you experience a difference in climate?

Usted experimenta una diferencia en el clima?

Did you experience a higher variability in climate the last couple of years?

¿Usted experimentó una mayor variabilidad en el clima en los últimos años?

Did you experience climate extremes the last couple of years? Heatwaves or heavy rainfall?

Usted experimentó extremos climáticos en el clima en los últimos años? ¿Olas de calor o fuertes lluvias?

Do you experience impacts on your life due to climate change?

¿Experimenta impactos en su vida debido al cambio climático?

How does it affect the work of agriculture in your case?

Como afecta el trabajo de agricultura en su caso?

Do you experience a different growing season of your crops?

¿Usted experimenta una temporada de crecimiento diferente de sus cultivos?

Do you experience a difference in quality of your produce?

Usted experimenta una diferencia en la calidad de sus productos?

Do you experience a difference in quantity of your produce?

Usted experimenta una diferencia en la cantidad de sus productos?

Do you experience an increase of pests and diseases on your crops?

¿Usted experimenta un aumento de plagas y enfermedades en sus cultivos?

Do you have other problems due to climate change?

Usted tiene otros problemas porque el cambio climático?

Do you need to adapt to climate change or do you feel the need to do so?

¿Necesita adaptarse al cambio climático o siente la necesidad de hacerlo?

What kind of climate change adaptations are necessary?

¿Qué tipo de adaptaciones al cambio climático son necesarias?

Which kind of adaptation is the most important one for you?

¿Qué tipo de adaptación es la más importante para usted?

What do you think about climate mitigation next to climate adaptation?

¿Qué opina de la mitigación climática junto con la adaptación climática?

What kind of climate mitigation strategies come into your mind?

¿Qué tipo de estrategias de mitigación climática le vienen a la mente?

Which strategy do you think is the most important one?

¿Qué estrategia cree que es la más importante?

Does your agricultural work have a cultural value for you?

El trabajo de la agricultura significa cultura para usted?

What would you say your cultural values towards agriculture are?

¿Cuáles diría que son sus valores culturales hacia la agricultura?

Do you think the region of La Rioja in itself has a strong cultural value towards agriculture?

Are you afraid of losing the cultural value of agriculture in the near future?

Do you think climate change poses a threat to the cultural values due to stress on the agriculture?

¿Usted cree que el cambio climático supone una amenaza para los valores culturales debido al estrés que sufre la agricultura?

What aspect of climate change poses the biggest threat on your culture?

¿Qué aspecto del cambio climático representa la mayor amenaza para su cultura?

Do you have a connection to Nature that is special to you?

¿Tiene una conexión con la naturaleza que sea especial para usted?

How would you describe this connection to Nature?

¿Cómo describiría esta conexión con la naturaleza?

Does this connection to Nature exist due to your work in agriculture?

¿Existe esta conexión con la naturaleza debido a su trabajo en la agricultura?

Is your connection to Nature affected by climate change?

¿Su conexión con la naturaleza se ve afectada por el cambio climático?

Appendix 2: Additional information on the culture of agriculture and its connection to Nature

As my research also encompassed findings on the culture of agriculture and its connection to Nature, I have included it in the Appendix in order to have the possibility to get a deeper understanding of the positionality of the farmers.

While talking and being with the different participants it became very apparent that their work in agriculture is not just a job for them. This was mentioned multiple times and brought up very clearly by farmer 3: *“For me it is a way of life, that is, for me it is not a job that I have to do, for me it is a way of life.”* This was said by multiple farmers and one clear example of how this manifests itself is the following. Farmer 2 said to me he had talked to someone working in the industrial agriculture and the person asked him where he was going to go to during holidays. He said to the worker that he would be going to his fields, which was an unexpected answer for the worker. This interaction points out the different perspective farmer 2 had, compared to someone working in a different type of agriculture similarly structured as other jobs in our society. Another difference from the industrial agriculture that was pointed out by him is the way they, him and the worker, see their trees. For him it is important whether they are doing well and it is not per se about the money, while this is the case for the industrial way of farming. Talking to farmer 3, I also clearly felt the special connection he has with his trees. He pointed out that he comes to his farms to see the different changes in the trees that happen over one or a few days and he made clear that he enjoys this. The enjoyment of seeing the plants develop was also described by farmer 5 as he explained that it entails waking up wondering how the plants are doing, whether they are doing well as part of your family. He also explained his admiration of the different stages of trees; the tree being dead, then it blooms and in the end it bears fruits to feed people. Another clear example of the distinctive relationship farmer 3 has with his trees is the way he remembers the age of a certain field of cherry trees as the trees were planted a year after his son was born. He also expressed the importance of the trees planted by his father as it was his father’s family business. The trees not solely represent money for him, they first and foremost represent family history, memories and living beings. Farmer 2 also brought up the family history of how he started working at a young age with his father. He explained to me that his father always lived in the countryside and instead of doing sports in the weekend, he would go help his father and he always liked to do so. He explained to me that he also currently prefers to go to his fields instead of going to a bar during the weekends as it fulfills him: *“Being here to see this and on another farm, that is what fills me, that is what fills me.”*

Another perspective that came forward was the historical roots of agriculture and how this relates to the culture. Farmer 7 introduces this topic well by pointing out that agriculture has always been the traditional means of subsistence and everyone has lived from it. He also points out that he carries agriculture inside of him and stresses the importance of self-supply. He practically produces everything himself and in this way he also knows that he does not eat food on which pesticides have been used. Participant 4 went further into the peasant history of Spain which is linked to the festivities and traditions of the regions themselves. He explained that the town festivities of Nalda take place when the plum harvest ends. Participant 6 points out the rich culture and especially the knowledge that was present in generations back, reaching from the foundational planting and harvesting to working with aromatics and their medical knowledge. She makes clear that this is clearly a culture, and also one we should get to know more about, learn from it and act upon it.

As already touched upon slightly, the farmers also have a deeper connection to Nature, this became very clear during the fieldwork. The different connection to their trees described above is already a clear distinct relation the farmers have to Nature. Farmer 2 also mentioned to me that when there is a bad harvest of almond trees, he would still continue to grow them as he cares for them, while a big company would not do so easily. Another viewpoint on Nature is the one of farmer 3 in which he explained the following: *“I don't say weeds, I say plants, because they are plants too.”* He would not use the word ‘weeds’ as the plants are not seen useless and disturbing to him. He explained to me that they are bio-indicators, for example, a type of plant appearing, means the soil there is very compacted. He also indicated his preference of vegetative covers that are created spontaneously by Nature and not designed by ourselves. He has this preference as the plants that come out, have a reason for doing so and help the soil (recover). As I talked to mostly people working on a different (ecological) level with Nature, similar perspectives were discussed. Participant 4 described good agriculture as one that enhances the regeneration of the soil, includes proper protection of its environment and in the end does not interfere too much, seeks to contribute and to not remove. Additionally, he explained that they work with mycorrhizae and you can have flowers that are sort of traps as they prevent your crops being attacked. In the end he concluded with, “So well, let's play, permaculture.”, as Nature already has solutions to problems we are tackling very unnaturally. He also pointed out the importance of the so-called ‘weeds’ as he was working together with little children and a little girl was cutting the weeds, so he explained his perspective (the importance of weeds) to her. He made clear with this example that is important to learn and be open in it. The loss of this connection to Nature was also brought forward by participant 6 as she made clear that we are lacking this knowledge and connection and we need to get it back. Similarly, this

reconnection to Nature was advocated for by farmer 3 in which he pointed out the reliance on technology nowadays. He thinks that instead of having a lot of artificial intelligence, we should have more natural intuition in agriculture. The last point addressed, and also clearly part of the culture, is the need or desire of being in Nature. Farmer 7 made this clear by saying that he rather spends time outdoors than in a city. Farmer 5 explained that he had worked in a mechanic shop from where he could not see the sunlight and he did not enjoy it: *“In the end, I got home, I was stressed, I was not liking it, I needed to go out, see the sun, get cold, get hot, and in the end it's another thing, it's one of those things that made me realize that I like being in the countryside in agriculture. And for me it's very much like a relationship I've lived with since I was little, because it's something that if I'm missing it, it's like I'm having a hard time, so to speak.”*.

References

- Alam, A., & Rukhsana, N. (2023). Climate Change Impact, Agriculture, and Society: An Overview. In Springer eBooks (pp. 3–13). https://doi.org/10.1007/978-3-031-28251-5_1
- Byg, A., & Salick, J. (2009). Local perspectives on a global phenomenon—Climate change in Eastern Tibetan villages. *Global Environmental Change*, 19(2), 156–166. <https://doi.org/10.1016/j.gloenvcha.2009.01.010>
- Debela, N., Mohammed, C., Bridle, K., Corkrey, R., & McNeil, D. (2015). Perception of climate change and its impact by smallholders in pastoral/agropastoral systems of Borana, South Ethiopia. *SpringerPlus*, 4(1). <https://doi.org/10.1186/s40064-015-1012-9>
- Hamal, R., Thakuri, B. M., Poudel, K. R., Gurung, A., & Yun, S. J. (2022). Farmers’ perceptions of climate change in Lower Mustang, Nepal. *Environmental Monitoring and Assessment*, 194(9). <https://doi.org/10.1007/s10661-022-10286-3>
- IPCC (2001) Climate change 2001: Impacts, Adaptation and Vulnerability, Summary for Policymakers, WMO.
- King, D. N. T., Skipper, A., & Tawhai, W. B. (2008). Māori environmental knowledge of local weather and climate change in Aotearoa – New Zealand. *Climatic Change*, 90(4), 385–409. <https://doi.org/10.1007/s10584-007-9372-y>
- Kloprogge, P., & Van Der Sluijs, J. P. (2006). The inclusion of stakeholder knowledge and perspectives in integrated assessment of climate change. *Climatic Change*, 75(3), 359–389. <https://doi.org/10.1007/s10584-006-0362-2>
- Mbow, C., C. Rosenzweig, L.G. Barioni, T.G. Benton, M. Herrero, M. Krishnapillai, E. Liwenga, P. Pradhan, M.G. Rivera-Ferre, T. Sapkota, F.N. Tubiello, Y. Xu, 2019: Food Security. In: *Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems* [P.R. Shukla, J. Skea, E. Calvo Buendia, V. Masson-Delmotte, H.-O. Pörtner, D.C. Roberts, P. Zhai, R. Slade, S. Connors, R. van Diemen, M. Ferrat, E. Haughey, S. Luz, S. Neogi, M. Pathak, J. Petzold, J. Portugal Pereira, P. Vyas, E. Huntley, K. Kissick, M. Belkacemi, J. Malley, (eds.)]. <https://doi.org/10.1017/9781009157988.007>

Mertz, O., Mbow, C., Reenberg, A., & Diouf, A. (2008). Farmers' perceptions of climate change and agricultural adaptation strategies in Rural Sahel. *Environmental Management*, 43(5), 804–816.

<https://doi.org/10.1007/s00267-008-9197-0>

Ogra, M., Manral, U., Platt, R. V., Badola, R., & Butcher, L. (2020). Local perceptions of change in climate and agroecosystems in the Indian Himalayas: A case study of the Kedarnath Wildlife Sanctuary (KWS) landscape, India. *Applied Geography*, 125, 102339. <https://doi.org/10.1016/j.apgeog.2020.102339>

Vargas-Amelin, E., & Pindado, P. (2014). The challenge of climate change in Spain: Water resources, agriculture and land. *Journal of Hydrology*, 518, 243–249. <https://doi.org/10.1016/j.jhydrol.2013.11.035>

Vedwan, N. (2006). Culture, Climate and the Environment: Local Knowledge and Perception of Climate Change among Apple Growers in Northwestern India. *Journal of Ecological Anthropology*, 10(1), 4–18.

<https://doi.org/10.5038/2162-4593.10.1.1>

Vedwan, N., & Rhoades, R. (2001). Climate change in the Western Himalayas of India: a study of local perception and response. *Climate Research*, 19, 109–117. <https://doi.org/10.3354/cr019109>

World Meteorological Organization. (2023, November 14). Weather. WMO.

<https://wmo.int/topics/weather>

World Meteorological Organization. (2024a, February 5). Climate change. WMO.

<https://wmo.int/topics/climate-change#:~:text=Climate%20change%20is%20the%20term,period%2C%20typically%20decades%20or%20longer>

World Meteorological Organization. (2024b, March 20). Climate. WMO.

<https://wmo.int/topics/climate#:~:text=Climate%20is%20the%20average%20weather,2023>