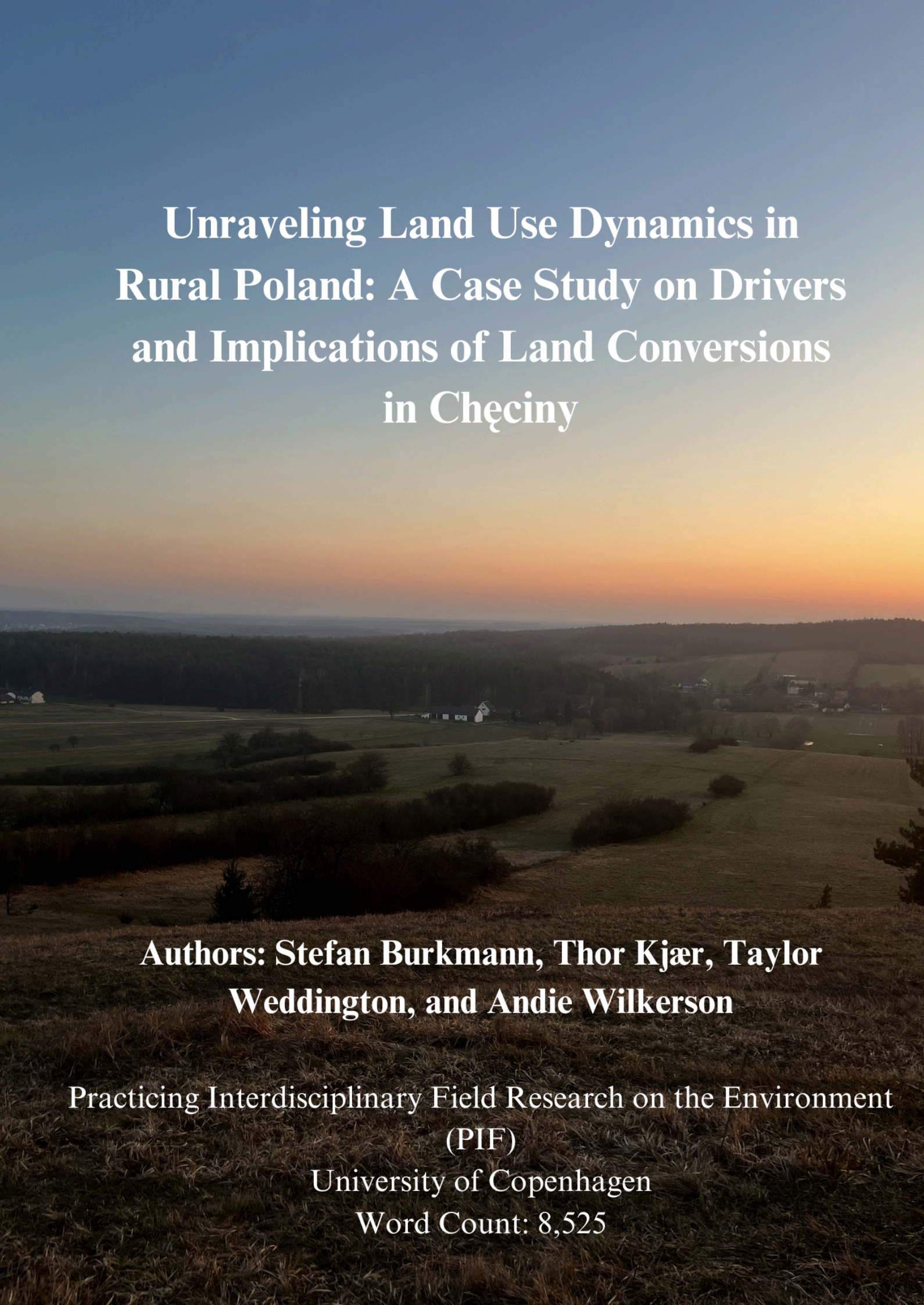

Unraveling Land Use Dynamics in Rural Poland: A Case Study on Drivers and Implications of Land Conversions in Chęciny

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Abstract

Land use in rural Poland is shifting as agriculture moves away from small farms and land is converted from arable land to other uses such as residential areas, protected nature, and land abandonment. Chęciny is a small village in rural Poland that is also experiencing shifts in land use, and we wanted to understand what types of conversions are happening in Chęciny, what is driving these conversions, and their implications. Understanding land conversion plays an important role in guiding planning decisions for sustainable development. Based on preliminary research, we found there is a lack of knowledge on the drivers and implications of land conversions specifically in Chęciny along with a gap in research on land abandonment within local contexts. This led us to our research question: What are the drivers and economic, social, and environmental implications of land conversions in Chęciny? We used social and natural science methods such as interviews, surveys, and soil assessments to understand the socio-economic and environmental variables and utilize sustainable land use concepts to analyze our results. We found that conversions from arable land to abandoned land are driven by the aging population, land fragmentation, poor soil quality, natural hazards, and lack of subsidy support for small-scale agriculture. Based on our results, we conclude that while Chęciny's increase in land abandonment has some environmental benefits, it will not be sustainable for the long-term development of the region.

Acknowledgments

We would like to take a moment to express our gratitude to the people who made our research possible. First, we extend our sincere appreciation to our primary translator, Malwina Dąbrowska, whose efforts not only facilitated communication but also provided valuable insights into the context and culture of the region. Without her hard work, and commitment to the project we would have not been able to achieve our research goals.

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Chapter 1: Introduction

In Poland, the land is used predominantly for agricultural production, accounting for approximately 47% of the total land area (The Global Economy, 2021). However, as is the trend in most European countries, there is a conversion of land from arable land to other uses, such as the expansion of cities, transportation networks, and environmental programs, with some landowners simply abandoning the arable land, allowing it to sit disused (Banski & Kaminska, 2022). Despite a general trend of increasing land concentration, Poland's agricultural land still has one the highest levels of land fragmentation in the EU, as 52% of farms are less than 5 hectares (Badach et al., 2023). The land fragmentation combined with a lack of investments and low soil quality means that agriculture in Poland generally has low productivity (Badach et al., 2023; European Commission, 2014). As the Common Agricultural Policy (CAP) of the EU distributes funding disproportionately more to bigger farms, the many relatively small farms in Poland are especially challenged (Guyomard et al., 2023).

Narrowing the scope to the Świętokrzyskie Voivodeship, agricultural farms account for over 46% of the total land (Urząd Statystyczny w Kielcach, 2021). Here, farms are smaller than the national average and 63% of farms are smaller than 5 ha (Badach et al., 2023). Within the Świętokrzyskie Voivodeship, Kielce County has shown the highest agricultural potential, with 128,800 ha of agricultural land (Musiał et al., 2020). Despite this high potential, Kielce has simultaneously seen the largest decline in land receiving agricultural area payments from the European Union (Musiał et al., 2020). This led us to our study location, Chęciny municipality. Located in Kielce County, this area can be characterized by low agricultural productivity, small farms (less than 5 ha), and little usable area per person, all of which can motivate the conversion of agricultural land to other uses (Gałczyńska, & Ilieva, 2002). One relevant type of land conversion in the study area is the abandonment of land.

A study by Kuemmerle et al. (2016) showed that 20,500 km² of cropping and grazing land was abandoned in Europe between 2000 and 2012, while 16,430 km² were cultivated after 2006. Therefore, we engage with land abandonment and its implications for sustainable land use.

The definition of agricultural land abandonment varies by study. Ustaoglu and Collier (2018) define "land abandonment as a loss of utilized agricultural area that has not been converted to urban uses or afforested." Whereas the Keenleyside and Tucker (2010) break land abandonment down into three parts: actual abandonment, semi- or hidden abandonment, and transitional abandonment. Actual abandonment refers to where farmland is totally disused, semi- or hidden abandonment occurs where the "land is not formally abandoned and is subject to some form of management," and transitional abandonment is "as a result of land use change." These definitions enable us to differentiate between different kinds of agricultural land abandonment.

Actual land abandonment is a contentious field where researchers have found different conclusions, especially regarding the implications (Ustaoglu & Collier 2018; Leal Filho et al., 2016). The consequences can be positive, negative, or variable depending on biophysical conditions, natural ecological processes, and agricultural legacy (Ustaoglu & Collier 2018). After the abandonment, there is a phase of forest regrowth and natural regeneration. This creates the conditions for possible positive impacts such as carbon sequestration, biodiversity conservation, improvements in quality and supply of water, soil recovery, and nutrient availability, and an increasing attraction for eco-tourism and hunting activities (Ibid.). However, some studies have shown land abandonment can cause a reduction of soil quality, water availability, biodiversity, cultural landscapes, and aesthetic values (Ibid.).

The abovementioned studies cite an increasing need for abandonment to be studied within local contexts (Ustaoglu & Collier 2018; Leal Filho et al., 2016). Within this research gap comes our motivation for studying these dynamics within the context of Chęciny. Furthermore, social, economic, and environmental aspects of land use are of interest to the local community as these matters have been addressed in Chęciny's development strategy (Grzegorczyk et al. 2013). From this background we seek to understand what types of conversions are happening in Chęciny, what is driving these conversions and the implications of the conversions.

1.1 Research Question and Objectives

From our preliminary research, we formed our final research question: What are the drivers and economic, social, and environmental implications of land conversions in Chęciny? The following sub-questions guide our research:

- What types of land conversions are happening in Chęciny?
- What are the drivers of land use change in Chęciny?
- What are the socio-economic implications of converting land for landowners?
- What are the environmental implications of converting land for landowners?

We expect this research will further investigate the outcomes of the changing land use so stakeholders and policymakers can make more informed decisions that are beneficial for people, land, and the environment.

1.2 Project Design

The design of our project can be broken down into 4 key steps: planning, data collection, data analysis, and discussion, as seen in Figure 1. Beginning with planning we started by establishing knowledge gaps related to land use transitions. Through our literature search using keywords such as “land use transitions,” “managed meadows,” “development strategy,” “Poland,” and “Świętokrzyskie.” From the literature, we learned about the importance of agriculture to the country of Poland, and how due to a variety of reasons, the region of Świętokrzyskie has seen several land-use transitions, mainly from arable land to other land uses. We used this preliminary understanding of the area to also begin searching for theoretical frameworks.

From this knowledge base, we devised our research questions and objectives and began to fill out our research matrix. In order to theoretically approach our topic we dealt with the concept of sustainable land use. Before we went to the field, we drafted the questionnaire and interview questions, obtained materials, and planned our fieldwork schedule.

Once in Chęciny, the data collection portion of our research plan began. We spent the first few days establishing an understanding of the region and attending meetings and

presentations from key stakeholders to gain local context. We then worked on finalizing our questionnaire in Polish and began seeking respondents and collecting soil samples. While in Chęciny, we were also able to begin preliminary steps in interview coding and data analysis.

The data analysis was to answer 3 main questions - What land conversion is happening? Why is this land conversion happening? What are the outcomes of this land conversion relative to our sustainable land use framework? Finally, from understanding the answers to these questions, we can conduct a discussion, positioning this research into the wider lens of land use transitions in the Świętokrzyskie Voivodeship and the sustainable development of the region.

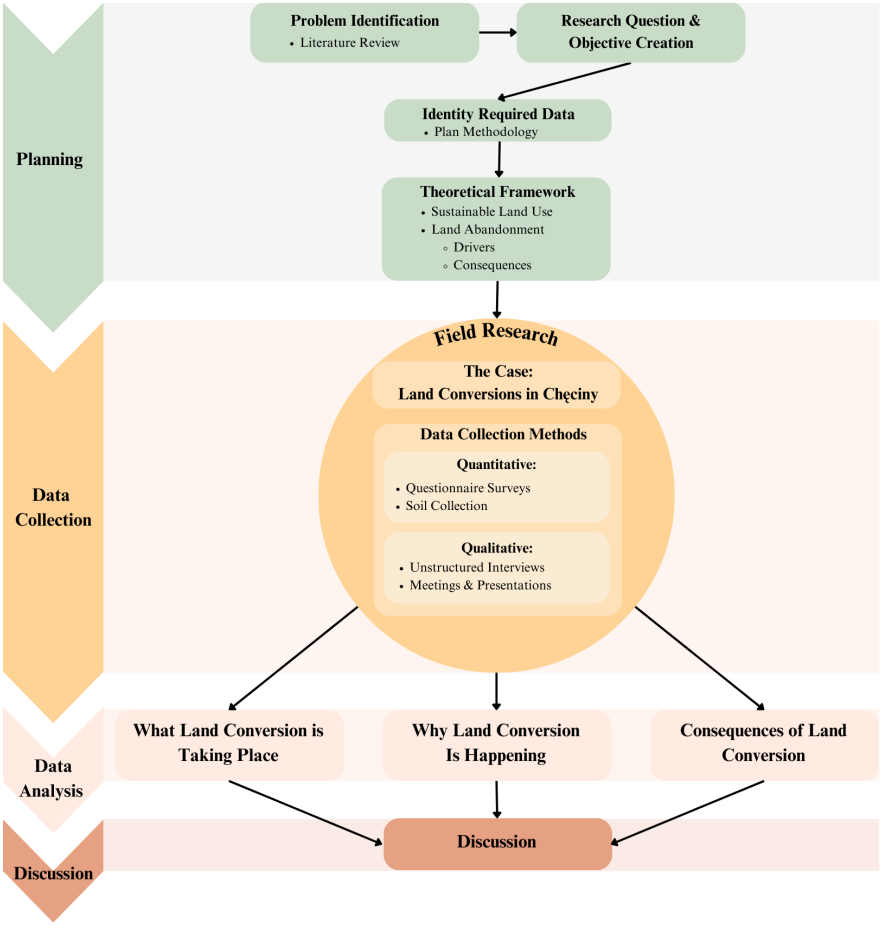

Figure 1: Project Design

Chapter 2: Theoretical Framework

2.1 Sustainable Land Use

We have chosen sustainability as a starting point for our theoretical framework which is divided into social, economic and environmental aspects. We focus on sustainable land use and management, as these play an essential role in the achievement of the UN Sustainable Development Goals (SDGs) (Leal Filho et al., 2016).

Land use trends have been shifting globally due to increasing population and urbanization, leading to a strain on the land for its resources. Sustainable management of land use is necessary to address these growing needs. Through sustainable land management, the most potential socio-economic and environmental benefits from ecosystems are taken into account alongside the potential spillover effects of land use (Velasco-Munoz et al., 2021).

Fernandes and Burcoff (2006) define sustainable land management "as a knowledge-based procedure that helps integrate land, water, biodiversity, and environmental management (including input and output externalities) to meet rising food and fiber demands while sustaining ecosystem services and livelihoods."

Similarly, Velasco-Munoz et al. (2021) describe "sustainable land management [...] as a holistic approach that seeks to achieve the highest productivity of ecosystems considering biophysical, sociocultural, and economic needs." From these two definitions, it becomes clear that sustainable land use is a comprehensive concept that understands ecosystems and their interactions with humans holistically.

Soil ecosystems are crucial contributors to food supply, water purification, and climate mitigation through carbon sequestration (Lehmann et al. 2020). Furthermore, sustainable land management confronts land degradation and desertification and reduces negative impacts on ecosystems and biodiversity (Velasco-Munoz et al. 2021). Additionally, sustainable land use supports incomes and livelihoods (Ibid.). In this sense, land use can support sustainable development.

2.2 Indicators of Sustainable Land Use

Identifying indicators that point towards managing and using land sustainably varies greatly based on the context of the region and may also be dependent on the difficulty in measuring these complex and diverse indicators (Velasco-Munoz et al., 2021). Studies examining the agricultural aspect of sustainable land use have utilized physical indicators such as “soil erosion, soil organic C, nutrient balance, and soil acidification” (Nziguheba et al., 2022).

To fit these indicators within a larger sustainability framework we also needed to include aspects related to social and economic components. As identified by Leal Filho et al. (2016), socio-economic indicators of agricultural land abandonment include demographic trends, agricultural income and subsidies, and settlement patterns. This literature inspired the indicators we utilize in our research.

As shown in Figure 2 we landed on nine total indicators for sustainable land use. Although these nine indicators do not converge with all the indicators used in the literature from our theoretical framework, these nine felt the most accomplishable within our timeframe and relevant to Chęciny based on our literature review. Within the environmental aspect, we decided to examine the indicators of ecosystem services that are relevant to the context of the area, which faces flooding and drought. Other studies examining the sustainability implication of converting agricultural land to abandoned land have mentioned the effects on water cycle processes and we wanted to see how these characteristics show up in other land conversions. These indicators include comparing the soil's ability to retain and absorb water as well as the ability to act as a carbon sink. For social indicators of sustainable land use, we chose to examine the demographics of landowners and the impact on employment. Finally, we chose the economic indicators of land subsidies and revenue, associated with land conversion. Together these indicators help us to understand if the land uses and conversions within the region fit within a larger sustainability framework, and thus could be relevant to understanding the future sustainability of the region.

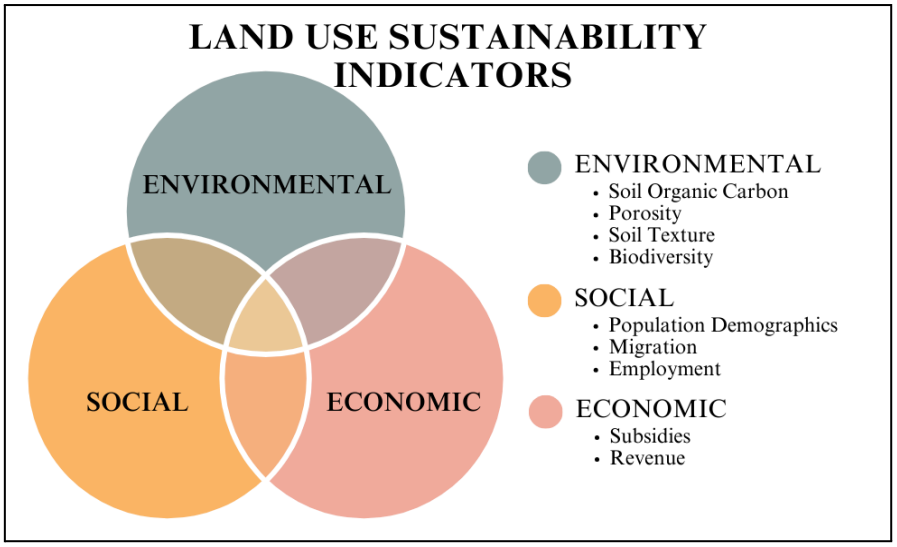

Figure 2: Land Use Sustainability Indicators Diagram

Chapter 3: Methodology

To address our research objectives we combined social and natural science methods in an interdisciplinary approach. We triangulated questionnaires, unstructured interviews, meetings with key informants, as well as soil assessments. Through our collection of quantitative and qualitative data, we approached our topic from different perspectives to ensure a holistic understanding.

3.1 Case Study Area

We chose the rural parts around the town of Chęciny as our study area. We limited our research to this area rather than a larger area to obtain a more representative sample from a smaller population for the quantitative data. The small study size also helped us to get a deeper understanding of our study area through our qualitative methods. Chęciny is a town of 14,651 people, located within the Świętokrzyskie Voivodeship, nestled in the hills of rural Poland. Like many other rural areas in Europe, Poland has experienced a shift in land use trends in which agricultural land is being consolidated and intensified to more productive areas and former agricultural land is being converted into urban areas, transportation networks, nature protection, or left unused and abandoned (Banski & Kaminska, 2022 & Ustaoglu & Collier, 2018).

3.2 Questionnaire

We created a questionnaire containing 21 base questions and 15 additional questions that are shown depending on whether the participant undergoes a land conversion. The questionnaire takes approximately 15 minutes to complete. It was designed to be taken by people in the region who manage land. The questions cover basic demographics, area of land managed, if a land conversion has taken place, changes in revenue and subsidies due to the conversions, and the participant's perception of natural hazards and biodiversity changes. The questionnaire was written in English and then translated into Polish by our translator from the University of Warsaw. As stated in Chapter 1, land abandonment has many different definitions, when referring to actual abandoned land to respondents we used a specific Polish translation of "permanently unused land" to avoid misunderstandings. Both the English and Polish versions were entered into SurveyXact. The final English questionnaire can be found in Appendix 3, and the Polish questionnaire can be found in Appendix 4.

Originally we planned on conducting a random sample from a list of farmers in Chęciny, however, neither the agricultural office nor the mayor's office could provide us with an updated list of farmers in Chęciny, so we pivoted our sampling to a convenience method. In practice, this meant that we identified farmland with Google Earth maps and approached informants at their residences. We conducted the questionnaire with landowners and farmers and asked them for further contacts. This method resulted in 21 questionnaire responses, however, 2 of those responses were discarded as the respondents left many of the questions blank. We also recorded 4 responses at the Targi Kielce Agricultural Fair.

In total, we finished with 23 completed responses. We also attempted to obtain responses via phone, email, and social media posts, but likely due to the offline lifestyle of our respondents, these methods did not prove useful.

Data cleaning and management was done in Google Sheets and then the cleaned data was imported into R to perform statistical analysis and test. We used RStudio version 2023.12.1+402, running R version 4.3.3 (Angel Food Cake).

3.3 Soil Collection

For the soil samples, we collected two 100 cm^3 volumes of soil from the surface of the soil, after removing the top layer of organic matter, as well as 5 soil augers from each site. The collected soil was labeled and placed into plastic bags and returned to the European Centre for Geological Education, where we laid the soil out on labeled papers to dry. Once dried the soil was rebagged into its original bag, and stored to take back to the University of Copenhagen.

When choosing locations for the soil samples, we prioritized land in which farmers or neighbors could describe the area to understand the historical context of the soil. In addition, we tried to get a representative sample of land use types while staying within the constraints of our research area. In total 8 locations were sampled. However, Location 3 which was taken at a commercial nursery, was determined to be unimportant to our dataset due to its location. That sample was discarded while in Chęciny. The other seven locations were coded according to their land use type (abandoned land, meadow, or active cropland). We ended up having three abandoned land locations, two meadows, and two active croplands. The locations of all the soil samples can be seen in Figure 3.

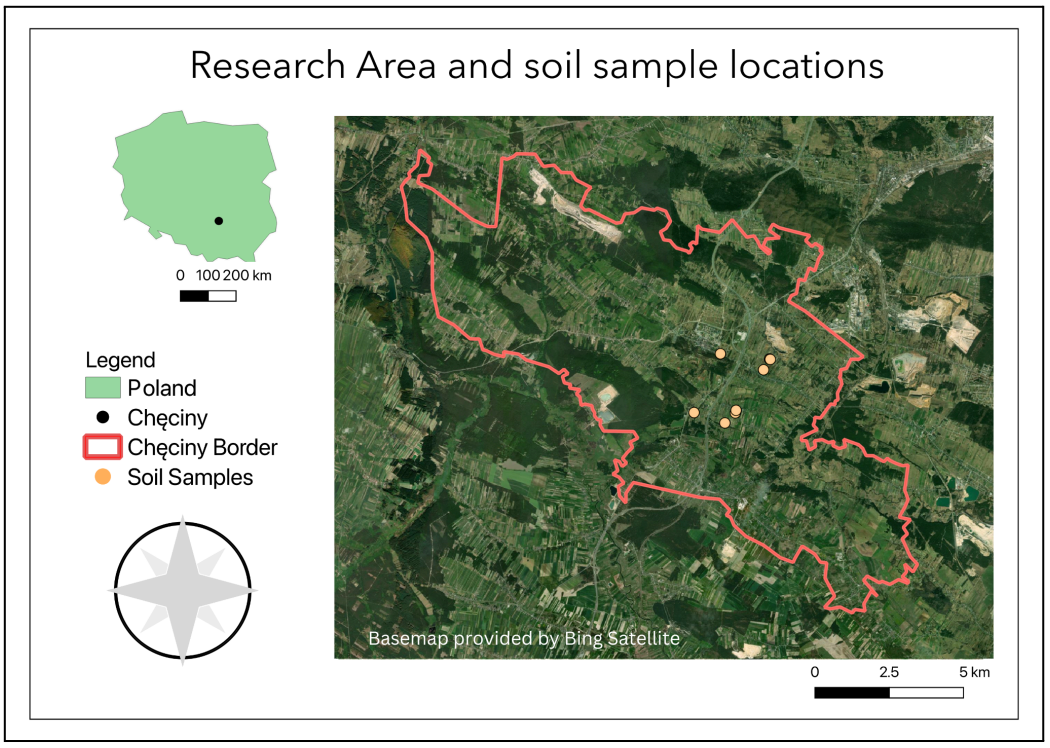

Figure 3. Soil Sample Collection Locations

Upon returning to the University of Copenhagen, the soil was assessed with bulk density, water-holding capacity, total carbon, and soil texture tests. For these tests we followed the protocol as stated in *Tropical soil biology and fertility: a handbook of methods* (Anderson & Ingram, 1996).

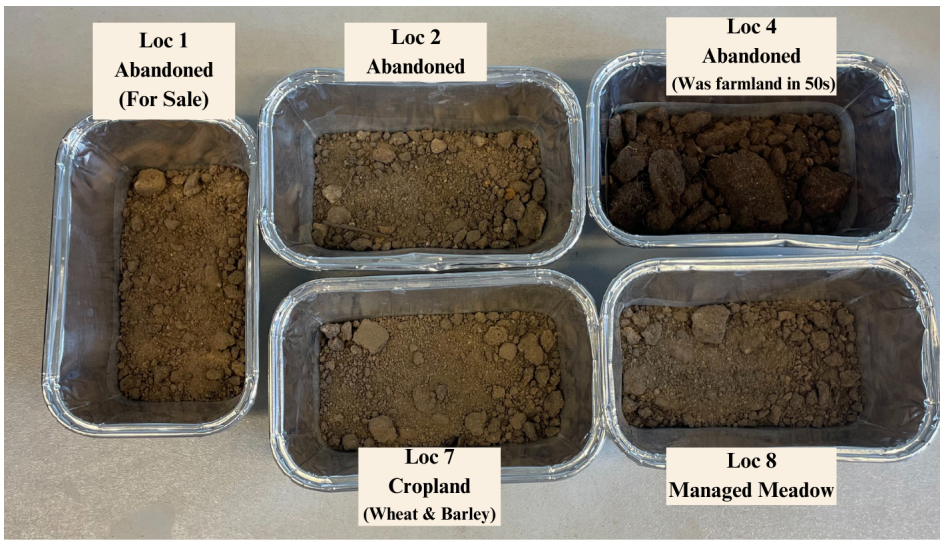

Figure 4: Batch 1 of Soil Samples Before Drying

For bulk density and total carbon, the soil was placed into beakers and dried in an oven at 105°C overnight; photos of this drying process can be seen in Figure 4. Both samples were ground and sieved, despite bulk density not requiring that step, due to a misunderstanding in the lab. However, only a small number of stones were removed from one of the samples, so this error should be minimally visible in our data. The results of all the soil tests can be seen in Appendix 5. The results were then averaged by land use type and compared.

3.4 Unstructured Interviews

We conducted unstructured interviews with informants during the questionnaire. We did unstructured interviews with 19 of the 23 questionnaire respondents. Because the respondents took the questionnaire verbally with the help of our translator, they often provided additional relevant information beyond the scope of our questionnaire. Therefore, the questionnaires acted as an introduction, and the interviews created a space for more complex responses. These responses could provide us with a deeper understanding of the data from our questionnaire, and provide general knowledge on land conversions in the local area and the

informant's perception of the development. The unstructured interviews also occasionally helped us find more informants in the area.

Through our previous unstructured interviews in the area, it became clear there was one commercial farmer who became a key informant to our research. Prior to the interview, we prepared maps that the informant could draw their land on. As the informant's land was fragmented and the map turned out not being able to encompass all of it, so instead we pivoted to mapping on Google Maps.

We retrieved data by taking notes of any information that was translated to us during the questionnaire. We asked additional questions when appropriate and if the informants seemed willing to be interviewed further. All notes were transferred to one document for analysis. They were analyzed with qualitative content analysis, where data is put in a table and relevant categories of information are highlighted with different colors. The relevant categories were chosen based on our research objectives and included terms such as “Unused Land,” “Infrastructure,” and “Small to Bigger Farms.”

3.5 Meetings and Presentations

We attended meetings with key informants such as the regional bank in Kielce; “Bank Spółdzielczy w Kielcach”, the Świętokrzyskie Agricultural Advisory Center, and the Mayor of Chęciny. The mayor of Chęciny was a key informant from our specific study area, he could provide knowledge of the local context and gave us some initial information about agriculture and land conversions in the area that we could investigate further. The meeting with the regional bank and Agricultural Advisory Center provided information about development in agriculture and land use mostly in Świętokrzyskie Voivodeship e.g., trends in subsidies and loans for farmers. These insights helped us understand our findings in a broader context.

The meetings consisted of presentations by the informants and questions and answers with us and other groups of students. We retrieved data by taking notes of all information after translation and asked questions through the present translators. The information gathered was analyzed with the same qualitative content analysis as used for unstructured interviews.

3.6 Reflections and Limitations of Methodology

The most important limitation was time. To have performed more statistical analysis on our questionnaire data we would have needed more respondents which would have required more time in the field.

The same limitation applies to soil assessments where we chose to compare a few samples instead of making a statistical analysis. Because of the time limitation, we did not have many farms to choose from when retrieving soil samples, consequently most of the samples were not fully comparable. The soil we wanted to compare was retrieved in different locations, and the soil texture for example seemed to vary a lot over short distances, meaning that other factors than land use could affect the indicators we were studying. However, on one occasion we did get two samples from different land uses that were adjacent to each other and had similar conditions besides the land use.

Regarding our questionnaire, we found that some data was difficult to collect. It posed the challenge of respondents being unprepared to answer specific monetary questions and they may not have been willing to answer sensitive questions orally. For example, one respondent cited to know how much they earn in subsidies they would have to look through their files. Furthermore, our questionnaire was intended to only address the implications of land conversion. However, through unstructured interviews and meetings, we uncovered information on drivers. We found that it could have been useful to design the questionnaire to find drivers, but since the questions were not intended for this objective the data is not fit for analysis on causality. In order to find causality we could have asked questions about land use at two points in time, before and after a possible conversion.

Finally, since all our informants were Polish speakers our questionnaire, unstructured interviews, and meetings were dependent on translators. All qualitative data is based on live translation. This made it more difficult to structure our interviews and therefore impacted our choice of method. It also led to simplified qualitative data, and information possibly being lost in translation. However, because of the excellent cooperation with our translator and their high competencies, we consider this only a limitation and a marginal source of error.

Our analysis is adapted to the limitations of our data, making it more reliant on qualitative data and triangulation of methods, and the mentioned limitations and potential sources of error are considered in the presentation of our results and conclusion.

Chapter 4: Data Analysis and Results

4.1 Respondents

Our respondents included individuals ranging in age from 26 to 82, with one respondent choosing to leave their age blank. The median age of the respondents was 60 years old, and this can be seen in Figure 5.

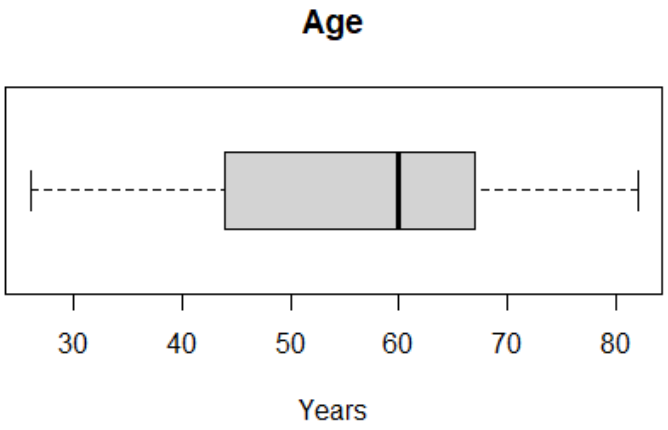

Figure 5: Box and Whisker Plot of Respondents Age

The respondents were asked a series of questions regarding their land use and farming purposes. Of our respondents, a majority used their land for cultivation, with half also having unused land. Grazing was the least relevant land use in the region with only one person answering at a use type. This was explained by some unstructured interviews where people acknowledged the region used to have much more livestock but over time people have stopped investing in this.

The respondents were also asked if they would label themselves as commercial or subsistence farmers, with an option to select both or an additional other category. 16 of 23 respondents self-identified as subsistence farmers while only six respondents chose commercial farming. These results can be seen in Figure 6.

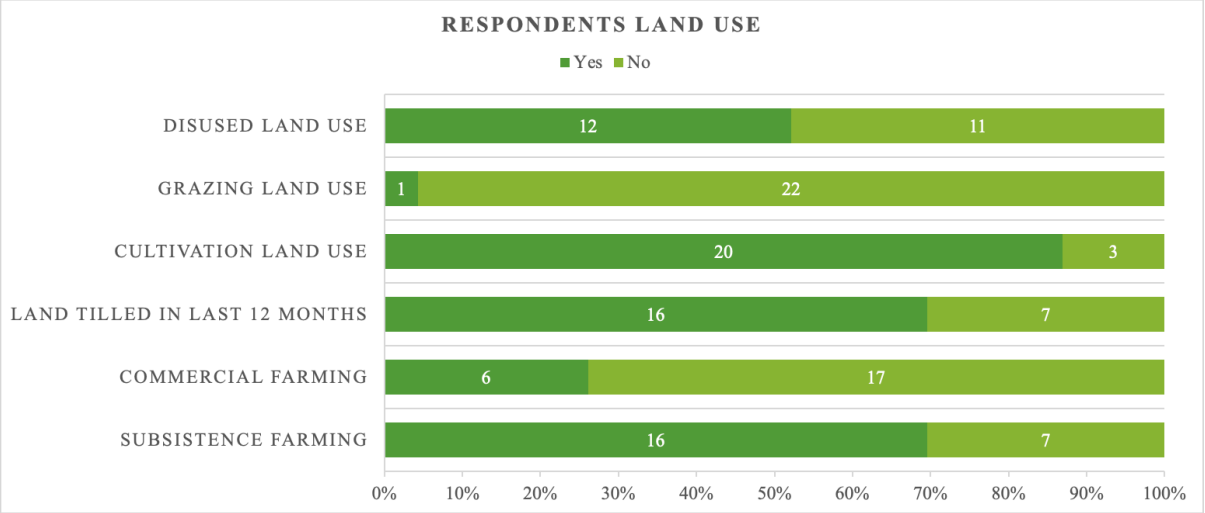

Figure 6: Respondent's Land Use

The respondents were asked questions regarding their land, its uses, and if they converted their land within the last 10 years. Of the respondents who converted their land, 2014 was the year with the most conversions. Figure 7 shows the graph of land conversions by year.

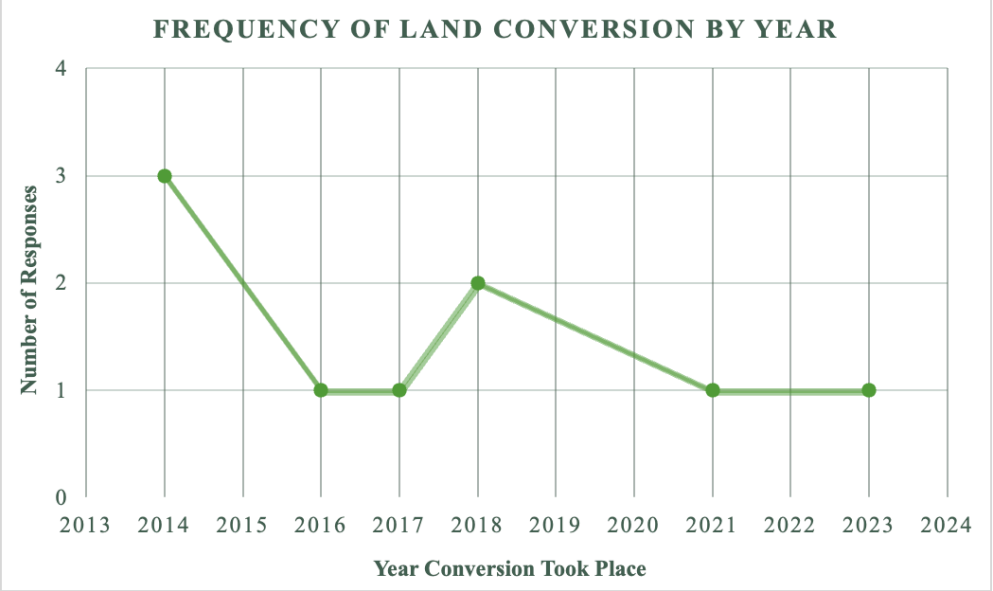

Figure 7: Land Conversion Frequency By Year

4.2 Land Conversions

This section presents the types of land conversion we identified and the demographics of landowners who converted in Chęciny through our questionnaire and qualitative content analysis.

Our questionnaire shows that 9 out of 23 respondents had converted parts of their land in the last 10 years. Eight of nine respondents converted from arable land, and we identified conversions to the following four types of land use: unused land, natural protection, building plots, and pastures (see Figure 8). The other respondent converted from pasture land to arable land.

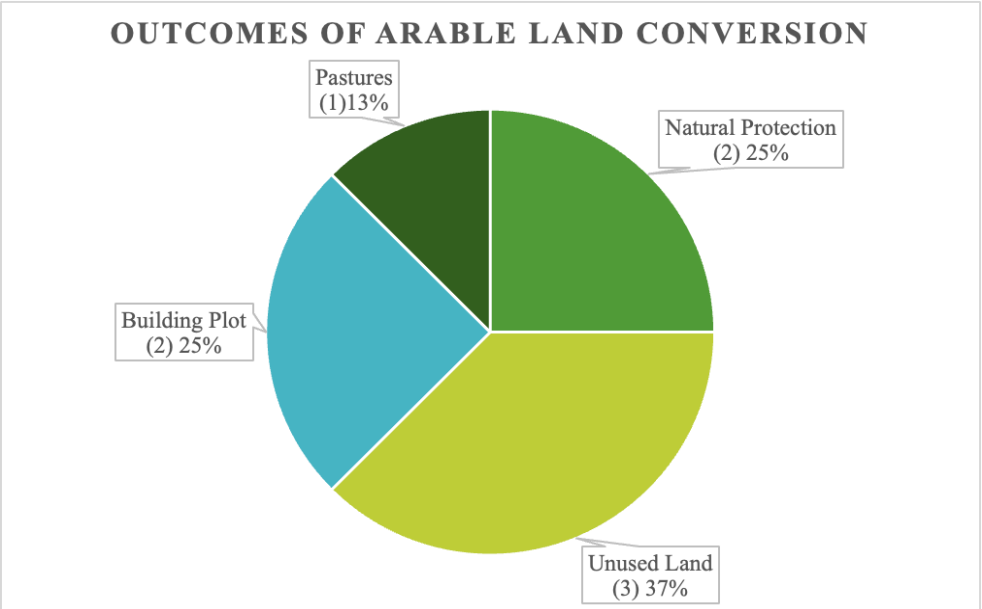

Figure 8: Outcomes of Arable Land Conversion

Besides the one respondent who converted to agricultural land, these conversions fall under the three categories of abandonment of agricultural land by Keenleyside & Tucker (2010), actual abandonment, semi- or hidden abandonment, and transitional abandonment respectively (see chapter 1). The most typical conversion was to unused land with three occurrences out of eight, accounting for the second highest average of land converted with an average of 2 hectares, as seen in Figure 9.

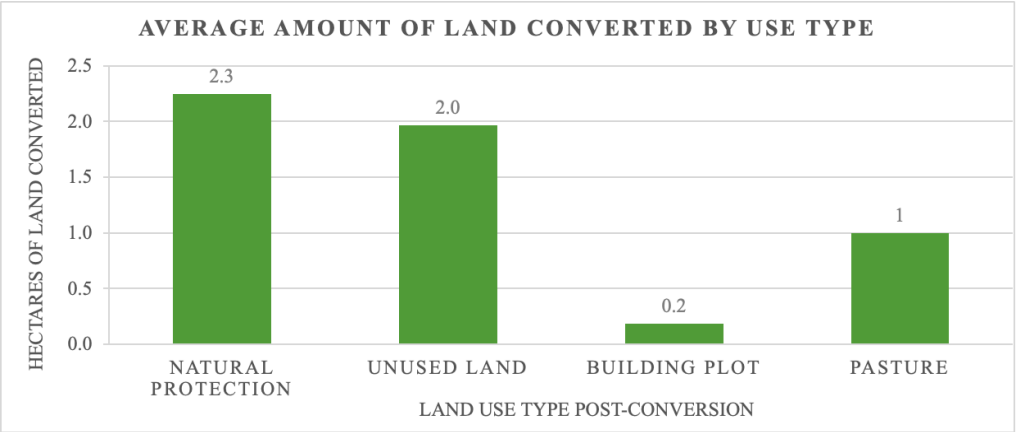

Figure 9: Average Amount of Land Converted by Type

When compared to the total owned area, excluding built houses, this number jumps even higher, with people who convert to disused land converting 98% of their total land, while natural protection only resulted in 44% of land converted, as seen in Figure 10. The total land area question in the questionnaire excluded building area, so the percent of total area cannot be calculated with the data we obtained for individuals who converted their land to building plots.

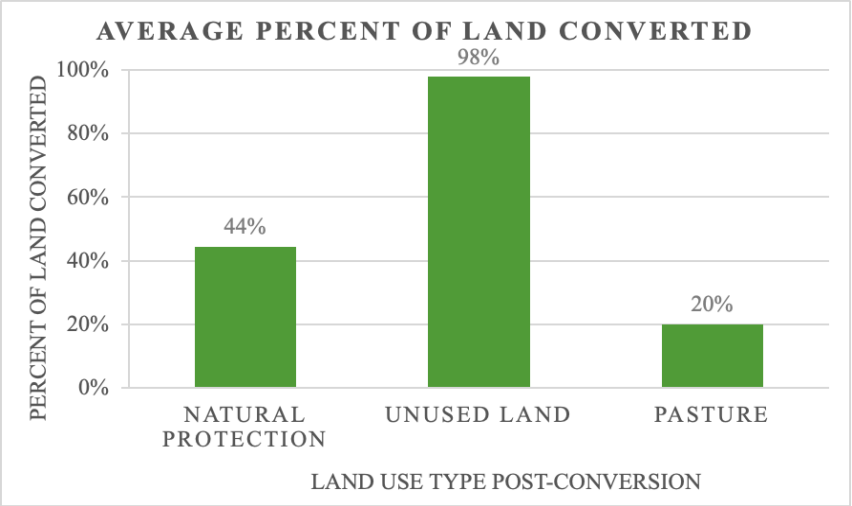

Figure 10: Average Percent of Total Land Converted

Our qualitative data shows a similar pattern as unused land was mentioned by the mayor of Chęciny as he described generally that people kept their land without farming it. This also relates to the conversion to building plots as he explained that prices on land for real estate are rising and therefore people are keeping unused land, in order to sell for real estate in the future. He also described how people are moving from bigger cities to Chęciny and

agricultural areas are turning into residential areas. Qualitative data from the bank meeting shows similar trends as the bank informants have seen a substantial decrease in the share of farmers among their customers in the last 10 years, within the Świętokrzyskie Voivodeship. They also explained that these agricultural areas are often turned into real estate, and during this time the prices for land have doubled.

"Prices to buy land increase strongly; average 40.000 zł./hectare, 10 years ago it was half." - Bank Representative from Kielce

Additionally, in an unstructured interview, one landowner stated that there is lots of unused land in the area. Others stated that their own and their neighbor's houses were built on former agricultural land, however, these conversions were not within our designated 10-year range, as they were either 20 years ago or not specified when.

"Everyone in the neighborhood street is on converted land because they built residential areas." - Land Owner

Our research also shows a trend of agricultural land being converted to protected nature. One respondent to the questionnaire had his land expropriated because of Natura 2000, and another in the Natura 2000 area had converted to a managed meadow recently.

"I had 4ha of land close to the river, but Natura 2000 came and took 2 ha of land because there were endangered bird species living there."- Farmer

Two other informants had the perception that subsidies for protecting nature, such as meadows, are a reason why landowners are not cultivating their land or selling it to other farms. Additionally, the mayor of Chęciny mentioned conversion from agriculture to protected nature through EU-programs as one of the changes in land use he perceived besides real estate and unused land. Another land owner made a similar claim about landowners in the area converting to managed meadows.

"People convert to non-used land and cut grass to get money." - Land Owner

In summary, our research tells us that actual abandonment of agricultural land is the most significant land conversion in the last 10 years in Chęciny. Generally, we see that the amount

of agricultural land is decreasing, and besides unused land, it is converted to protected nature or real estate.

Commonalities of Respondents that Convert Land

Of respondents who converted land, their current land use type was also considered. The responses for individuals who converted land can be seen in Figure 11. However, these trends appear in similar percentages when compared to our overall survey responses found in Figure 6. This could point to land use not being of high importance when an individual is deciding if they should convert land. Interestingly, grazing as a land use only appeared once in our responses and that individual converted land. It would be interesting to see if this trend is spread amongst more people who have used grazing as a land use type in a larger survey.

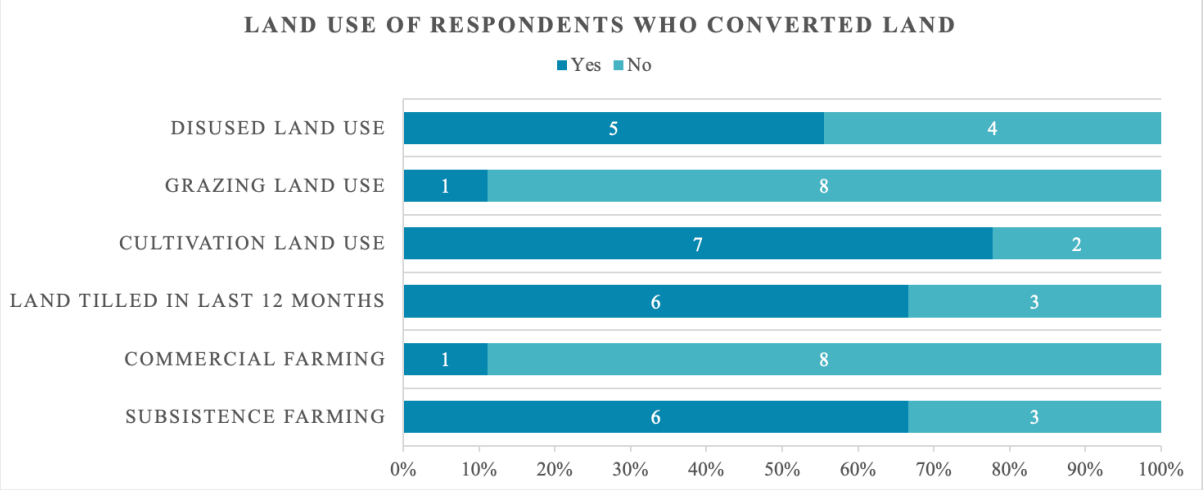

Figure 11: Land Use of Respondents Who Converted Land

4.3 Drivers of Land Conversion

This section presents drivers of the abovementioned land conversions identified through statistical analysis of our questionnaire and qualitative content analysis of meetings and interviews.

Age

Age was most likely to predict land conversion of variables run in our linear regression (p-value of 0.337) as seen in Figure 12. From the linear regression, we find a negative correlation, the older the respondent is, the less likely they will convert their land. However,

this result is still statistically insignificant, likely a result of our limited age range and sample size.

```
Coefficients:
            Estimate Std. Error z value Pr(>|z|)
(Intercept)  0.22523    1.76081   0.128    0.898
Age         -0.01899    0.02905  -0.654    0.513
NatHaz       0.55721    0.93895   0.593    0.553
```

Figure 12: The Probability Chosen Variables are Responsible for Land Conversion

Despite this limitation, the unstructured interviews allowed for further insight into why our ages were generally so similar. Of 19 interviews, eight explained farming work was hard which encouraged young people to migrate to nearby cities or other countries to seek less strenuous and higher-paying work.

"Every second house is someone who is working abroad"- Land Owner

"*Kids moved to the big city to study and live.*"- Land Owner

This idea was further supported by the presentation with the mayor's office, where it was explained that people have moved to larger cities or nearby satellite cities to commute to higher paying jobs. The mayor's office also claims this trend may be shifting in the future as recent years have seen more people moving into the smaller towns in search of lower land prices and a quieter lifestyle. This migration back into the smaller peripheral towns could be a cause for further land conversion, so this variable could be further studied on a larger scale in future projects.

Land Fragmentation

Furthermore, we have identified land fragmentation as a possible cause of land conversions from agricultural land in Chęciny.

Our research shows a high level of land fragmentation in the area, which is evident in Figure 13 which represents the total land sizes in the questionnaire. It shows the median size of farms is 2 ha and 75% of farms are 4.5 ha or less.

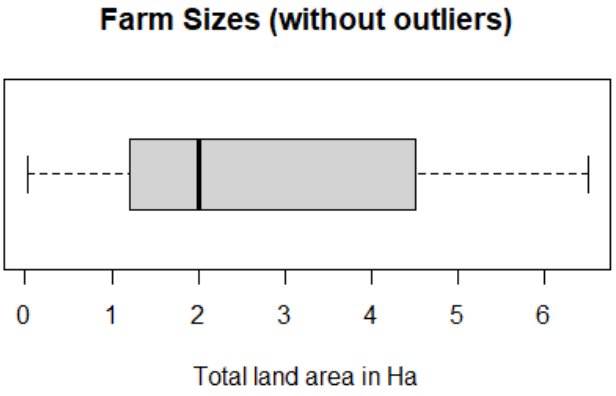

Figure 13: Farm Size in Hectares

We could not find land fragmentation as a cause of conversion through our linear regression, as we did not ask any questions on this subject in the questionnaire, but our research does show the economic drawback of having small farmland, and that land fragmentation also seems to affect the bigger farms.

Land fragmentation can be a factor in land conversions from agricultural land because small farms seem to be economically unsustainable. Only 3 out of 22 farmers stated that 76-100% of their income was from agriculture, four stated 1-25% while the rest had no income from agriculture despite having farmland.

In our unstructured interviews, two farmers stated that it was difficult to sell products. They explained that prices of crops had decreased while expenses were increasing, which meant that small farms had disappeared. According to the bank small farms were struggling because prices of agricultural products decreased while fertilizer prices increased.

"Larger farms get more funding than smaller ones, so they are able to buy more land."
- Bank Representative from Kielce

Small farms are especially struggling presumably due to economies of scale, and because of insufficient subsidies, because farms smaller than five ha do not have access to the same EU subsidies as bigger farms.

Even though most farms in our study area were small, we did identify a trend of rising land concentration, due to big farms taking up more land. One informant to the questionnaire

stated that the small farms had started to disappear after Poland joined the EU, and two large farms had emerged in their area.

"There were plenty of small farms, and it was fragmented. During the communist era, people divided their plots. Now, after joining the EU, the small farms started to disappear, and ultimately, two larger farms emerged, which benefited from EU funds."- Land Owner

Another informant said that two farmers owned most of the land in his village. This is evident in our questionnaire where we have two outliers in farm sizes. One of them was from the village referred to by the aforementioned informant. A family farm with 160 ha of agricultural land, leasing half of it. They emphasized the economic benefits of having more land due to EU subsidies. Land fragmentation also seemed to be a challenge for their farm as not all his neighbors were willing to lease or sell their land to him, causing less efficient land management due to more transportation between plots of land as seen in Image 1.

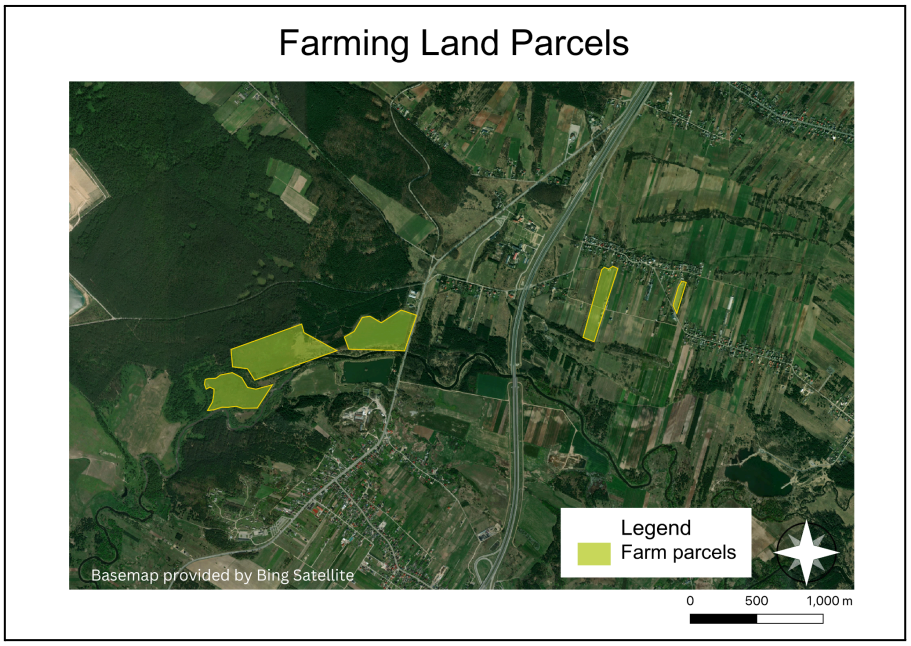

Image 1: Farming Land Parcel

"Smaller fields are combined into a big one where we can - but there is lots of land fragmentation." - Farmer

They stated that more land should be combined for agriculture otherwise it could cause more land abandonment. Consequently, land fragmentation is identified as a possible cause for agricultural land being left unused, converted to protected nature, or sold for real estate.

Perceptions of Natural Hazards

The perceptions of whether people experienced natural hazards within the last 10 years were coded by NatHaz, another one of our more significant variables. From the linear regression, it can be stated that as the perception of natural hazards within the last 10 years increases, so does the rate of land conversion as compared to those who have experienced no change or a decrease in natural hazards. If drought, flood, or other disasters are making agriculture difficult, it creates an incentive to transition to less intensive land use. This is especially relevant near the river areas that flood with respondents describing this area as *"Unused land close to the river - not good quality."* Respondents also refer to the challenges of natural hazards as *"Rivers become small or disappear, groundwater level falls down, some wells go dry"* and that "*Weather is super volatile - shifts between drought and super wet often*".

Subsidies

One respondent from our unstructured interview had changed their land use from corn production to disused more than 10 years ago and cited both volatile weather and EU subsidies for natural land as key reasons for the land conversion. This brings up another general theme that came up in terms of why people were converting land, subsidies. Another interviewee cited that a few years prior he had received 3000 PLN for agriculture, but now he would only receive 1000 PLN, because the government must ask for money from the EU to provide the subsidies.

"The government tries begging like a homeless person to get more funding so they get what subsidies the government can get."- Farmer

Because of his health problems and the declining subsidy amounts he found agriculture to no longer be worth the time and energy it required. Other respondents echoed this problem and a general dislike for the ever-changing requirements to meet in order to obtain agricultural subsidies.

"Even if a chicken dies, you need to make a full report"- Land Owner

A larger sample size with more detailed questions on the attitudes and perceptions of these subsidies would be beneficial to understanding if it can help explain why land conversions are taking place.

Additionally, the meeting with the bank in Kielce clarified that small-scale farmers receive only little or no subsidies because their farms are too small. Furthermore, the bank's loans for farmers decreased from 15 to 8 percent in the last ten years. As most of the bank's agricultural clients are small farms, this trend indicates the shrinkage of agriculture in the region.

Soil Texture

Beyond the findings of the regression analysis, the soil texture could also be a primary cause of land conversion. For soil texture, all soils had some sand aspect, as seen in Figure 14. This reflects the region's geologic history as the areas surveyed sit adjacent to a river and at the base of a mountain range. Both of these geologic drivers cause erosion of particles and result in sandy soil. This finding also reflects some responses from our unstructured interviews, as 22% of respondents cited soil quality as a main issue the agriculture of the region was facing.

Soil Assessment Results		
Location Number	**Land Use**	**Soil Texture**
2	Abandoned	Loamy Sand
1	Abandoned (For Sale)	Sandy Loam
4	Abandoned (Was Farmland in 50s)	Sandy Clay Loam
6	Meadow	Sandy Clay
8	Managed Meadow	Sandy Loam
5	Cropland	Sandy Loam
7	Cropland (Wheat & Barley)	Sandy Clay

Figure 14: Lab Results for Soil Assessments

The region also has some clay rich soils. One respondent cited the clay texture of the soil as a primary reason managing meadows faced difficulty. This respondent explained that the rain combined with the clay soil to create a *"playdough-like texture"* and driving a tractor through that was very difficult.

Our research yielded several results regarding why land conversions are taking place. From an aging population to land fragmentation, natural hazards, and subsidies, a clearer picture of what is motivating landowners to convert land is starting to form. Although we only have a small sample size, these findings could help point future research in the right direction as more people explore the decision making factors that go into converting land.

4.4 Implications of Land Conversion

This section will present the results of our analysis of socio-economic and environmental implications based on our indicators of sustainable land use.

4.4.1 Socio-economic

The socio-economic implications of land conversion include revenue, subsidies, employment, and attitudes toward land conversion. Revenue, employment, and subsidies were anticipated before going into the field so had corresponding questions in our questionnaire, however, it was not until we made it into the field and began conducting unstructured interviews that the feelings and attitudes of land conversion became prominent.

Revenue and Subsidies

As referenced in Figure 5, many of the respondents were over the age of fifty and received all or most of their revenue from retirement pensions. Change of revenue following conversion mainly found no change, with only one respondent citing a loss of 5,000 PLN. While subsidies are also a determining factor in whether land is converted, they could also be an outcome of land conversion. This is because, through the conversion of land, different subsidies are made available or unavailable to the landowner. For this reason, subsidies represent an opportunity cost of land conversion which we found on occasion through the questionnaire where the respondent lost access to subsidies due to converting from agriculture to protected nature.

"When farmers convert land into another type of land, they are not considered as farmers anymore and consequently cannot receive the bank's funds for farming anymore."

- Bank Representative from Kielce

However, because of the very limited data we have no change in subsidies due to land conversions we can not conclude whether it is a positive or negative implication.

Employment

As referenced in the respondents section of Chapter 4, the respondents who were involved in agriculture were mostly subsistence farmers with an average of 2 hectares of land that did not generate revenue or employment. Employment similarly saw little change in the survey. Only one commercial farmer cited losing employees, the rest had no change. One interview, with a commercial farmer whose son wanted to continue the business, explained that it is difficult to find employees who are willing to work such labor intensive jobs for so little money.

"If young people can make money with less work then how can we expect them to want to work in the field."- Farmer

Social attitude

Feelings and attitudes toward conversion are an aspect of land conversion we did not anticipate before entering the field, but upon conducting interviews it became clear that that is a large component of how the land is viewed. When discussing the option of selling the land rather than letting it sit abandoned, respondents cited the land has historical ties, with one respondent explaining the land they owned had been their parents since 1957.

"Farmers do not want to sell their land but they are willing to lend it"
- Bank Representative from Kielce

Even if the land is not actively used for cultivation, grazing, or natural areas, the connection to ancestry and personal histories may motivate people to keep the land. Beyond family, people also feel connected to their country, as one respondent explained, the converted land will go back to the country when he can no longer use it.

"People have sentiment and enthusiasm, and if the older people were healthy, the land would still be used, but they perform work that their health allows, and the changes are to receive better food and hay for the animals"- Land Owner

In addition, many respondents seemed sad that the land that was once used is now abandoned, and there seemed to be a feeling of sadness that they could no longer take care of the land.

"People have the feeling they want to help, but due to health cannot"- Land Owner

"We are sad to be forced to give up land"- Land Owner

From the perspective of a commercial farmer, some vocal members of the community often write to local institutions complaining about the smell and noise their livestock bring. They further explained that livestock used to be common in the area, but because of these attitudes, people have stopped raising livestock in order to avoid these small community battles, especially because without community support there is unlikely to be financial support as well.

4.4.2 Environmental

The analysis of environmental implications is based on questionnaire data and soil assessments. In Figure 15, the averages of the soil assessment results from a total of seven locations are compared based on land use.

Average by Land Use Type of Soil Assessment Results			
Land Use	**Average Water Holding Capacity (%)**	**Average Bulk Density (g/cm3)**	**Soil Carbon (%)**
Abandoned	0.27	0.85	1.47
Meadow	0.35	1.14	1.22
Cropland	0.24	1.18	0.98

Figure 15: Averaged Soil Assessment Results by Land Use

The results can be broken down into two parts, the soil assessments in the region and individual perceptions of flora and fauna changes within the last 10 years. Beginning with the soil assessments, there are 3 key variables: water holding capacity, bulk density, and soil carbon.

Water Holding Capacity and Bulk Density

From these comparisons, the average water holding capacity is highest in the land used for meadow and the lowest in land used as cropland with the average water holding capacity of abandoned land falling in between. In addition, meadow land has a lower bulk density and therefore more porous soil compared to cropland. The data shows that abandoned land has a better bulk density than meadows, indicating that it would be the most porous; however, this could be a result of one of the locations in the meadow area having an extremely dense clay texture. Although we did not have enough soil samples for the data to be statistically significant, these results can indicate that meadow land use would absorb and retain water best during rainfall events and contribute the highest to ecosystem service indicators related to mitigating flooding and drought.

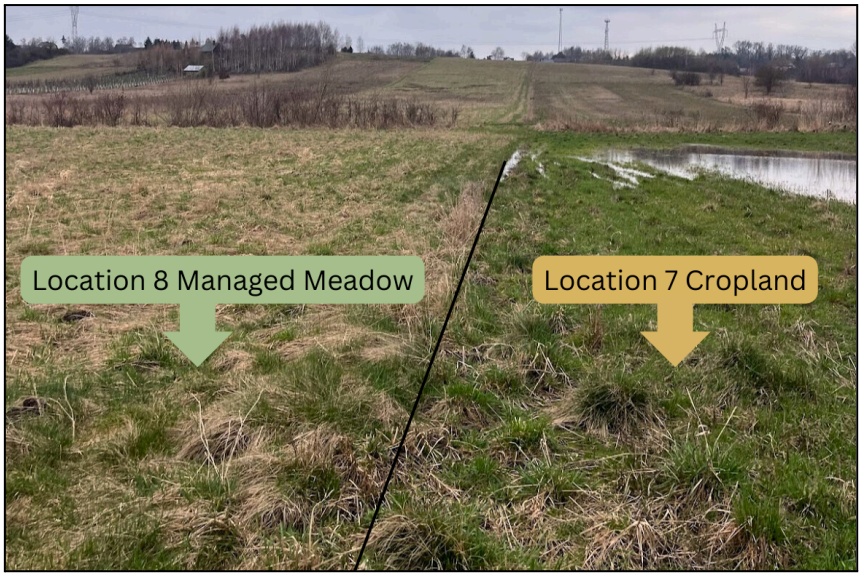

Image 2: Location of soil samples 7 and 8

Locations 7 and 8 were samples from two areas of differing land use right next to each other as seen in Image 2. Due to the spatial proximity of the sample areas, they both have the control variables of location and soil texture and are comparable to examine the dependent variables as seen in Figure 16.

Soil Assessment Results					
Location Number	**Land Use**	**Soil Texture**	**Water Holding Capacity (%)**	**Bulk Density (g/cm3)**	**Soil Carbon (%)**
7	Cropland (Wheat & Barley)	Sandy Clay	0.23	1.05	1.02
8	Managed Meadow	Sandy Loam	0.35	0.88	1.29

Figure 16: Soil Assessment Results for Two Comparable Sites

Location 7 is used as active cropland that is cultivated yearly for wheat and barley while location 8 is meadow area that is mowed. From Figure 16 it is shown that the meadow has the highest indicators of ecosystem services of absorbing and retaining water with a higher water holding capacity and bulk density compared to the cropland.

Soil Organic Carbon

In addition, the meadow has a higher soil carbon percentage which indicates that meadows may perform better as a carbon sink. As seen in Figure 15, abandoned land has the highest potential to act as a carbon sink with the highest average carbon percentage, meadow second, and cropland last. This data indicates that when examining results from each of the three soil variables, meadow, and abandoned land have similar potential to perform ecosystem services compared to cropland.

Perceptions of Flora and Fauna

To examine the biodiversity aspect of the environmental indicators of sustainable land use, we collected responses regarding the perceptions of flora and fauna changes from people who converted land and those who did not. Out of the 9 respondents that converted land, 7 answered they have perceived an increase in flora and fauna in the last 10 years (77%). Out of 15 that did not convert land, 12 also said they perceived an increase in flora and fauna (80%). Regardless if they converted land or not, most respondents answered there is an increase in flora and fauna. In regards to the types of flora and fauna, most respondents who saw an increase in flora and fauna mentioned that the most common animals were roe deer, wild boar, foxes, and insect pests such as mosquitos. Hares were often pointed out as a species that has declined. Multiple respondents also pointed out that the animals are getting closer to residential areas.

Based on the trend of increasing animals and their increasing proximity to residential areas, it could be speculated that this is related to the increase of abandoned and natural areas. Spaces that were previously used for agriculture are now returning to nature with high grassy plots that are fragmented in between residences. This natural area could provide habitat for these species mentioned by respondents that are perceived to be on the rise.

Chapter 5: Discussion

5.1 Broader Implications

While our research was focused on Chęciny, it exemplifies the trend of land abandonment in rural areas across Europe. Actual abandonment of agricultural land, such as the ones we identified in Chęciny, provides environmental benefits, through improved water holding capacity, carbon sequestration, and perceived biodiversity enhancement, all of which were supported by previous literature as cited in Chapter 2.2.

While abandoned land may offer some environmental benefits, more intentional strategies to increase ecosystem services while maintaining small-scale farming may be of higher value. Because abandonment is unplanned at a large scale, it is faced with the challenge of land fragmentation. This land fragmentation is a problem for commercial farmers who must spend time and money to travel between disconnected fields. Additionally, any benefits are only sustainable in the long term if the land remains abandoned, which is not a guarantee, especially when landowners are incentivized to sell land for real estate development by increasing property prices.

We did not identify any significant socio-economic implications of land conversion from our questionnaire. Farmers did not achieve relevant changes in revenues or subsidies through land conversion, likely because their small land size disqualified them from receiving EU subsidies. Similarly, most respondents do not sell their products nor do they have employees.

However, findings from our unstructured interviews highlighted a demographic change in the area. Agricultural work is increasingly unattractive to young people who can find higher paying and less strenuous work in nearby cities, demonstrating economic and social challenges to sustainable agriculture as a possible cause for land abandonment.

Furthermore, abandonment and land conversion may be a consequence of soil texture. Sandy soil conditions suggest that cropland is not the optimal use of land. It could enhance the benefits of land conversions to further incentivise management of meadows possibly through livestock grazing to better utilize the land economically and environmentally. These incentives would provide more sustainable land management, as defined in Chapter 2.1.

Although our research only focuses on Chęciny, the disappearance of small family farms and the demographic shifts of peripheral areas are trends emerging across the world. Our research in Chęciny acts as a case study highlighting these trends.

Our case shows that land use in Chęciny does not suffice the criteria of sustainability as the actual land abandonment does not yield optimal results under socio-economic nor environmental terms. This indicates that policies like the CAP that drive agricultural development do not sufficiently take small-scale farming into account. Adaptations to existing policies will be necessary to mitigate the analyzed trend of land abandonment.

In addition to the diminishing of small farms, around the global north and especially in Europe, there has been a rise in agricultural protests with farmers demanding stable or better conditions from governments and the European Union as they face rising costs and regulations. This civil unrest points to the failure of current governance of agriculture. This civil unrest is echoed in our respondents' experiences within Chęciny, as one land owner explained, “protests against the European Union are the single largest hazard” they face. Our research in Chęciny is vital to understanding local tensions regarding the future of land use, as agriculture in Europe comes to a critical juncture.

5.2 Potential Research Projection

While our research was able to address the drivers and implications of land use conversions in Chęciny, we faced time and accessibility constraints reducing the statistical significance and robustness of our findings. There is potential for further research expanding on this topic and broadening the scope of what our research was able to accomplish. For example, to better understand the aspect of land conversions from the perspective of commercial farmers, it would be necessary to expand the research area outside of the Świętokrzyskie Voivodeship or even further. In addition, collecting more physical environmental indicators such as conducting more thorough biodiversity assessments on abandoned land and meadows, more

soil samples in adjacent plots, as well as vegetation carbon. E.g., biodiversity assessments would enable a deeper look at the implications on flora and fauna from land conversions. It is also important to note that land conversions in this area will always be changing and it could be very interesting to monitor land use transitions temporally as the region develops and shifts from agriculture to residential areas as seen in Figure 14.

Chapter 6: Conclusion

We found that the European trend of agricultural land conversion is evident in Chęciny. The most relevant land conversion we identified was actual abandonment. For the small-scale farms which are predominant in Chęciny farming is economically inefficient. Most farmers do not generate income from their production and receive only little or no subsidies. Additionally, aging of farmers and little attractiveness of agriculture for young people, as well as poor environmental conditions drive the abandonment of land. Instead, landowners hold onto their land and hope to sell it for higher value in future as prices for land have doubled during the past ten years.

While the analyzed land conversions led to the improvement of some environmental characteristics such as bulk density, water holding capacity and soil carbon, land abandonment did not enhance socio-economic indicators. Therefore, we argue that land abandonment as an unintentional process does not correspond to the notion of sustainable land use. Policy changes e.g., in the CAP of the EU, are needed to guide land management in a more sustainable direction and to support farmer’s livelihoods.

Although our research is limited, these preliminary findings demonstrate an interesting point of departure for future research, as understanding the land use transitions in rural regions is key to ensure sustainable development goals are met locally and beyond.

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Appendix 1: Author Contribution Table

Section	**Author**
Abstract	Taylor Weddington
Chapter 1: Introduction	All
1.1 Research Questions and Objectives	All
1.2 Project Design	Andie Wilkerson
Chapter 2: Theoretical Framework	
2.1 Sustainable Land Use	Stefan Burkmann
2.2 Indicators of Sustainable Land Use	Taylor Weddington
Chapter 3: Methodology	
3.1 Case Study Area	All
3.2 Questionnaire	Andie Wilkerson
3.3 Soil Collection	Andie Wilkerson
3.4 Unstructured Interviews	Thor Kjær
3.5 Meetings and Presentations	Thor Kjær
3.6 Reflections and Limitations of Methodology	Thor Kjær, Stefan Burkmann
Chapter 4: Results	
4.1 Respondents	Andie Wilkerson
4.2 Land Conversions in the Region	Thor Kjær
4.3 Drivers of Land Conversion	All
4.4.1 Socio-Economic	Andie Wilkerson
4.4.2 Environmental	Taylor Weddington
Chapter 5: Discussion	
5.1 Broader Implications	All
5.2 Potential Research Projection	Taylor Weddington
Chapter 6: Conclusion	Stefan Burkmann

All authors contributed to and aided in the editing of all sections

Appendix 2: Table of Methods

Main Research Question	What are the drivers and economic, social, and environmental implications of converting land in Chęciny?	
Sub Research Question	**Methodology**	**Analysis**
What types of land conversions are happening in Chęciny?	23 questionnaires (+2 questionnaires not used) 19 unstructured interviews 3 presentations and meetings (with the Agricultural Advisory Center, The Mayor's Office, & The Bank)	Comparison of Data Tables Qualitative Content Analysis
What are the drivers of land use change in Chęciny?	23 questionnaires (+2 questionnaires not used) 19 unstructured interviews 3 presentations and meetings (with the Agricultural Advisory Center, The Mayor's Office, & The Bank)	Linear Regression Comparison of Data Tables Qualitative Content Analysis
What are the socio-economic implications of converting land for landowners?	23 questionnaires (+2 questionnaires not used) 19 unstructured interviews 3 presentations and meetings (with the Agricultural Advisory Center, The Mayor's Office, & The Bank)	Qualitative Content Analysis
What are the environmental implications of converting land for landowners?	8 Soil Sample Locations - 7 Soil Cores - 14 Bulk Density	Bulk Density Assessment Soil Organic Carbon Qualitative Content Analysis

	- 1 location discarded 23 questionnaires (+2 questionnaires not used) 19 unstructured interviews 3 presentations and meetings (with the Agricultural Advisory Center, The Mayor's Office, & The Bank)	

Appendix 3: Questionnaire Questions - In English

We are Masters's Students at Copenhagen University taking part in an Interdisciplinary Field Methods Course. This questionnaire is part of the requirements intended to examine economic, social, and environmental aspects of land use change of farmers taking part in arable land conversion. This questionnaire is anonymous and intended for research purposes only. We would be grateful if you spent a few minutes on the survey. The following survey will take approximately 15 minutes to complete. Thank you for your time!

Best,
Thor, Taylor, Stefan, & Andie

Age:_____

Gender:_____

What municipality do you live in?_____

How long have you lived in this municipality?_____

Please select the options that best describe your agricultural activity (multiple choice):

(1) Commercial farming (selling produce or animal products)

(2) Subsistence farming (not selling products/farming to produce food for subsistence)

(3) Other: _____

What percentage of your income comes from agriculture in the last 12 months?

(1) 0

(2) 1 - 25

(3) 26 - 50

(4) 51 - 75

(5) 76 - 100

What is the total area of your land in hectares, excluding residential land (including pasture, arable land, fallow land, residential land, etc.)?_____

Are you a household owner or a land renter? How many hectares fall into a given category?

(1) Own _____

(2) Lease _____

(3) Other _____

Have you tilled your land or some of your land in the past 12 months?

(1) Yes

(2) No

For which of the following purposes have you used your agricultural land in the last 12 months? How many hectares of land would you estimate for a given category? (multiple choice)

(1) Cultivation _____

(2) Grazing _____

(3) Abandoned/disused area _____

(4) Other _____

If cultivating, what type of crop:_____

For grazing, what animals:_____

Have you changed some of your land use in the last ten years? (Examples of land use: arable land, semi-natural pastures, protected nature areas, forests, abandoned/disused land)

(1) Yes

(2) No

From _____ to _____ Land use examples: arable land, semi-natural pastures, protected nature, forests, abandoned)*

From _____
To _____

How many hectares?*_____

In what year did the land conversion take place?*_____

What is the change in the farm's annual revenue as a result of land conversion?*

(1) It has increased

(2) It has decreased

(3) It has remained unchanged

If your farm's revenue has changed, what is the change to your farm's annual revenue (excluding subsidies) due to converting land? (in PLN)* _____

Did you receive any subsidies as a result of the land conversion?*

(1) Yes

(2) No

Has this conversion prevented you from receiving grants you previously received?*

(1) Yes

(2) No

Has the number of employees on your farm changed over the last 10 years? If it increased or decreased, by how much?*

(1) It has increased _____

(2) It has decreased _____

(3) It has remained unchanged

How many złoty do you receive annually from subsidies, as a result of land use change?*_____

From what program?*_____

How many złoty did you receive annually from subsidies, before the change of land use change?*_____

From what program?*_____

How many of the above-mentioned employees (excluding seasonal workers) moved from larger cities to Chęciny?*_____

How many of the above-mentioned dismissed employees (excluding seasonal workers) left Chęciny and moved to larger cities?*_____

Have you undergone more than one land use conversion within the last 10 years?

(1) Yes*

(2) No

*If yes, repeat above questions marked with an asterisk

Do you receive any agricultural subsidies?

(1) Yes

(2) No

(3) I don't know

If so, how much do you receive for the agricultural grants/subsidies? _____

From what program_____

Are you aware of any subsidies that exist for the conversion of agricultural land to natural area?

(1) Yes

(2) No

(3) I don't know

Have any of the neighboring farms converted land within the last 10 years?

(1) Yes

(2) No

(3) I don't know

Has there been a change in the level of natural hazards on your property in the last 10 years? (such as drought and floods) What kind(s) of natural hazards:

(1) Increase in the number of natural disasters _____

(2) Reducing the number of natural disasters _____

(3) No changes

Have you noticed changes in flora and fauna on your land over the last ten years? What kind(s) of flora and fauna:

(1) Increased development of fauna and flora _____

(2) Reduced development of fauna and flora _____

(3) No changes

Do you have any other comments you would like to share with us?

_____

Your feedback is really important to us and we appreciate the time you have taken to participate in this research project. Your contributions will help us identify possible sustainable development strategies for the area. Once again, many thanks for sharing your thoughts, views and opinions with us.

Best wishes,

Best,
Thor, Taylor, Stefan, & Andie

Appendix 4: Questionnaire Questions - In Polish

Jesteśmy studentami magisterskimi na Uniwersytecie w Kopenhadze biorącymi udział w interdyscyplinarnym kursie metod polowych. Niniejszy kwestionariusz jest częścią wymogów mających na celu zbadanie gospodarczych, społecznych i środowiskowych aspektów zmiany użytkowania gruntów przez rolników uczestniczących w przekształcaniu gruntów ornych. Ankieta jest anonimowa i przeznaczona wyłącznie do celów badawczych. Będziemy wdzięczni, jeśli poświęcą Państwo kilka minut na wypełnienie ankiety. Wypełnienie poniższej ankiety zajmie około 15 minut. Dziękujemy za poświęcony czas!

Z poważaniem,
Thor, Taylor, Stefan i Andie

Wiek:_____

Płeć:_____

W jakiej gminie Państwo mieszkają?_____

Jak długo Państwo mieszkają w tej gminie?_____

Proszę wybrać opcje, które najlepiej opisują Państwa działalność rolniczą (wielokrotny wybór):

(1) Rolnictwo komercyjne (sprzedaż produktów lub produktów zwierzęcych)

(2) Rolnictwo na własne potrzeby (nie sprzedawanie produktów/rolnictwo w celu produkcji żywności na własne potrzeby)

(3) Inne _____

Jaki procent Państwa dochodu stanowi dochód z rolnictwa w ciągu ostatnich 12 miesięcy?

(1) 0

(2) 1 - 25

(3) 26 - 50

(4) 51 - 75

(5) 75 - 100

Jaka jest całkowita powierzchnia Państwa gruntów w hektarach, z wyłączeniem terenów mieszkalnych (w tym pastwisk, gruntów uprawnych, gruntów odłogowanych, terenów mieszkalnych itp.)?_____

Czy są Państwo właścicielami gospodarstwa domowego czy wynajmującymi ziemię? Ile hektarów przypada na daną kategorię?

(1) Własne _____

(2) Dzierżawa _____

(3) Pozostałe _____

Czy uprawiali Państwo swoją ziemię lub jej część w ciągu ostatnich 12 miesięcy?

(1) Tak

(2) Nie

Do jakich z poniższych celów wykorzystywali Państwo swoje grunty rolne w ciągu ostatnich 12 miesięcy? Ile hektarów ziemi oszacował by Pan/Pani dla danej kategorii? (wielokrotny wybór)

(1) Uprawa _____

(2) Wypas _____

(3) Naturalny/nieużywany obszar _____

(4) Inne _____

Jeśli uprawa, jakiego rodzaju uprawy:_____

W przypadku wypasu, jakie zwierzęta:_____

Czy w ciągu ostatnich dziesięciu lat zmienili Państwo część swojego użytkowania gruntów? (Przykłady użytkowania gruntów: grunty orne, pastwiska półnaturalne, obszary naturalne, lasy, tereny porzucone/ nieużywane)

(1) Tak

(2) Nie

Z _____ na _____ . (Przykłady użytkowania gruntów: grunty orne, pastwiska półnaturalne, obszary chronionej natury, lasy, tereny porzucone/ nieużywane)

Z	_____
Na	_____

Ile hektarów?_____

W którym roku nastąpiło przekształcenie gruntów?_____

Jaka jest zmiana rocznego przychodu gospodarstwa w wyniku przekształcenia gruntów?

(1) Zwiększyła się

(2) Zmniejszyła się

(3) Została bez zmian

Jeżeli przychody Państwa gospodarstwa uległy zmianie, ile Państwo utracili lub uzyskali w wyniku przekształcenia gruntów (nie wliczając dotacji, w zł)?_____

Czy otrzymali Państwo jakieś dotacje w związku z przekształceniem gruntu?

(1) Tak

(2) Nie

Czy ta konwersja uniemożliwiła Państwu otrzymywanie dotacji, które Państwo wcześniej otrzymywali?

(1) Tak

(2) Nie

Czy na przestrzeni ostatnich 10 lat zmieniła się liczba pracowników w Państwa gospodarstwie? Jeśli wzrosła lub spadła, to o ile?

(1) Zwiększyła się _____

(2) Zmniejszyła się _____

(3) Została bez zmian

Ile rocznie wynosi dofinansowanie, ktore otrzymują Państwo z powodu zmiany użytkowania terenu (w zł)?_____

Z jakiego programu?_____

Ile rocznie wynosiło dofinansowanie, ktore otrzymywali Państwo z poprzedniej dotacji (w zł)?_____

Z jakiego programu?_____

Ilu z wyżej wymienionych zatrudnionych pracowników (z wyłączeniem pracowników sezonowych) przeniosło się z większych miast do Chęcin?*_____

Ilu z wyżej wymienionych zwolnionych pracowników (z wyłączeniem pracowników sezonowych) opuściło Chęciny i przeniosło się do większych miast?*_____

Czy w ciągu ostatnich 10 lat przeprowadzili Państwo więcej niż jedno przekształcenie użytkowania gruntu?*

(1) Tak

(2) Nie_____

*If (1) Tak repeat * questions again for next conversion

Czy otrzymują Państwo jakieś dotacje rolne?

(1) Tak

(2) Nie

(3) Nie wiem

Jeśli tak, jaką kwotę otrzymują Państwo z dopłat rolniczych? (w zł)_____

Z jakiego programu?_____

Czy są Państwo świadomi istnienia dotacji na przekształcenie gruntów rolnych w obszary naturalne?

(1) Tak

(2) Nie

(3) Nie wiem

Czy któreś z sąsiadujących gospodarstw przekształciło swoje grunty w ciągu ostatnich 10 lat?

(1) Tak

(2) Nie

(3) Nie wiem

Czy w ciągu ostatnich 10 lat odczuwają Państwo zmianę poziomu zagrożeń naturalnych na terenie Państwa nieruchomości (takich jak susza lub powodzie)? Jakiego rodzaju:

(1) Wzrost liczby klęsk żywiołowych _____

(2) Zmniejszenie liczby klęsk żywiołowych _____

(3) Brak zmian

Czy zauważyli Państwo zmiany we florze i faunie na swojej ziemi w ciągu ostatnich dziesięciu lat? Jeśli tak, jakie rodzaje flory i fauny:

(1) Zwiększony rozwój fauny i flory _____

(2) Zmniejszony rozwój fauny i flory _____

(3) Brak zmian

Czy mają Państwo jeszcze jakieś uwagi, którymi chcieliby się z nami podzielić?

_____

Twoja opinia jest naprawdę ważna dla nas i doceniamy czas, który poświęciłeś/łaś na udział w tym projekcie badawczym. Twoje wkłady pomogą nam zidentyfikować możliwe strategie zrównoważonego rozwoju dla regionu. Jeszcze raz serdecznie dziękujemy za podzielenie się z nami swoimi myślami, poglądami i opiniami.

Z poważaniem,

Thor, Taylor, Stefan i Andie

Appendix 5: Soil Analysis Results

				Water Holding Capacity				Bulk Density Soil Sample 1			Bulk Density Soil Sample 2			
Location Number	Location Type	Texture	Carbon	Mass of Beaker	Mass of Wet w/ Beaker	Mass of Dry w/ Beaker	%	Mass of Beaker	Mass of Dry w/ Beaker	Bulk Density	Mass of Beaker	Mass of Dry w/ Beaker	Bulk Density	Bulk Density Average
2	Abandoned	Loamy Sand	1.02	0.81	12.91	10.60	0.24	9.20	105.50	0.96	9.00	122.50	1.14	1.05
1	Abandoned (For Sale)	Sandy Loam	0.96	0.82	14.95	11.90	0.28	8.90	81.80	0.73	9.20	67.90	0.59	0.66
4	Abandoned (Was Farmland in 50s)	Sandy Clay Loam	2.43	0.80	11.58	9.10	0.30	9.00	97.70	0.89	9.10	91.90	0.83	0.86
6	Meadow	Sandy Clay	1.14	0.90	10.80	8.20	0.36	7.90	148.40	1.41	7.80	145.60	1.38	1.39
8	Managed Meadow	Sandy Loam	1.29	0.73	13.32	10.07	0.35	9.00	97.20	0.88	9.00	97.20	0.88	0.88
5	Cropland	Sandy Loam	0.93	1.00	12.00	9.80	0.25	7.90	146.00	1.38	7.90	133.20	1.25	1.32
7	Cropland (Wheat & Barley)	Sandy Clay	1.02	0.83	13.87	11.40	0.23	9.10	127.00	1.18	9.00	100.80	0.92	1.05

Key

Abandoned Land	Meadows	Cropland

Appendix 7: Synopsis

SYNOPSIS

Title: Changes and Challenges of Land Conversions in Chęciny

(Ault, 2020).

Practicing Interdisciplinary Field Research on the Environment (PIF)

University of Copenhagen

Word Count: 1852

Authors: Stefan Burkman, Thor Kjær, Taylor Weddington, and Andie Wilkerson

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Introduction

In Poland, the land is used predominantly for agricultural production, accounting for approximately 47% of the total land area (The Global Economy, 2021). However, as is the trend in most European countries, there is a conversion of land from arable land to other uses, such as the expansion of cities, transportation networks, and environmental programs (Banski & Kaminska, 2022). Despite a general trend of increasing land concentration, Poland's agricultural land still has one the highest levels of land fragmentation in the EU, as 52% of farms are less than 5 hectares (Badach et al., 2023). The land fragmentation combined with a lack of investments and low soil quality means that agriculture in Poland generally has low productivity (Badach et al., 2023; European Commission, 2014). Consequently, agriculture in Poland is challenged by competition with other EU countries (Badach et al., 2023; Rzeszutko & Kita, 2018). As the Common Agricultural Policy of the EU distributes funding disproportionately more to bigger farms, the many relatively small farms in Poland are especially challenged (Dessendre & Guyomard, 2023).

Narrowing the scope to the Świętokrzyskie Voivodeship, agricultural farms account for over 46% of the total land (Urząd Statystyczny w Kielcach, 2021). Here, farms are smaller than the national average and 63% of farms are smaller than 5 ha (Badach et al., 2023). The Voivodeship also has the largest share of protected areas of Voivodeships in Poland, with 66% of land labeled as protected areas, which can include agricultural land (Bętkowski et al., 2019). In Poland, the drive to protect agricultural soils has made it so land use conversion between agriculture and other natural landscapes is simple, while conversion to other uses such as development or mining requires land owners to go through administrative paperwork, costing both time and funds (OECD, 2017).

Within the Świętokrzyskie Voivodeship, Kielce has shown the highest agricultural potential, with 128,800 ha of agricultural land (Musiał et al., 2020). Despite this high potential, Kielce has simultaneously seen the largest decline in land receiving agricultural area payments from the European Union (Musiał et al., 2020). Between the years 2005 and 2018, over 20,000 farms (10,500 ha of land) stopped receiving area payments, often as a result of increased administrative requirements, which contributed to farmers leasing or selling their land to neighboring farms (Musiał et al., 2020). This loss of payments is notable because it reflects

the trend of the change in land ownership as smallholder farms consolidate into fewer, larger farms (Musiał et al., 2020).

In Poland, agricultural land includes protected environments ranging from Natura 2000 areas to landscape parks such as the UNESCO Świętokrzyskie Geopark, as seen in Figure 1. (Musiał et al., 2020). These natural areas not only provide forest cover and biodiversity hotspots, but they also make the area attractive for recreational and touristic activity.

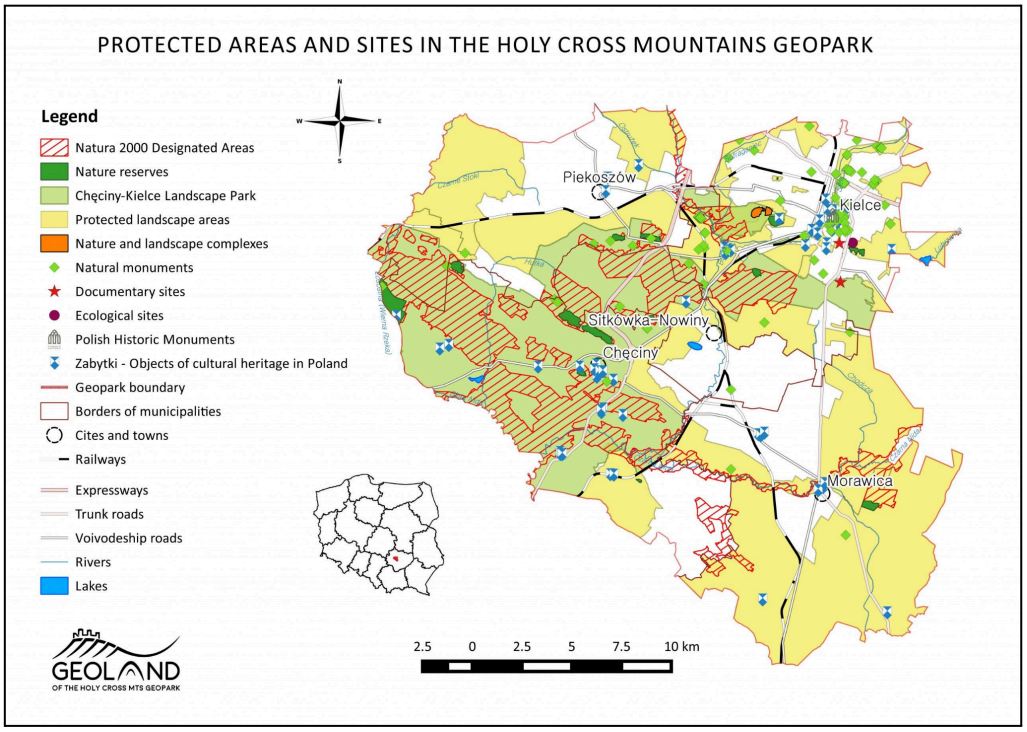

Figure 1: Overview of the land cover in the Holy Cross Mountains located in the Świętokrzyskie Voivodeship and specifically Chęciny where our research is concentrated.

To better address the issues facing the Świętokrzyskie Voivodeship, The *Development Strategy of the Świętokrzyskie Voivodeship 2030+* was written (Bętkowski et al., 2019). The development strategy aims to identify both challenges facing Poland and the Świętokrzyskie Voivodeship along with outlining the main objectives for the social and economic development of the region over the next ten years. A goal of the development plan is to use a territorially balanced development approach in which each territory uses its unique characteristics to its advantage for future development. The strengths of the Świętokrzyskie

Voivodeship include its natural landscape and geological resources, the possibility for tourism, and the richness of the local flora and fauna including the rare grassland steppe ecosystem. Challenges outlined in the development plan include droughts and water shortages due to low levels of precipitation which are made worse by the high demand for water from regional industries like mining and agriculture. However, the area also experiences severe flooding during heavy rain events. In the Development Strategy, they include policies to reduce negative outcomes of these challenges including adaptation strategies to address flooding and droughts, adapting agriculture to climate changes, expanding forests, and the preservation of semi-natural areas for biodiversity. Specific goals outlined in the development plan to reduce the impact of flooding include increasing surface water retention through ecosystem preservation and spatial planning through conducting a landscape audit (Bętkowski et al., 2019).

For the purpose of our research, our scope will be centered on the town of Chęciny, located just over 13 km from Kielce city. The landscape of Chęciny contains grasslands on limestone hills, which were developed for agro-pastoral activities, such as grazing (Jaworska et al., 2012). The land cover of the Holy Cross Mountain area and specifically Chęciny are represented in Figure 1. The grasslands in the Chęciny district are unique habitats with several rare and endangered species of fungi. These habitats are threatened by artificial afforestation and abandonment of grazing which allows shrubs and young trees to grow on the grasslands (Jaworska et al., 2012). Furthermore, the natural environment in Chęciny is influenced by mining of raw materials which also negatively affects the landscapes (Grzegorczyk et al., 2013).

Research Question and Objectives

We plan to use a sustainability science framework to analyze our data. In this framework, we take the three pillars of sustainability (social, economic, and environmental) and combine them to gain an interdisciplinary perspective of the system as a whole.

This sustainability framework drew us to our final research question: What are the economic, social, and environmental implications of converting arable land to semi-natural grasslands in Chęciny? The following sub-questions will guide our research:

- What are the economic implications (subsidies, opportunity costs, spillover effects) of converting arable land into semi-natural grasslands for the farmers?
- What are the socio-economic implications (employment, urban-rural migrations) of converting arable land to semi-natural grasslands?
- How does the establishment of semi-natural grasslands impact soil quality, water holding capacity, erosion, and carbon sequestration?
- How does the establishment of semi-natural grassland impact flora and fauna?

This research is relevant because the impacts of land conversion need to be holistically understood. From a practitioner's perspective, it is important to know what consequences will follow the actions taken by farmers. Our hope is this research will further investigate the outcomes of the changing land use so stakeholders can make more informed decisions that are beneficial for people, land, and the environment.

Methodology

In order to analyze economic, social and environmental implications of land use change we combine social and natural science methods in an interdisciplinary approach. We triangulate different quantitative and qualitative methods to better understand our problem from different perspectives.

Our preliminary assumption is that land conversion from arable land to semi-managed grasslands has economic, social and environmental implications for farmers. Therefore, we assume land conversion as the independent variable. We will measure this variable as the share of converted land out of total farm size. In order to determine the economic, social and environmental implications of land conversion (dependent variables) we have to operationalize these concepts into measurable variables and indicators.

For the economic dimension, we look at subsidies before and after (past 12 months) the land conversion as well as on net annual income referring to agricultural activities before and after (past 12 months) the land conversion. For the social dimension, we focus on employment and rural-urban migrations. We want to find out whether farmers hired or dismissed workers due to the land conversion. Furthermore, we want to analyze whether land conversion relates to

migrations from or to Chęciny. For the environmental dimension, we focus on soil and biodiversity assessments as well as carbon stocks. We chose these specific parameters based on the interests of the Voivodeships as stated in the Development plan which includes the preservation of semi-natural areas to promote diversity and mitigate climate change impacts. We want to understand how land conversion influences soil quality, carbon stocks, as well as species richness and diversity of flora and fauna species.

To gather this data, we will conduct surveys, semi-structured interviews, document analysis as well as soil and biodiversity assessments. We will attempt to use a simple random sampling from a list of farmers in the region. However, we are aware of our short timeline and the possibility people may not want to speak with us, so our selection method may shift to convenience or voluntary sampling depending on the field conditions. The use of satellite data could support us in finding farms that we want to sample. We will label sampled farms as either “arable plots” or “grassland plots” and will use the survey (appendix 2) to find out the share of converted land out of total farm size, as well as the relevant economic and social parameters. In order to analyze relationships between land conversion and its economic as well as social implications we will conduct correlation and regression analysis.

Furthermore, we will conduct semi-structured interviews (appendix 3) with relevant farmers and stakeholders like the Agricultural Center to gain more in-depth knowledge on land conversion and its implications. The interviews will be analyzed with qualitative content analysis.

When conducting our survey, we prefer to speak to the owner/operator of the farm, as we are asking questions about employment as well as subsidies and income. Depending on who we can speak to when we arrive this preference may not be possible. We are not restricting our survey participants with any other demographic choices, as we believe we are already limited by the geographical region (Chęciny), the availability of arable land and grassland plots, and the participation of key individuals. The survey will be conducted through a survey software, but we will also have printed papers and pens available in case the technological barrier is a hindrance to participation or other technical difficulties occur in the field. We will work with our Polish translators to ensure the questions are available in Polish and understandable. Due to the short timeframe of this project, we will give the survey and interview questions to fellow students and supervisors to make sure that questions will yield relevant outcomes and

that those are clear and easy to understand. However, a complete pretest might not be possible.

For the soil samples, we will collect a 100 cm^3 volume of soil from 20 cm below the surface of the soil as well as 5 soil augers from sites approved by the farmers to use, but preferably not too close to the border of the land. This soil will be returned to the University of Copenhagen where we will conduct assessments of the soil's bulk density, water-holding capacity, and total carbon. For the biodiversity assessment, we will take species samples of representative quadrats on the land. This quadrat will be 25 cm by 25cm and from this data we will determine the species richness and diversity, using the Shannon Index, for each plot. For the comparison between these two groups, we will analyze our data with independent t-tests.

Time schedule of work

For the data collection we will have two weeks at the site. Based on the experiences of former students, we will use the first two days in Chęciny to explore the area and talk to people, ideally key informants like the mayor on 1st March. After that, we will spend four days visiting farms where we will conduct surveys as well as biodiversity, carbon, and soil assessments. The next days we take time for key informant interviews with our priority being able to talk with the agricultural center and national forests contacts. In the remaining five days, we will conduct further surveys, and interviews, as well as soil and biodiversity assessments if those are needed. Furthermore, we will take part in two local events to socialize with the community. These are a national dance tournament on 3rd March and a concert on 10th March. For a visual overview, we have included a precise timetable in Appendix 4.

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Appendix 1: Research Matrix

Overall Research Question:	What are the economic, social, and environmental implications of converting arable land to semi-natural grasslands (other options: Natura 2000, abandoned land, pasture)?			
Theme	**Sub Research Question**	**Variables**	**Methods**	**Analysis**
Economic & Social	What are the economic implications of converting arable land into semi-natural grasslands for farmers ?	Independent: Share of converted land area out of total farm size Dependent: Subsidies, opportunity costs, spillover effects	Document Analysis Survey SSIs	Correlation and Regression analysis, Content analysis (Data Coding/Indexing)
	What are the social implications of converting arable land to semi-natural grasslands for farmers?	Independent: Share of converted land area out of total farm size Dependent: Employment, Rural-Urban Migration	Document Analysis Interviews Survey	Correlation and Regression analysis, Content analysis (Data Coding/Indexing)
Environmental	How does the establishment of semi-natural grasslands	Soil parameters	Soil sampling	Independent T-test Bulk density analysis

	impact soil quality, water-holding capacity, erosion, and carbon sequestration?			Total carbon Water Holding Capacity
	How does the establishment of semi-natural grasslands impact flora and fauna?	Biodiversity (richness and diversity of species) Carbon Stock	Biodiversity Assessment (Shannon Index) Carbon calculation	Independent T-test

Appendix 2: Survey Questions

Survey Questions

* Questions may change as we discuss with local stakeholders what thresholds are most relevant**.**

Introduction

We are Masters's Students at Copenhagen University taking part in an Interdisciplinary Field Methods Course. This questionnaire is part of the requirements intended to examine economic, social and environmental aspects of land use change of farmers taking part in arable land conversion. This questionnaire is anonymous and intended for research purposes only. We would be grateful if you spent a few minutes on the survey. The following survey is 15 questions and will take approximately 10 minutes to complete. Thank you for your time!

Best,

Thor, Taylor, Stefan, & Andie

Background:

1. **How old are you?**
2. **What is your gender?**
3. **Which municipality do you live in?(check with translator)***
4. **How long have you lived in this municipality?**
5. **Please select the options that best describe your farming activities (multiple selections allowed):**
    a. **Commercial Farming (selling Produce or animal products)**
    b. **Subsistence Farming (Not selling produce/farming for the purpose of food for own consumption)***
    c. **Other: _____**
6. **Has farming been your household's primary source of income in the last 12 months?**

7. **How many hours per week have you worked at your farm on average during the last 12 months?**

Research:

1. **What is the total size of your land, excluding residential areas (including pastures, cultivated land, fallow land, etc.)?**

____ ha

2. **Does your household own or rent the land? And how many hectares per each?**

☐ **Own** **_____ ha**

☐ **Lease** **_____ ha**

☐ **Other** **_____ ha**

3. **For what of the following purposes did you use your farmland in the past 12 months? What amount of land would you estimate for each? (Multiple Selections Allowed)**

☐ Cropping _____ha

☐ Grazing _____ha

☐ Natural Area _____ha

☐ Other: _____ _____ha

If cropping, what kind of crops: _____

If grazing, what animals:____

4. **Have you tilled your land or some of your land in the past 12 months?**

☐ **Yes**

☐ **No**

5. **Have you changed some of your land use within the last ten years? (Examples of land use: arable land, semi natural grasslands, natural area, forest)**

   ☐ Yes

   ☐ No

   If yes:

   a. **From _____ to _____**
   b. **If yes how many ha**
   c. **What year did the conversion happen?**
   d. **Did you receive compensation for the conversion of areas?***

      ☐ Yes

      ☐ No

      If yes: How much:

      If yes: Through which program (if known)?

   e. **What was the annual amount of subsidies you received for your land before the conversion?**

   f. **What was the annual amount of subsidies you received for your land over the past 12 months?**

g. What was your net annual income generated from activities on your land before the conversion?

h. What was your net annual income generated from activities on your land over the past 12 months?

i. Has the number of employees changed on your farm because of the land conversion?

- ☐ Yes
- ☐ No
- ☐ I

-If increased how many, if decreased how many?

j. How many and what kind of workers have you hired as a result of land conversion?*

- ☐ None
- ☐ Employee _____
- ☐ Seasonal _____
- ☐ Friend/Family _____
- ☐ Other: _____ _____

k. How many and what workers have left your farm due to land conversion?*

- ☐ None
- ☐ Employee _____
- ☐ Seasonal _____

☐ Friend/Family _____

☐ Other: _____ _____

l. How many of the hired employees mentioned above (excluding seasonal workers) moved from larger towns to Chęciny?

m. How many of the dismissed employees mentioned above (excluding seasonal workers) left Chęciny and moved to larger towns?

n. Have you experienced a change in the amount of natural hazards on your property over the last 10 years? (such as drought and flooding)

☐ Increased natural disasters

What kind: _____

☐ Decreased natural disasters

What kind: _____

☐ No Change

o. Have you perceived changes in flora and fauna on your land next to the converted land?

☐ Increased flora and fauna

What kind: _____

☐ Decreased flora and fauna

What kind: _____

☐ No Change

6. If No: Repeat similar questions (d-o)

Open ended

7. **Are there any other comments you would like to share with us at this time?**

Interview Request:

If you are willing to be contacted for a short 15-minute follow-up interview please leave your email and/or phone number below.

Appendix 3: Semi-Structured Interview Guides

3.1 Has Converted Land

1. Can you point out on the map where land has been converted from arable to semi-managed grasslands in the last 10 years?
2. What type of land conversions have been made on your land in the last 10 years?
    - **a.** Have you noticed any changes on your land or in your management practices due to these conversions?
      (Such as need for input such as fertilizer and pest/weed control, yield changes, drought, flooding etc.) *(ask translator)
    - b. When?
    - c. Where?
    - d. Have you received any external financial support for the conversion?
        - i. What program is it through - if known
    - e. Has your financial support otherwise changed?
3. What type of land conversions have been made on neighboring farms in the last 10 years?
    - a. If your neighbor has made changes, have you noticed any changes on your land? Such as need for input such as fertilizer and pest/weed control, yield changes, drought, flooding etc. *(ask translator)
        - i. When?
        - ii. Where?
4. Can you point out on the map where there has been flooding/drought?
5. What are your thoughts; generally, on the conversion of arable land to semi-managed grassland?

6. Are you aware of any financial support systems (subsidies, grants, etc.) that are available to farmers converting land from arable to semi-managed grasslands? If so, what programs?

    a. Do you receive funding from any of these programs?

7. Do you have a support system available to you to access knowledge and information regarding land use change and/or agricultural technologies?

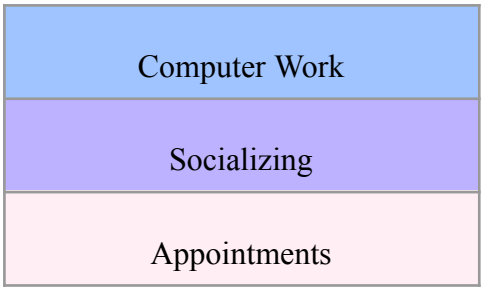
3.2 Has Not Converted Land

1. Can you point out on the map where land has been converted from arable to semi-managed grasslands?
2. Can you point out on the map where there has been flooding/drought?
3. What factors are preventing you from converting arable land to semi-managed grasslands?
4. Do you plan to convert in the future?
5. Are you aware of any financial support systems (subsidies, grants, etc.) that are available to farmers converting land from arable to semi-managed grasslands? If so, what programs?
6. Do you have a support system available to you to access knowledge and information regarding land use change and/or agricultural technologies?
7. What are your thoughts; generally, on the conversion of arable land to semi-managed grassland?

Appendix 4: Timetable

	1/3	2/3	3/3	4/3	5/3	6/3	7/3	8/3	9/3	10/3	11/3	12/3
	Friday	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Monday	Tuesday
			National Dance Competition							Womens and Mens Day		
9:00 - 10:00												
10:00 - 11:00	Meeting: Mayor					Meeting: School Complex		Meeting: Cooperative Bank				
11:00 - 12:00												
12:00 - 13:00	Lunch											
13:00 - 14:00												
14:00 - 15:00												
15:00 - 16:00					Meeting: University of Third Age							

Legend
Exploring the Area/Context
Survey
Interview
Soil Assessment
Biodiversity Assessment


Computer Work
Socializing
Appointments