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Linking the concept of degrowth and ecovillages – an investigation of German ecovillages

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TABLE OF CONTENTS

Table of contents I

List of figures III

List of tables IV

List of acronyms V

1. Introduction 1

   1.1 Problem statement 1

   1.2 Main objective and research question 3

   1.3 State of research 3

   1.4 Structure of the thesis 5

2 Theoretical Framework 6

   2.1 Green growth 6

   2.2 Degrowth 9

      2.2.1 Development of the degrowth discourse 9

      2.2.2 Definition 10

      2.2.3 Implementation of degrowth and its approaches 12

   2.3 Ecovillages 16

3 Methodology and data 19

   3.1 Study area 19

   3.2 Data collection 22

   3.3 Calculation methods to capture degrowth 26

4 Results 28

   4.1 Housing & electricity 28

   4.2 Transportation 31

   4.3 Food 34

   4.4 Miscellaneous consumption 36

   4.5 Overall assessment of throughput and emissions 38

   4.6 Inequality 39

4.7 Subjective well-being 42

4.8 Challenges 44

5 Discussion 46

5.1 Assessment of the environmental impact of ecovillages 46

5.2 Positive influence of ecovillages 47

5.3 Rural values as reference scenario 49

5.4 Suggestions on well-being 50

5.5 Transforming challenges into dilemmas 51

5.6 Feasibility on a large scale 52

6 Conclusion 54

6.1 Limitations 55

6.2 Implications and further research 55

7 References 57

Appendix I 65

Appendix II 68

Appendix III 71

Appendix IV: Personal declaration 73

LIST OF FIGURES

Figure 1: The degrowth transition to a steady state economy 14

Figure 2: Location of investigated ecovillages in Germany 20

Figure 3: Illustration of data collection process 22

Figure 4: Exemplary Carbon Footprint and its classifications 27

Figure 5: Classification of SWB values 28

Figure 6: Energy consumption per person by comparison 29

Figure 7: CO_2 emissions per person in energy by comparison 30

Figure 8: Yearly passenger kilometer by type of transportation in comparison 32

Figure 9: CO_2 emissions per person in transportation by comparison 33

Figure 10: Yearly food consumption by food category in comparison 34

Figure 11: CO_2 emissions per person in food consumption by comparison 35

Figure 12: Aggregate carbon footprint by comparison 39

Figure 13: Reasons for individual SWB in the ecovillages 43

LIST OF TABLES

Table 1: Rationale and goals of degrowth 12

Table 2: Basic information of the investigated ecovillages 22

Table 3: Information on the participated interviewees 24

Table 4: Overview of sources to elaborate on the environmental impact 25

Table 5: Overview of methods to capture the concept of degrowth 26

Table 6: Examples for miscellaneous consumption per person 36

Table 7: Overall assessment of formulated hypothesis 38

Table 8: Subjective well-being of ecovillages and reference values 42

Table I.1: Energy sources and their properties 65

Table I.2: Energy use and sources in Niederkaufungen (2011-2021) 65

Table I.3: Electricity use and sources in Niederkaufungen (2011-2021) 65

Table I.4: Energy consumption and carbon footprint in Siebenlinden 66

Table I.5: Energy consumption and footprint of ecovillages and Germany per person 66

Table II.1: Emissions of transport in Germany per passenger kilometer in 2019 68

Table II.2: Passenger kilometer by transport in the ecovillages and Germany 68

Table II.3: Carbon footprint in kg per person by transport 69

Table III.1: Food consumption in the ecovillages and Germany per person in kg 71

Table III.2: Carbon footprint per person in kg of the food consumption 71

LIST OF ACRONYMS

BMEL	Bundesministerium für Entwicklung und Landwirtschaft
BMDV	Bundesministerium für Digitales und Verkehr
CHP	Combined heat and power plant
Destatis	Statistisches Bundesamt
DMC	Domestic Material Consumption
EKC	Environmental Kuznets Curve
GDP	Gross Domestic Product
GEN	Global Ecovillage Network
GHG	Greenhouse Gas
HDI	Human Development Index
IC	Intentional Communities
KNK	Kommune Niederkaufungen
MF	Material Footprint
OECD	Organization for Economic Cooperation and Development
PV	Photovoltaic
SL	Siebenlinden
SWB	Subjective well-being
TH	Tempelhof
UBA	Umweltbundesamt
UNEP	United Nations Environment Programme
UNDP	United Nations Development Programme

1. INTRODUCTION

1.1 Problem statement

There is evidence for human activity as the main driver for climate change and global warming, which are two of the main problems humans have to deal with both in present and future (IPCC, 2014). Important planetary boundaries have already reached dangerous tipping points and further will follow, if the overall amount of greenhouse gases and other harmful substances do not decline significantly (Steffen et al., 2015). Moreover, by looking at the ecological Footprint of the world, a vast number of countries are living beyond their means (Lin et al., 2018). It is striking that countries with a higher level of GDP are followed by higher emissions of greenhouse gases. However, economic growth seems not only to be an indirect driver of climate change, it is also an indicator for the prosperity of a country. There is a positive relationship between GDP and preferable parameters, such as life expectancy (Miladinov, 2020), poverty reduction (Klasen, 2008) and happiness (Veenhoven & Vergunst, 2014). Therefore, in nearly every country economic growth is one of the main goals to achieve.

The desirability of economic growth poses a quandary in light of the pressing threat of climate change. This dilemma is acknowledged, but proponents of green growth contend that an inevitable trade-off does not exist. There are several definitions of green growth that differ in their exact requirements, generally it can be described as a concept of lowering environmental impact, while simultaneously increasing GDP (Hickel & Kallis, 2020, p. 470). UNEP defines green growth as concurrently increasing income and well-being of humans life, 'while significantly reducing environmental risks and ecological scarcities' (UNEP, 2011, p. 16). This highlights a strong focus on environmental improvements. UNEP also states the importance of achieving absolute decoupling, which is achieved when a rising GDP is followed by a decreased environmental impact such as greenhouse gas emissions. However, there is only strong evidence for relative decoupling in many countries, i.e. the increase of greenhouse gas emissions are lower than the economic growth (Haberl et al., 2020). Sufficient absolute decoupling, which is necessary to achieve global emission targets is not empirically found (Jackson & Victor, 2019). Besides, by looking at resource use, conclusions seems to be similar. Achieving absolute decoupling is a potentially attainable objective in some affluent nations with robust abatement policies, nevertheless such a goal is not viable on a worldwide scale and physically impossible on a prolonged period. (Hickel & Kallis, 2020).

There is another economic concept, which deals with the environmental issues connected with economic growth. It is called degrowth and differs from green growth as its transformative changes are more radical (Muraca, 2013). According to Demaria et al. (2013), degrowth is both a social movement and academic field and mostly refers to different streams of growth critics. A unique definition is not determined, however degrowth can be described as a decline in material production and consumption to achieve an overall environmental preservation, while simultaneously improving the quality of life (Kallis, 2011, p. 874). While green growth focuses on growth and considers that environmental protection is possible through innovations and efficiency improvements, the degrowth movement denies this idea and emphasizes the need for an overall decline in energy and resource production and consumption. A decline in GDP is not a goal of degrowth in itself, but likely to happen when societies´ throughput is downscaled (Hickel & Kallis, 2020).

The extant literature on the notion of degrowth is characterized by significant diversity, encompassing a broad spectrum of ideas and perspectives. When it comes to the implementation of degrowth, suggestions about it differ also among degrowth researchers. The focus is mainly on a top-down implementation, i.e. strategies that are adopted by the highest level of a system and suggest a need for significant state intervention (Cosme et al., 2017). In a national context it means the governmental side and implementation strategies covers different governmental actions, such as taxes, caps and regulations. However, while the list of proposals is large, a list of practical implementations at a national context is non-existent due to the fact that there is no example from theory into practice (Büchs & Koch, 2019). In addition, some researchers point out that the degrowth process should be voluntary, as this is crucial to be sustainably embraced and mainstreamed at the cultural level for the broad population, which is hardly achievable with massive state intervention (Alexander, 2013; Schneider et al., 2010). The other approach, which is called bottom-up approach is driven on a voluntary basis and has many practical examples. It refers to a mode of action that begins at the local level and involves the initiatives and actions of individuals, communities, and local governments which aim to cultivate degrowth ideas from the ground up (Alexander, 2013). These can have forms such as urban gardens, food cooperatives, ecovillages and eco-communities and also other micro-level civil society and business initiatives, which are degrowth-compatible (Buch-Hansen & Nesterova, 2023). Ecovillages “provide insights as to how degrowth society might look” (Cattaneo, 2015) and can be seen as practical examples for degrowth due to their “ecological performance and social conviviality” (Cattaneo, 2015, p. 168). The principal aim of this thesis is to investigate the degree to which certain ecovillages, as a pragmatic bottom-up approach, integrate the concept of degrowth into their practices. In this regard, the study utilizes a selection of ecovillages from Germany as a basis for examining this matter.

1.2 Main objective and research question

My first research question is the following:

To what extent is the concept of degrowth implemented in the selected ecovillages?

To answer this research question the extent of annual energy and material consumption in throughput per individual is examined in the ecovillages and compared with average values from Germany. This covers different areas such as housing, transportation, food and other consumption. To grasp the degrowth goal of lowering the environmental pressure, CO_2 emissions are used as an indicator and examined in the ecovillages. Moreover, the social goals of a reduced inequality and increased well-being are also investigated in the ecovillages.

The following hypotheses are explored:

H1: The material and energy throughput of the ecovillages is lower than the German average.

H2: The percentage reduction in CO_2 emissions is higher than the reduction material and energy throughput.

My second research question is as follows:

What are the main challenges in ecovillages and are they connected with the concept of degrowth?

The objective of this research question is to identify the primary challenges that ecovillages encounter in their daily life. These challenges are examined to see whether they are unique to individual ecovillages or whether they have commonalities. Possible dilemmas will be presented.

1.3 State of research

There is a significant number of scientific papers dealing with the topic of degrowth. In recent years, the number has increased considerably (Fitzpatrick et al., 2022, p. 5). A good source to have an overview of publications about degrowth is the systematic overview of degrowth policy proposals of Fitzpatrick et al. 2022. An enormous range of different topics, namely 50 goals and 100 objectives were identified and clustered into 13 policy themes. The review by Fitzpatrick (2022) builds on the review by Cosme et al. (2017), and includes significantly more papers. Another overview is given by the work of Weiss and Cattaneo (2017), who reviewed 91 degrowth-related articles and especially the development over time between 2006 and 2015. Based on their analysis, the articles covered a vast range of viewpoints, and degrowth thinking could not be universally defined with a single comprehensive definition. Nonetheless, their findings indicate that a majority of the papers addressed normative concerns prior to 2012, with a shift towards a greater emphasis on modeling or practical implementation in more recent years.

It is commonly observed in academic literature that there is a lack of consistency in the definition of key terms (Cosme et al., 2017). One reason is the difficulty due to the enormous range of topics already mentioned, but another reason is the deliberate lack of a precise definition, as this would not do justice to the degrowth movement (Latouche, 2010). Nevertheless, it is important to extract a definition that contains as much overlap as possible from the publications to capture the basic idea of degrowth. Based on the normative and rather formal works, a definition of degrowth will be developed, which will be used in the further course of the thesis.

As reported by Cosme et al. (2017), a significant proportion of degrowth research, approximately two-thirds, adopts a top-down approach, while only a quarter of the literature examined embraces a bottom-up perspective. It might therefore be of interest to examine the bottom-up approach due to several points. Firstly, the research on bottom-up implementations such as ecovillages is relatively scarce. One example is the research of Lockyer (2017), who investigated in the Dancing Rabbit Ecovillage in Missouri, USA whether different transition discourses, including degrowth, take place in their development. He concluded that degrowth is to some extent achieved, due to decreased consumption patterns and the maintenance of a high quality of life. Another example is the work form Cattaneo and Gavaldà (2010), who examined rural-urban squats outside of Barcelona and name them as a practical implementation towards degrowth. Furthermore, in other publications different components of the degrowth concept were investigated in some ecovillages. Daly´s (2017) meta-analysis compiles a comprehensive list of studies examining the CO_2 footprints of ecovillages, thereby enabling an assessment of their ecological impact in terms of emissions. Grinde et al. (2018) conducted a survey of multiple ecovillages located in the United States with the aim of investigating subjective well-being, thereby illuminating a crucial social facet of the degrowth paradigm. Both recognize the significance of conducting further research on additional ecovillages.

Cattaneo (2015) also sees an urgency to empirically investigate the ecological effect of ecovillages. Thus, there is a need to investigate the degrowth idea more holistically in ecovillages. Secondly, some degrowth researcher highlight the voluntary base of a degrowth transition and thus criticize top-down implementations. Therefore it "should be a collectively choice of life, not an externally-imposed imperative" (Cattaneo & Gavaldà, 2010, p. 581). Lastly the top-down discussion of degrowth is questioned due to its high level of theoretical and not yet implemented utopian character (Büchs & Koch, 2019), its possible negative implications on the financial and monetary system (Tokic, 2012) and also the questionability of the environmental effectiveness and social feasibility of degrowth (van den Bergh, 2011).

Literature about ecovillages includes papers about certain ecovillages and its connection to degrowth (Lockyer, 2017), a meta-analysis from studies of world´s ecovillages (Barani et al., 2018) and practical tools for successful ecovillage growing (Christian, 2003). However, Barani et al. (2018) states that literature on ecovillages is relatively small and more research is desirable. So there is both a need for investigating the degrowth concept in a bottom-up approach such as ecovillages and investigating ecovillages in general. Ecovillages seem to increase the well-being of their inhabitants (Grinde et al., 2018), but also have to deal with several issues, which could lower the well-being (Mychajluk, 2017). Social concerns are highlighted, including the extent to which a community permits individuality versus requiring subordination to communal norms, as well as the decision-making process, which may become protracted due to communal decision-making (Farkas, 2017). Not only endogenous social challenges are mentioned, also financial difficulties arise due to the motivation to meet high sustainability standards in almost all areas of life, which are very costly (Mychajluk, 2017). Mychajluk (2017, p. 191) points it out as "the challenge of trying to build a sustainable community in an unsustainable world". Thus, there are papers that deal with the challenges of individual ecovillages, though no general formalization, distinction or prioritization is made. Besides, there is no paper dealing with a possible connection between the challenges and degrowth. Consequently, there is a need to evaluate the most pressing challenges of selected ecovillages and relate them to degrowth.

1.4 Structure of the thesis

Chapter 2 introduces the theoretical framework, which the research is based on. It starts by examining the concept of green growth, followed by the exploration of degrowth and concludes with a clarification what ecovillages are. In chapter 3 an overview of data and methodology used to conduct the research is given. Particularly the chosen ecovillages are presented, the different steps and sources of gathering data are examined and the qualitative and quantitative methods to illustrate the concept of degrowth are propounded. Chapter 4 represents the ascertained results. It first discusses the identified environmental pressures, subdivided into separate sub-areas, and then presents the findings on inequality and well-being. In chapter 5 the acquired knowledge is discussed, critically reflected and related to existing literature. Furthermore, limitations are pointed out and considerations are made if other calculation methods and proxies for environmental pressure had been chosen. Moreover, deliberation is also given to whether implementation on a larger scale would be possible and desirable. Lastly, chapter 6 concludes the thesis with a summary about the most important insights and potential fields for future research.

2 THEORETICAL FRAMEWORK

2.1 Green growth

As green growth is a term with several definitions proposed by a variety of organizations and experts, it is crucial to give an overview of the most common ones and figure out overlaps. One common characteristic among existing definitions is their frequent vagueness, nevertheless all definitions encompass the concept of an expanding economy (as measured by the value of produced goods and services) that conserves natural assets and services (Bowen & Hepburn, 2014). At the global level, there are three major organizations that advocate for the theory of green growth and propose their own definition: OECD, UNEP and the World Bank. Each of these institutions released a report on green growth around the time of the Rio+ 20 Conference in 2012 (Hickel & Kallis, 2020, p. 470). The World Bank (2012) defines it as "economic growth that is efficient in its use of natural resources, clean in that it minimizes pollution and environmental impacts (…)". While it is acknowledged that the environmental impact should be mitigated, the degree to which this mitigation should occur is not clearly defined, leaving a significant degree of discretion in interpreting this aspect. The OECD (2011) determines green growth in the following terms: "fostering economic growth and development while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies". This definition can be seen slightly stricter as it focusses on a maintenance on the provision of resources and environmental services. The last definition comes from UNEP (2011), which highlights the importance of a significant reduction in "environmental risks and ecological scarcities" and simultaneously a growth in income and well-being. It can be seen as the strictest definition due to the advertence of a significant reduction in environmental pressure. Hereby UNEP employs the term green economy instead of green growth. All three definitions have in common the importance of economic growth, but differ in their stringency as to how strong environmental protection should be. In general, it can be said that the current growth-based economic model should remain in place and that further economic growth will simultaneously reduce environmental degradation. To achieve green growth resource-efficient innovations are needed, fostering by governments through several mechanisms, such as carbon taxes, subsidies, innovations and cap and trade systems (D'Alessandro et al., 2020, p. 329).

Proponents of green growth highlight on the one hand the necessity for economies to grow. One main reason for the importance to grow is the answer of politics when signals point to an imminent recession with its manifold negative implications and is seen as a crucial political imperative (Bowen & Hepburn, 2014, p. 408). Another reason is the possibility to lift people around the world out of poverty and help low-income countries to develop (Dercon, 2014). On the other hand due to increasing greenhouse gas emissions, which are followed by climate change, the loss of biodiversity and increasing scarcity of fresh water, a rethinking is essential (OECD, 2012). One theoretical concept which shows the connection between economic growth and environmental degradation (e.g. resource extraction, greenhouse gas emissions) is the so-called Environmental Kuznets Curve (EKC). The EKC has an inverted U curve, i.e. first the environmental degradation increases with the economic performance up to a certain point, and from this point it decreases with increasing economic performance. The phenomenon, that the economy is growing while the environmental pressure is simultaneously declining is called decoupling and is the main rationale behind green growth (Hickel & Kallis, 2020, p. 469). Green innovations and efficiency improvements can lead to decoupling. Common examples are renewable energy technologies such as solar panels and wind turbines, which produce electricity without emitting CO_2 emissions or the improvement of lighting through LED lights, which reduce the amount of energy needed to power homes and businesses. Empirical evidence for relative decoupling, i.e. an increase in GDP is followed by a lower increase in environmental pollution, is found in many countries (Haberl et al., 2020, p. 32). Furthermore, there are also examples for absolute decoupling, i.e. an increase in GDP is followed by a decrease in environmental pressure. Le Quéré et al. (2019) found a reduction of CO_2 emissions in 18 developed countries such as Germany, France or Spain between 2005 and 2015 by 2.4% with a simultaneously economic growth with 1-2%. The majority of the decline is explained by the decreasing use of fossil fuels in final energy use. Moreover, Hickel and Kallis (2020) demonstrate a decrease in emissions in both the US and EU28 from 2006 to 2016 when measured in either territorial or consumption-based terms. There is evidence to suggest that the theoretical concept of green growth can be observed in empirical data. However, it remains to be seen whether this is sufficient for achieving the essential climate goals outlined in the Paris Agreement and also the question if absolute decoupling is applicable globally.

To obtain a more comprehensive perspective, finite resources should be considered in addition to carbon dioxide emissions as indicators of environmental degradation. When using the domestic material consumption (DMC), which is the total weight of raw materials extracted from the domestic territory, adding the difference between physical imports and physical exports, relative decoupling is empirically found in many developed countries and even absolute decoupling in some countries (Hickel & Kallis, 2020, p. 472). DMC is seen as an indicator with limited explanatory power, as it does not take into account the environmental impact of the production and transportation of imported goods (Akizu-Gardoki et al., 2020; Hickel & Kallis, 2020, p. 472). In a globalized economy characterized by the outsourcing of production by wealthy nations to less developed ones, the corresponding aspect of material consumption has been externalized from the balance sheet of the former. An indicator which includes this circumstance is the material footprint (MF). Wiedmann et al. (2015) found no absolute decoupling for MF nationwide and only empirics for relative decoupling in China, India and South Africa. In the 27 EU states, MF increased even more strongly than GDP in the period between 2002 and 2013, so that one can speak of re-materialization. In general it depends which indicator is used, however even though by employing DMC, empirical evidence of absolute decoupling remains limited. Hickel and Kallis (2020) conclude that there is no feasibility on global scale and the maintenance over a longer period is highly improbable.

The previous analysis demonstrates that certain nations are experiencing absolute decoupling with regards to GHG emissions. Nevertheless, achieving sufficient absolute decoupling is essential for meeting the carbon budget targets outlined in the Paris Agreement. To achieve this it would be necessary for the carbon intensity of global economic output to decrease by an average of approximately 14% annually over the next 30 years, which was not even close to ever being achieved (Jackson & Victor, 2019, p. 951). Reasons for not achieving sufficient decoupling are among others rebound effects, problem shifting and especially cost shifting (Parrique et al., 2019). The first reason means that efficiency leads to an increasing consumption of the same good (direct rebound effect) or freed money due to cost savings are spent in consumption elsewhere (indirect rebound effect). Problem shifting refers to the occurrence of new environmental problems when solving others (e.g. pressure on resources by producing batteries for electric cars). The third reason is cost shifting which means outsourcing of biophysically-intensive production in low-income countries. Especially this argument demonstrates the questionable feasibility of decoupling worldwide. In sum green growth with its concept of decoupling seems to be a doubtful solution to achieve sufficient decreases in environmental pressures and a necessity for other solutions is therefore given.

2.2 Degrowth

The following chapters serve to illuminate the concept of degrowth and develop a definition that will be used in the course of answering research questions.

2.2.1 Development of the degrowth discourse

The concept of degrowth has been a subject of philosophical discourse for a considerable period of time. The French term "décroissance" (degrowth in English) was first employed to describe a societal path in 1972. Subsequently, it was referenced in the Meadows report to the Club of Rome and a conference in Montreal in 1982 and was primarily utilized as a synonym for economic recession. The term gained traction as an activist slogan in France, Italy, and Spain in the following years. The social movement pertaining to degrowth emerged in Lyon, France as a result of protests for car-free cities and other environmental causes (Demaria et al., 2013).

The term “degrowth” was introduced 2008 at the first degrowth conference held in Paris which also marked the birth of degrowth as an international research area. Since its introduction, the topic of degrowth has gained increasing attention and recognition among a growing number of scholars and researchers in the academic community. For instance, the number of policy proposals pertaining to degrowth has risen exponentially within the timeframe of 2005 to 2020, starting from a minimal number to a total of 140 by the year 2020 (Fitzpatrick et al., 2022).

It is worth noting that in recent years, the popularity of the degrowth concept has both risen within academic circles and in the general public. This is also reflected in the number of degrowth-related web searches on the Google search engine, which have increased from a few hundred in 2006 to nearly 16,000 in 2015. Nevertheless, it is important to note that these numbers are still relatively small in comparison to the 46.5 million search queries for "Economic growth" (Weiss & Cattaneo, 2017). Moreover, while the concept of degrowth is gaining traction in academic circles, as evidenced by the increasing number of conferences, initiatives and publications dedicated to the topic, it remains on the fringes of mainstream political discourse and public debate (Büchs & Koch, 2019).

Additionally it is noteworthy that the literature on degrowth displays strong concentrations with regard to authors, countries, and journals. Close to half of the papers examined in Weiss and Cattaneo (2017) originate from Spain from a small group of authors, who are also almost all employed at the same university. This could impede a diverse and more international perspective on the concept, in order to further advance the discourse. Moreover, degrowth-related papers are mostly found in the same journals; the peer-reviewed papers used by Cosme et al. (2017) for example, are predominantly found in the journals "Journal of Cleaner Production", "Ecological Economics" and "Futures". In contrast, the topic does not receive any attention in prestigious, economic-related journals such as the Quarterly Journal of Economics or the Journal of Economic Literature.

The concept of degrowth has not only evolved into an academic field, there have also been different developments within academic discourse. Based on the foundational literature published prior to 2012 which contains normative claims, unfit for rigorous scientific testing, recent developments in degrowth research have diversified to encompass formal economic analysis, examination of material and energy flow dynamics, and explorations of specific case studies (Weiss & Cattaneo, 2017).

2.2.2 Definition

Degrowth is a complex concept that cannot be easily defined in a single sentence. It is similar to concepts like freedom or justice in that it represents a goal or aspiration. Degrowth is a framework that brings together different perspectives, ideas, and actions. This versatility is seen as a strength, which is why the concept of degrowth is often presented in the form of a dictionary, where it is understood as a network of ideas and conversations (D'Alisa et al., 2015). The lack of a singular definition for degrowth is due to the various perspectives and ideas associated with it, as well as the intention to not limit it to one specific definition (Latouche, 2010). Nevertheless, there are numerous overlaps and similarities in academic publications. This chapter aims not to present the full scope of degrowth, it rather encompasses the core ideas in order to work with this definition in the further course.

The main idea regarding degrowth is a drastic reduction of a society's throughput to achieve ecological sustainability. Throughput means the energy and resource flows in and out of an economy (Kallis et al., 2018). To be more precise, the term encompasses two intertwined components of a system. Firstly, it encompasses any inputs, including all types of matter and energy such as renewable resources like wood or finite resources like coal and oil, which are linked to issues of scarcity. Secondly, it includes the resulting outputs, which are associated with the creation of waste and emissions, among other factors (Heikkurinen, 2018). As a result, a general decline in production and consumption is necessary to achieve a massive throughput decrease. Degrowth is not the opposite of growth, i.e. a forced decline in GDP. It is a decline in production and consumption that automatically leads to a lower level of GDP (Hickel, 2021). If one compares the two concepts of green growth and degrowth, they are similar in their objectives with regard to the climate, but they differ in the question of how this is to be achieved. Green growth posits the need for a continued increase in economic output, while degrowth postulates a decrease in consumption and production. It is not clear exactly how much the reduction in throughput should be, but it is essential to ensure that resource extraction and the emissions of greenhouse gases remain within the regenerative capacity of ecosystems and waste within their absorptive capabilities. The concept of planetary boundaries (Steffen et al., 2015) is often referred to in this context and also the targets set out by the Paris agreement regarding remaining carbon budgets. One can assert that the rationale for degrowth lies in reducing throughput, with the main goal of decreaseing the environmental degradation.

Not only environmental issues are an important part of degrowth, also social concerns play a significant role. A second goal is to reduce the worldwide inequality, referring to the fact that a significant amount of economic wealth is currently held by a small portion of the population, while a large proportion of individuals are unable to meet even their most basic needs (Gough, 2017). Piketty (2017) states the further increasing concentration of wealth in a small number of hands is followed by negative consequences, such as reduced social mobility, political instability and environmental degradation. Furthermore, income inequality seems to have a highly negative effect on subjective well-being (Sekulova, 2015). Degrowth both wants to reduce inequality in a national and global scope, covering income and wealth (Hickel, 2021).

The third goal is an increase in well-being. While most countries in the world have economic growth as a main national objective with a few exceptions such as Bhutan, which aims to maximize their Gross National Happiness (Tobgay et al., 2011), degrowth focusses on a growth of well-being as a central element of the economic system. It is important to note that the definition of well-being in degrowth differs from the one in neoclassical economy. In neoclassical economy, well-being is primarily defined as consumption opportunities and is based on the producer-consumer relationship. But in degrowth theory, well-being is influenced by a broader range of factors, including social relationships, environmental quality, and health (Andreoni & Galmarini, 2014). Well-being can be defined in several ways and there are different measures to grasp well-being in numbers. Objective well-being covers components such as income, health and education levels and is for example taken into account in the HDI (UNDP, 2022). Subjective well-being covers the life satisfaction or happiness of individuals by cantril life ladder type questions, as it criticizes the questionable reflection of real well-being through income-based metrics (Akizu-Gardoki et al., 2020). It is not explicitly stated what kind of well-being degrowth means when it wants to increase the quality of life, however as SWB is most in line with the ideas of degrowth, SWB is used in the following discourse as a measure of well-being or quality of life. The underlying premise of degrowth regarding economic growth and well-being is the assumption that the general subjective well-being of a country ceases to increase beyond a certain level of GDP. In numerous countries, happiness scores have plateaued despite continued growth in GDP (Easterlin et al., 2010). Akizu-Gardoki et al. (2020) discovered that beyond a certain level of energy consumption, well-being can even decline, and there could be a well-being turning point. When a certain level of GDP is reached to adequately fulfill universal human needs, subjective well-being does not continue to increase and may even decline due to, for instance, rising inequality.

Table 1 lists the rationale and goals of degrowth in a brief manner, which have been developed in this chapter and represent the concept of degrowth in the master's thesis. The first goal is closely related to the rationale and is a direct consequence of it, while the other two goals are more indirectly related to it.

Table 1: Rationale and goals of degrowth

Rationale	**Goals**
Throughput-reduction in material and energy	Reduce environmental degradation
	Reduce inequality
	Increase well-being

Source: Own representation.

2.2.3 Implementation of degrowth and its approaches

The requirement for direct government control in many proposals (such as caps, taxes, and regulations) for a degrowth transition suggests a need for significant state intervention. As the majority of policy proposals are top-down driven, i.e. strategies that are adopted by the highest level of a system such as the state, there seems to be a focus of researchers for this approach. Specifically nearly one half of the proposals share a national focus (Cosme et al., 2017).

There are several political instruments to reduce the energy and resource throughput and decrease environmental degradation. One important instrument are caps on resource use, emissions and pollution. These could encompass restrictions in end-use consumption, personal energy quotas, global "cap and share" programs and also multi-scalar caps which are deduced from national and global maximum. Other instruments are taxes, which for example belong to resource use, the extraction of resources at its origin and general greenhouse gas emissions and therefore try to internalize negative external effects. Moreover, incentives could be provided to promote local production and consumption to decrease global trade and promote organic farming and sustainable agriculture (Cosme et al., 2017; Fitzpatrick et al., 2022).

Policy proposals that aim to address the issue of inequality go in a similar direction. A main consideration is a general redistribution of income and wealth through several instruments. Such instruments are maximum caps, progressive taxes touching both income and wealth and additionally maximum income ratios and universal basic income (Cosme et al., 2017; Fitzpatrick et al., 2022). Nowadays, some instruments are implemented in Germany such as the minimum wage or a progressive income tax rate, but in a much weaker form when compared to the degrowth demands. Maximum income ratios are highly unlikely in a free market economy. Above all, the indispensable role of governance for an effective implementation of degrowth becomes obvious.

There are no direct policy-proposals to improve well-being, but it will be indirectly improved. If there are policies which decrease environmental degradation, decrease social inequality and increases leisure time due to reduced working hours, this will influence the well-being according to the degrowth movement. Especially a reduction in working hours and the different meaning of work in general is often mentioned in research about degrowth. According to Nørgård (2013) a reduced working time leads to a higher leisure time and therefore an increase in satisfaction and happiness. A reduced working time is also followed by lower income and therefore less consumption which would lower the overall throughput. Furthermore, work-time reduction is one answer to the probably increasing unemployment, due to decreasing production.

When considering the core concept of degrowth, which involves reducing the energy and resource throughput to a sustainably long-term level, it is important to examine the implications for the economy in terms of GDP. There is a general consensus in literature that a reduction in GDP is likely to be a consequence of degrowth, but not a standalone goal (Kallis, 2011; Schneider et al., 2010). The degrowth declaration states that "Once right-sizing has been achieved through the process of degrowth, the aim should be to maintain a 'steady state economy' with a relatively stable, mildly fluctuating level of consumption" (O'Neill, 2012, p. 1). This highlights the fact that a shrinking economy is necessary for a certain period of time, and in the long run, it must be maintained at a sustainable steady-state level (O'Neill, 2012). Figure 1 shows the probable development of a degrowth economy over time.

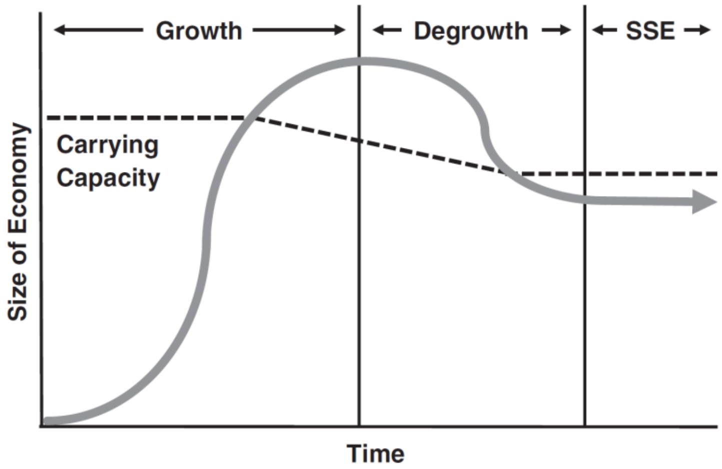

Figure 1: The degrowth transition to a steady state economy

Source: O'Neill (2012, p. 222).

However, proponents of degrowth are focused on reducing excess resource and energy use in high-income countries that exceed per capita fair-shares of planetary boundaries, and not advocating for degrowth to be universally applied to all countries. Many poor countries need to increase their resource and energy use in order to meet human needs, and degrowth does not apply to economies that are not characterized by excess resource and energy use (Hickel, 2021). Referring to figure 1, poorer countries would not follow a degrowth path at all, but a growth path, up to a certain level, which then functions as a perpetual sustainable steady state economy.

It is necessary to examine potential adverse consequences pertaining to the execution and principles of degrowth, as well as critical views regarding degrowth in general. van den Bergh (2011) criticizes several things regarding degrowth. Due to its multiple meanings, degrowth is likely to generate confusion rather than clarify the discourse on environmental policy.

Additionally, many interpretations of degrowth are not aligned with the goals of environmental sustainability, as they do not offer effective strategies for reducing environmental pressure or transitioning to a sustainable economy. Furthermore, the likely lack of social and political support makes degrowth an ineffective political strategy for achieving environmental sustainability. Especially the last point is important to be further considered, asking about the realistic feasibility of degrowth. Even though degrowth researcher Giorgis Kallis states that "planned degrowth is politically unlikely, given established interests and power relations" and that proposals are mostly utopian due to lack of existence (Kallis et al., 2018).

Tokic (2012) investigates possible implications of economic degrowth on the financial and monetary system. The stock market is crucial in a capitalistic society as it allows public companies to raise capital, provides a platform for investors to accumulate savings, and offers the potential for growth of invested money. A necessary condition of the stock market is GDP growth. Any early indication of a degrowth scenario, would crash the stock market and trigger further vicious cycles. An implosion of the economy would be a result and makes degrowth unsustainable (Tokic, 2012). In addition, the strong power of the stock markets on policymaking is discussed. As an example, Obama's attempts to introduce less financial market-friendly reforms were almost completely reversed when the crash occurred in March 2009. Tokic (2012) concludes that degrowth is only possible in a world without capitalism, otherwise it is "environmentally ineffective, socially and politically unfeasible, and economically inefficient" (Tokic, 2012, p. 55). Binswanger (2013) arrives at a similar assertion by contending that capitalism inherently generates an imperative for expansion and is contingent upon growth, implying that the adoption of degrowth can only be conceivable in a non-capitalistic world.

If a single country were to adopt a degrowth approach, it is highly likely that, in a globalized context, numerous companies and investors would seek to exit the country, thereby resulting in a transnational shift of consumption and production practices and the accompanying challenges.

A consideration of the bottom-up approach as an implementation approach of degrowth thought therefore makes sense based on the previous consideration. A macro-economic top-down implementation would only be feasible and meaningful in a non-capitalist world, which is very unlikely and, above all, contrary to economic interests and influential profiteers of today's economy. Given that the degrowth discourse predominantly highlights the importance of a voluntary transition, which is unlikely to be achieved with a high level of state intervention, the bottom-up perspective assumes significance, despite the fact that degrowth proposals rarely emphasize bottom-up approaches (Cosme et al., 2017).

The bottom-up approach refers to a mode of action that begins at the local level and involves the initiatives and actions of individuals, communities, and local governments. This approach differs from top-down approaches, which are typically driven by national or international organizations and governments. The bottom-up approach aims to cultivate sustainable and equitable economic systems from the ground up, instead of being imposed from above. The approach seeks to effect change through decentralized, participatory processes and to empower individuals and communities to take the lead in creating a more sustainable future (Alexander, 2013). Therefore it can be seen as a voluntary based decision-making.

Bottom-up initiatives can be defined as niche innovations with a grassroots approach, where diverse sets of activities between local communities, activists and neighbors take place to create sustainable development. These solutions are tailored to the local context and values, with the community having control over the process and outcome (Smith & Stirling, 2018). These can have forms such as urban gardens, food cooperatives, ecovillages and eco-communities and also other micro-level civil society and business initiatives, which are degrowth-compatible (Buch-Hansen & Nesterova, 2023). It should be noted that it is difficult to determine to what extent the respective bottom-up initiatives are compatible with degrowth or not. The approach varies regarding its size, with ecovillages potentially accommodating more than one hundred individuals, while co-housing projects typically cater to only a small number of residents. Implementation of degrowth differs at the micro level from the macro level. Macroeconomic instruments, such as a CO_2 tax, are certainly not implemented in bottom-up initiatives. Reducing production in order to reduce throughput can only be influenced to a limited extent, for example indirectly through individual consumption reduction. Nevertheless, the goals of the top-down approach are transferable to bottom-up approaches and partly achievable. If we look at ecovillages, for example, collective action can reduce individual environmental pressure in relation to one's own consumption, but also reduce throughput from production through a certain degree of self-sufficiency. Goals such as reducing inequality and increasing well-being can additionally be pursued in these projects.

2.3 Ecovillages

Firstly it is needed to clarify what ecovillages actually are. A first attempt to define ecovillages came from Robert and Diane Gilman in 1991. Ecovillages are a “human scale, full-featured settlement in which human activities are harmlessly integrated into the natural world in a way that is supportive of healthy human development, and can be successfully continued into the indefinite future" (Dawson, 2006). While this definition especially highlights the ecological aspect of ecovillages, Dawson (2006) also adds social and spiritual dimensions by highlighting the "communitarian impulse" and "strong shared value base". However, the Global Ecovillage Network (GEN), which aims to connect, educate and inspire ecovillages internationally have the following definition:

"An ecovillage is an intentional, traditional or urban community that is consciously designed through locally owned participatory processes in all four dimensions of sustainability (social, culture, ecology and economy) to regenerate social and natural environments" (GEN, n.d.)

It can be seen that this definition is very broad. As stated by Meijering et al. (2007) the identity of an ecovillage is typically shaped by the collective characteristics of its members. This leads to a substantial variation among ecovillages globally, rendering it unfeasible to devise a universal definition that accommodates all instances. Nevertheless, ecovillages unite the aim to experiment and model sustainable lifestyles (Barani et al., 2018). Whereas the term intentional communities is more broadly, ecovillages are focusing mostly on the ecological dimension of sustainability and trying to significantly reducing their environmental impact. There is often confusion between the terms intentional community, ecovillage or eco-community and a precise demarcation is not always given. Ecovillages are considered as impactful examples of lifestyle alteration, not only for residents physically reside in one, also for other people as they often include outreach programs in their initiatives to educate outsiders in a sustainable living behavior. Furthermore, ecovillages trying to be self-sufficient to a certain extent by implementing organic agriculture or different forms of sharing economies, but not seeking to be completely isolated from the outside society (van Schyndel Kaspar, 2008). To get a better picture of what ecovillages actually are, it is helpful to use some examples.

GEN lists about 10,000 communities over all continents (GEN, n.d.), although an exact number of how many ecovillages are existing is impossible to fully grasp. Whereas nearly 400 belong to the global north, focusing more on simplifying lifestyles to reduce ecological footprint, the vast majority are traditional communities from the global south, preserving precious low-impact traditions (Mychajluk, 2017). As shown in a map on their homepage, representing all ecovillages being part of GEN, it can be seen that ecovillages are dispersed all over the world. Despite this, the actual number of ecovillages is likely to be even greater, as not all ecovillage related projects are affiliated with GEN. In general, some ecovillages have gained notoriety as they have participated in numerous studies or been widely discussed in the public sphere.

One of best known ecovillage is the Findhorn Ecovillage in Scotland and often named as the "mother of all ecovillages" (Litfin, 2014). It was established in 1962 by a small group and has since undergone steady development, resulting in roughly 700 individuals residing in and around the ecovillage today. In 1998, the Findhorn Ecovillage was recognized as a UN-Habitat Best Practice and designated as a model for holistic and sustainable living (East, 2018).

Another example is the Dancing Rabbit Ecovillage in the northeast Missouri, USA. It is home to about 65 individuals on 280 acres in northeast Missouri, founded in the mid-1990s by graduate students from Stanford University who sought to take concrete action towards ecological preservation. Lockyer (2017) found out that the community living there had high levels of perceived happiness and satisfaction with life, despite utilizing a significantly lower proportion of resources, around 10%, compared to the average American in several crucial areas of consumption.

In Germany, there are also a few well-known examples, which are further evaluated in the chapter 3.1 study area, as they took part in the master thesis.

The previous information about ecovillages has especially shown the ideas and desirable outcomes of ecovillages. Certainly, ecovillages also have to deal with problems and challenges, both in the initial pioneer phase and when already established structures have been created. According to Christian (2003), a long-term ecovillage resident and group process consultant, approximately 90% of ecovillage efforts fail. The reasons for failure are diverse, with the inability to secure necessary land and funding being among the key factors. Nevertheless, among those ecovillages that do manage to commence development, a significant contributor to their collapse is often attributed to a lack of necessary social skills. As already seen, there are many examples for ecovillages which are persisting for 30 years or even longer.

According to Barani et al. (2018) the main challenges are the "difficulty of consensus-based decision-making" and problems with governmental authorities such as the lacking support and inflexibility. The first one highlights the social level, resulting in interpersonal conflicts, problems with sharing or lacking privacy. Social problems inside an ecovillage occur often. Farkas (2017) states several social dilemmas such as the ratio between individualism and communalism or question decision-making. The latter means for that without proper leadership, the community may suffer from lack of direction and ultimately fail. However, appointing leaders is opposite to consensus-building which are foundations of intentional communities.

Another challenge is the general existence of a sustainable community in an unsustainable world. Due to the low income potential of small-scale, ecological food production and the high cost of living an eco-friendly lifestyle, financial difficulties can arise (Mychajluk, 2017). Organic products are usually more expensive than conventional products.

As seen above, the challenges ecovillages have to deal with are numerous and diverse and probably differ from village to village.

3 METHODOLOGY AND DATA

This chapter presents the ecovillages utilized in the study and outlines the process of data collection. The central aspect is qualitative interviews with residents of the ecovillages. Additionally, supplementary data is obtained through other studies and relevant databases.

3.1 Study area

It was important to determine which of the ecovillages in Germany would be selected, as there are several of them. A good overview of the existing ecovillages in Germany can be found on the GEN overview map, which displays all projects that are part of GEN. For the master thesis, it was important to select ecovillages that prioritize the ecological aspect, have been established for a considerable period of time (at least 10 years) to have completed the initial pioneer phase, and have a certain number of inhabitants of around 100 people. Additionally, there should be a certain level of recognition, so that studies and investigations have already been conducted, allowing for access to data. As a result, the majority of the projects listed by GEN were excluded. The three remaining ecovillages were all contacted and asked to take part in the thesis, allowing for conducting interviews and using internal data. The ecovillages Tempelhof and Siebenlinden responded and took part in the study. Additionally, other suitable projects outside of the GEN network were contacted. The “Kommune Niederkaufungen” responded and is therefore also part of the thesis. Hence a total of three ecovillages form the empirical basis for this master thesis. Figure 2 shows the location of the respective ecovillages in Germany. Each of the three ecovillages are located in the rural area.

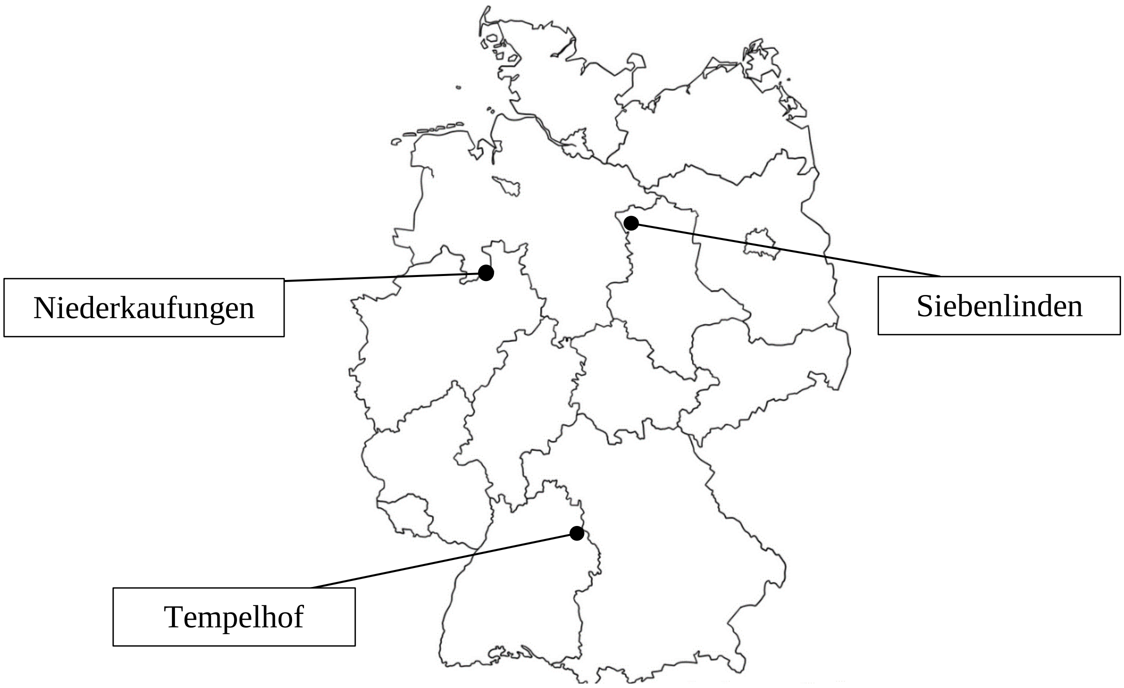

Figure 2: Location of investigated ecovillages in Germany

Source: Own representation, based on gen-deutschland.de.

Siebenlinden is one of the most famous ecovillages in Germany. The idea for the village originated in 1989 from individuals associated with a sustainable magazine who spent several years on planning, vision, and construction. In 1998 a place near the village of Poppau in the eastern state of Sachsen-Anhalt was found. A land use plan permitted the construction of a village, leading to the purchase of a 22 ha plot in 1998. Over the years, the ecovillage has steadily grown and the initial core group of 15 people has now expanded to 100 adults and 40 children (Interviewee 1.1, p. 9). The area has increased through acquisitions to approximately 100 ha, including sixty-four hectares of forest, which has been converted into a mixed forest and is sustainably managed, twenty-five of arable land, six of gardens, and six of buildable areas. The vision and goals are outlined in a set of guiding principles, which are constantly evolving. The initial strong focus on self-sufficiency and resource conservation has shifted towards a greater emphasis on community aspects. Since its inception, the general organizational structure has been based on democratic principles, with the initial consensus-based decision-making process giving way to decision-making by various councils (Interviewee 1.3, p. 30). The ecovillage sees itself as a model and research project for a future-oriented way of life and aims to establish ongoing local, regional, and international networks (Kunze & Hielscher, 2016).

The community of Tempelhof, located near Schwäbisch Hall in southern Germany, was founded at the end of 2010 and is thus the youngest of the ecovillages examined. Three years earlier, 20 people had already been intensely engaged in the implementation of an ecologically sustainable and socially just way of life. In total, the village has 30 hectares of land available, with 4 hectares of building land and 26 hectares of agricultural land. In the meantime, 90 adults and 30 children live in the village. The main focus of the village is on strengthening the community, with particular emphasis on the diversity and importance of an open communication culture. Decisions are made according to a so-called six-stage consensus culture (Interviewee 2.3, p. 62). In addition to the social aspect, the pursuit of a sustainable way of life is emphasized, based on the belief that all people today and in future generations have the same right to quality of life and use of resources. With the help of regenerative and solidarity-based agriculture, the ecovillage and its surrounding area are to some extent supplied with agricultural products. There is no private ownership of land, the non-profit Schloss Tempelhof Foundation has acquired the property and leased it for 99 years to the Schloss Tempelhof Cooperative. The property has thus been bought free and is protected from any future land speculation (Tempelhof, n.d.).

The last ecovillage is the commune of Niederkaufungen, located near Kassel in Hessen. It differs from the other two projects in that it was founded as a political commune and places a much stronger focus on community. It is not part of the GEN network and sees itself as an intentional community. Since it meets the definition of an ecovillage, it is treated as such in the master thesis. As early as the 1980s, a handful of people, which grew steadily over the years, had the idea of a commune that would encompass about 100 people. In 1986, the core area was acquired in Niederkaufungen and steadily expanded over time through the purchase of additional buildings and land. As of the end of 2022, the communal land comprises 1.1 hectares of building land, almost 40 hectares of agricultural land, and an outlying farmstead of 5.5 hectares. At the end of November 2022, 59 adults and 23 children and teenagers lived in the community. The most important principles in the commune are a leftist political understanding, a common economy, consensus-based decision-making, collective work, and the dismantling of small family and capitalist structures. There are numerous areas of work, including a day nursery, day care, and agriculture. The community also places a strong focus on ecological factors through direct energy-saving and resource-conserving measures such as insulation, as well as indirect measures through the high degree of shared use. These will be explained in more detail in Chapter 4. Since several other communities have been founded in the region, intensive collaboration and networking are sought, which are constantly evolving through joint working groups and cooperatives (Niederkaufungen, 2015, 2022; Simon et al., 2004). Table 2 summarizes some key information about the three ecovillages.

Table 2: Basic information of the investigated ecovillages

	Siebenlinden	Tempelhof	Niederkaufungen
Foundation	1998	2010	1986
Inhabitants	100 adults 40 children	90 adults 30 children	59 adults 23 children
Area size	6 ha buildable 25 ha arable 64 ha forest	4 ha buildable 26 ha arable	1.1 ha buildable 40 ha arable 5.5 ha farmstead

Source: Own representation, information based on conducted interviews and homepages of each ecovillage.

3.2 Data collection

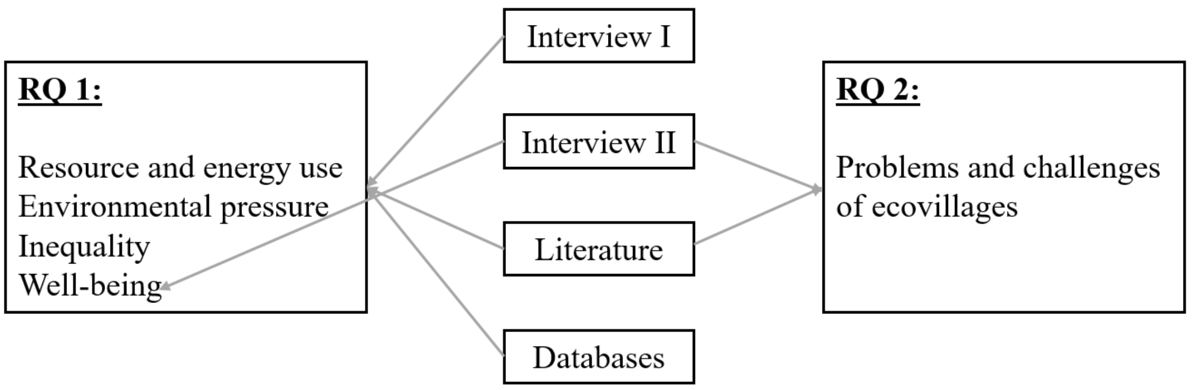

Figure 3: Illustration of data collection process

Source: Own representation.

Since the data collection for this master's thesis comprises several different types, Figure 3 provides an overview. For the first research question, primarily the findings from interview type I are used. In order to obtain more data on the topic of well-being, this is also part of interview type II. In addition, findings and data from previously conducted studies and existing databases are used. For research question 2, the findings come primarily from Interview type II, as well as academic publications.

The conducted interview type I was an expert interview that inquired about the fundamental components of the degrowth concept. The interviewee was a resident of an ecovillage who is knowledgeable about the subject matter and has been living in the village for some time. The interview was semi-structured, with some questions predetermined beforehand, while others were asked spontaneously during the interview. Although the interview's structure was roughly planned, changes could occur during the conversation. Each interview was unique regarding its course and questions, although the primary focus was consistent. The first part of the interview focused on the residents' general consumption patterns within their respective ecovillages. The questions covered topics such as energy and housing, nutrition, mobility, and miscellaneous consumption. The aim was to obtain quantitative data, such as the energy consumption within the village and particularly where the energy comes from, to determine a CO_2 value. If no data were available, rough estimates were requested. If a study had already been conducted in the village, the findings were discussed, and it was determined to what extent they represent the current status quo. The topic of inequality was exclusively addressed through qualitative questions since conducting a precise quantitative analysis and calculating inequality measures such as the Gini coefficient would require all wealth and income values, which would exceed the scope of the work. The focus was rather on whether the issue of inequality plays a role in the village and whether there are any approaches to eliminating any financial inequalities. The last set of questions covered the topic of well-being, aiming to determine the subjective, quantitative value of personal well-being, as well as qualitatively exploring how the interviewee's well-being value was composed. Additionally, questions were asked regarding the general well-being estimation within the village and its general importance. The interviews lasted an average of 45-60 minutes and were recorded using the Zoom video platform. Subsequently, the interviews were transcribed verbatim and anonymized, and the transcripts are included in the online appendix[1].

Interview type II primarily addressed the second research question, with no specific requirements for participation other than willingness and availability. The ecovillages distributed my request through their internal networks, and interested residents contacted me to schedule an interview. Two participants from Siebenlinden and Tempelhof ecovillages, and one from Niederkaufungen participated. The first part of the interview consisted of the same

[1] The online appendix is not freely accessible, but access can be granted upon request to the author.

well-being questions as interview type I. This was done to gather more individual data, even though the number of responses was still relatively small for meaningful results. The main part of the interview consisted of numerous qualitative questions that examined the problems and challenges faced by each ecovillage. Initially, the questions were intentionally left unspecific to obtain answers that were not influenced by the question itself. Subsequently, the questions became more specific to refine and differentiate the previously mentioned responses. Additionally, the challenges mentioned in the literature were explored to see to what extent they were relevant to the respective ecovillage. The interviews lasted an average of 30-45 minutes and were recorded using Zoom. They were then transcribed verbatim and anonymized and are included in the online appendix. Table 3 shows the conducted interviews.

Table 3: Information on the participated interviewees

Name	Ecovillage	Living duration in ecovillage	Date	Interview type
Interviewee 1.1	Siebenlinden	20 years	20.01.23	Type I
Interviewee 1.2	Siebenlinden	10 years	26.01.23	Type II
Interviewee 1.3	Siebenlinden	25 years	31.01.23	Type II
Interviewee 2.1	Tempelhof	10 years	31.01.23	Type I
Interviewee 2.2	Tempelhof	5 years	24.01.23	Type II
Interviewee 2.3	Tempelhof	10 years	06.02.23	Type II
Interviewee 3.1	Niederkaufungen	35 years	07.02.23	Type I
Interviewee 3.2	Niederkaufungen	<5 years	09.02.23	Type II

Source: Own representation, based on interviews.

As the interviews did not provide sufficient data on every topic, conducted studies are used in addition. For example, the work of Bocco et al. (2019) offers a diverse overview of the environmental impact of the ecovillage of Siebenlinden. During the period from 2016-2017, data on the daily lifestyles of the residents were collected, including the average energy consumption, divided by energy sources, daily consumption of durable products and food, and transportation habits. Additionally, the respective carbon and ecological footprints were calculated. According to interviewee 1.1 (p.5), there have been no significant changes in the village since the study was conducted. Consequently, a substantial amount of data is sourced from Bocco et al. (2019).

A similar study has been conducted for the community of Niederkaufungen. The results were summarized by Simon et al. (2004), along with other community projects. The study involved calculating carbon footprints based on surveys covering topics such as housing, mobility, and nutrition (Dangelmeyer, 2003; Fuhr & Klimer-Kirsch, 2003; Matovelle, 2003). The surveys were conducted in 2003 and were quite detailed. For the energy & housing field, current data is available as the community maintains an annual record of it. Depending on the availability of data (for example, on the topic of nutrition), the study's data was used, which may reflect the current conditions in the ecovillage only partially.

Table 4: Overview of sources to elaborate on the environmental impact

Author/Editor	**Title/Description**
Bocco et al. (2019)	Environmental impact assessment of Siebenlinden
Simon et al. (2004) Matovelle (2003) Fuhr and Klimer-Kirsch (2003)	Environmental impact assessment of Niederkaufungen
UBA (2022b)	Background information about the CO_2-Calculator for private person
Destatis (2022)	Environmental accounting of Germany
BMDV (2019)	Mobility in Germany
BMDV (2020)	Transport in figures 2020/2021
BMEL (2022)	Statistical Yearbook on Food, Agriculture and Forestry

Source: Own representation.

As there are no available quantitative studies for the ecovillage of Tempelhof, and none could be provided, a quantitative representation of this ecovillage is not possible. Nevertheless, the insights gained from the interviews are being used to compare and estimate the environmental impact of Tempelhof with the other ecovillages.

The German average in the respective subject areas is used as the reference value. This is taken from the CO_2 calculator of the Federal Environment Agency (UBA, 2022b) or studies and surveys conducted by public offices. Table 4 provides an overview of the most important sources used.

3.3 Calculation methods to capture degrowth

Since the exact concept of degrowth does not specify the topics of environmental degradation or well-being, it is of great importance which evaluation basis is used. Table 5 provides an overview of the underlying methods, used in the master thesis to capture the concept of degrowth from table 1.

Table 5: Overview of methods to capture the concept of degrowth

Reduction of throughput	Consumption patterns by category, expressed in varying units
Environmental degradation	Carbon footprint in CO_2 emissions
Well-being	SWB values, conducted with interviews
Inequality	Qualitative assessment, conducted with interviews

Source: Own representation.

To capture the reduction of throughput in material and energy, each category of figure 4 is examined. In the category housing & electricity, values of the used energy are given in kWh. For the other categories, exact values of material and energy throughput are difficult to obtain, however the consumption patterns in these categories can conversely give information about the throughput.

There are various ways to quantitatively capture environmental pressure. For example, the concept of planetary boundaries uses CO_2 concentration to measure climate change, aragonite saturation to depict ocean acidification, and many other parameters to show the diverse dimensions of planetary boundaries (Steffen et al., 2015). In this master's thesis, the carbon footprint is used to measure the environmental impact of ecovillages. This is done partly because climate change is one of the most pressing environmental problems and partly because it is a very common method with numerous already available data. There are different definitions of the carbon footprint, and the definition used by Bocco et al. (2019) is also used here, namely that the carbon footprint includes the total direct and indirect greenhouse gases emitted by individuals and products, including methane or nitrous oxide, and is expressed in terms of CO_2 equivalents. Average data are obtained from the CO_2 calculator (UBA, 2022b), an online-tool which determines the direct and indirect greenhouse gas emissions of an average person per sector and subcategory (heating and electricity in the housing sector, air travel, public transportation, and motorized individual transportation in the mobility sector, food, and other private and public consumption) and scales them with the values entered by the users. The average CO_2 emissions in Germany per sector in the CO_2 balance refer to the activities of German consumers (ifeu, 2007; UBA, 2022b). Figure 4 provides an example of the CO_2 calculator's evaluation for an average person and an exemplary individual[2]. Depending on the relevance, average data from other sources in table 4 are used, and the selection and calculation processes are described in detail in the appendix.

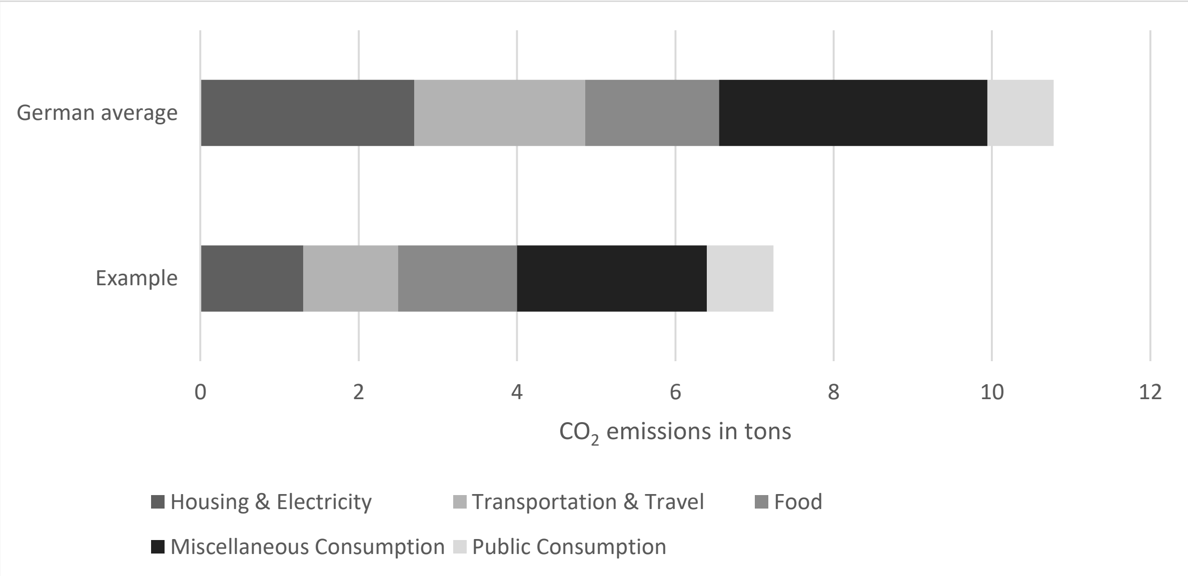

Figure 4: Exemplary Carbon Footprint and its classifications

Source: Own representation with data from uba.co2-rechner.de.

To capture the quality of life or well-being of individuals, subjective well-being will be applied. The subjective well-being of individuals is assessed through interviews, employing a standardized procedure, as used by the Gallup Organization for the Happiness Report (Gallup, 2009). This involves eliciting the current well-being, as well as the expected well-being in five years. Participants are required to provide a quantitative estimate on a scale ranging from 0 to 10, where 0 represents the lowest value and 10 represents the highest value. These scores are

[2] The values in the online tool UBA CO_2 calculator are continuously updated. The values used in this master's thesis are based on the status as of February 27th, 2023. Upon review on March 28th, 2023, updated values were found. Generally, the values are quite similar, and therefore, an update to the master's thesis was deemed unnecessary.

then categorized into three groups: "Thriving", "Struggling", and "Suffering". Figure 5 illustrates this classification.

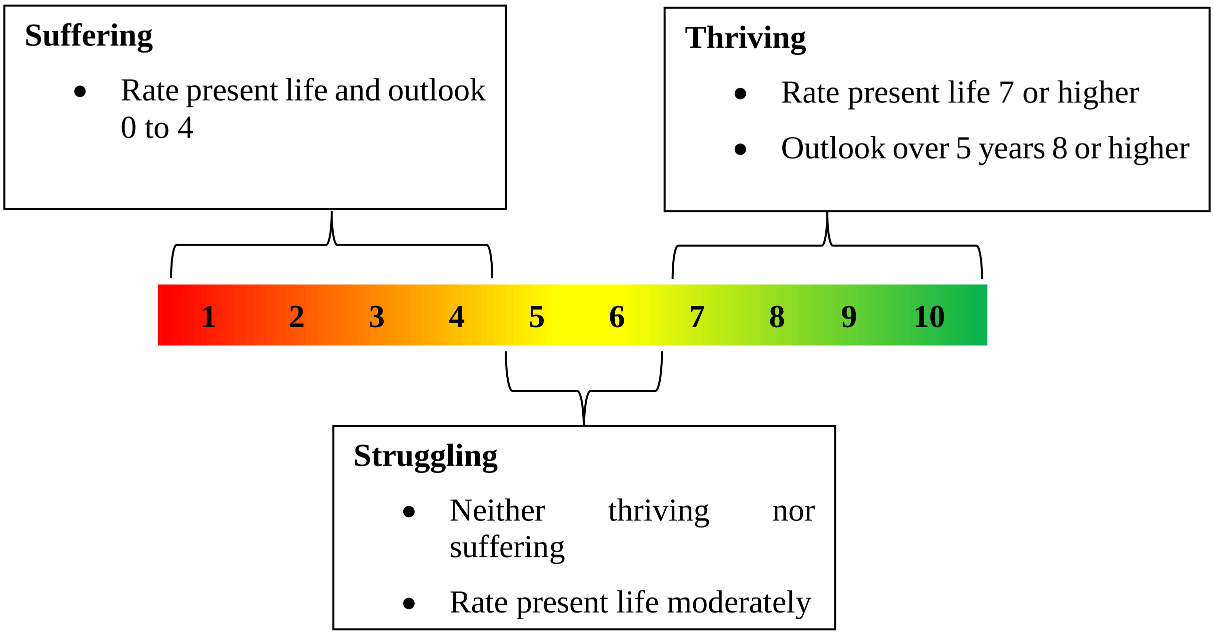

Figure 5: Classification of SWB values

Source: Own representation, based on (Gallup, 2009).

In addition to the quantitative data derived from the standardized procedure, qualitative questions are posed during the interviews to understand how the reported values are composed. Furthermore, attempts are made to determine whether the well-being value has changed over time. This is also assessed through the subjective experience of the participants.

4 RESULTS

The following subchapters present the results of the interviews and analyses conducted during the study. As no prior studies existed for the ecovillage Tempelhof, explicit data was avoided in this regard. However, the responses given during the interviews were applied to represent trends.

4.1 Housing & electricity

Figure 6 illustrates the annual per capita energy consumption of the two ecovillages Siebenlinden and Niederkaufungen, as well as an average German, in kWh. The required energy is divided into heat, electricity, and energy for cooking. Detailed breakdowns and precise calculations can be found in the appendix (see Appendix I).

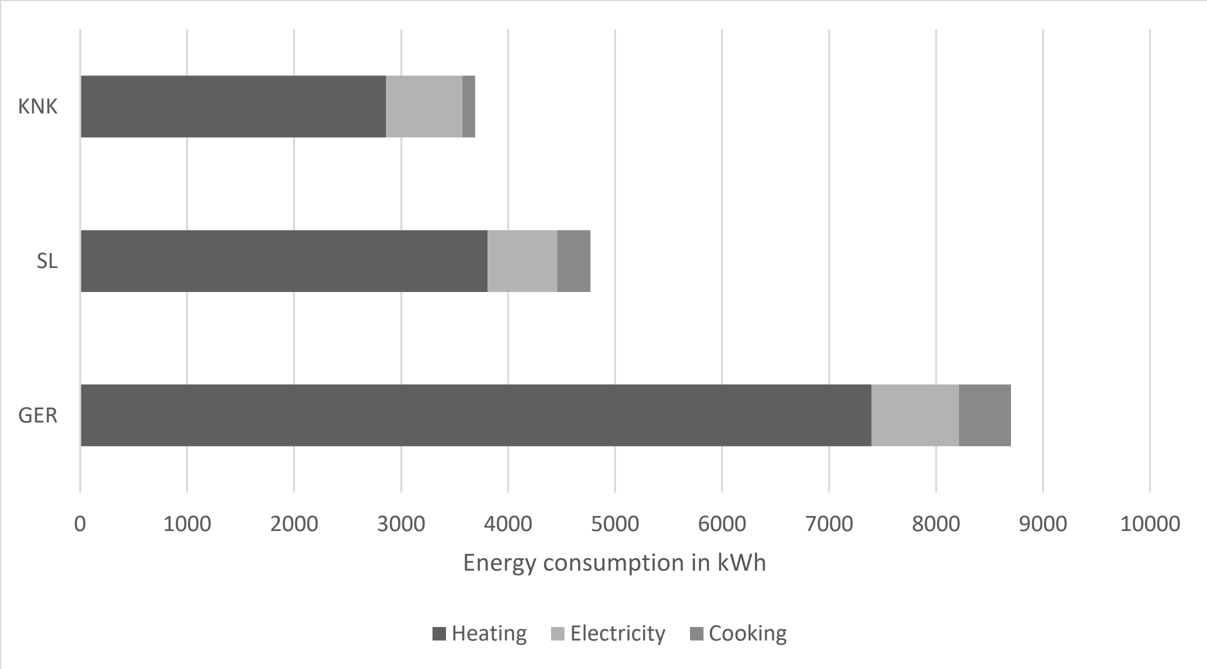

Figure 6: Energy consumption per person by comparison

Source: own representation, based on table I.5.

It is noticeable that the per capita energy consumption in the ecovillages Siebenlinden and Niederkaufungen is significantly lower than the national average. While the consumption in Siebenlinden is approximately 45% lower, it is around 57% lower in Niederkaufungen. The heating energy, which accounts for the majority of household energy consumption, has the greatest impact. This includes the heating of air in homes, as well as the heating of water. The electricity consumption and the energy required for cooking are also lower in the villages, but these do not significantly affect the total energy consumption.

In Niederkaufungen, heat is obtained through a natural gas-fired combined heat and power plant (CHP), as well as a wood-fired heating system. The proportions of these two heat sources have fluctuated over the last 10 years, but on average, the shares of both heat sources are roughly equal (see table I.2). A large proportion of the applied electricity (60%) is generated by the CHP, while the remainder is purchased as renewable energy. In addition, almost 20% of the CHP's produced electricity is fed into the public grid annually, along with nearly 49,000 kWh from its own photovoltaic systems. Cooking is done using gas.

In Siebenlinden, 80% of the heating is done using firewood, and nearly 20% is obtained from solar collectors. The entire amount of firewood comes from its own sustainably managed forest.

The required electricity comes in parts from its own PV system, as well as from the purchase of green electricity. Cooking is also done using gas.

Figure 7 shows the resulting carbon dioxide consumption of the ecovillages, as well as the consumption of an average German in terms of housing.

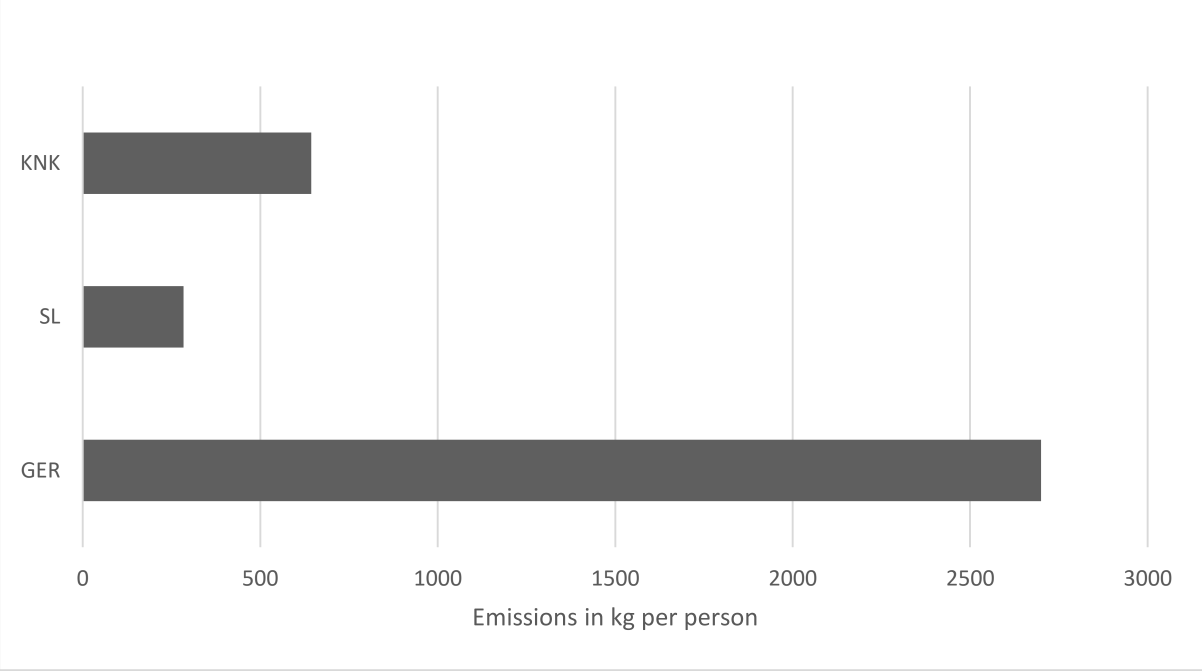

Figure 7: CO_2 emissions per person in energy by comparison

Source: Own representation, based on table I.5.

The per capita CO_2 emissions of the two ecovillages are much lower than the emissions of an average German. In Siebenlinden, the emissions amount to just under 10% of the average German's emissions, while in Niederkaufungen it is 24%.

It can be concluded that both the energy consumption of the ecovillages is lower and the resulting CO_2 emissions are lower. The percentage reduction in emissions is higher in both ecovillages than the percentage reduction in energy consumption.

The lower energy consumption is due to various factors. In all ecovillages, the average living space per person is about 35 m², while in Germany it was about 47,7 m² in 2021 (Destatis, 2022b). The living space is therefore more than a quarter smaller. In addition, the number of people per household in the ecovillages is higher than the national average (see table 6). Besides, nearly all accommodations are insulated and care is taken to behave in a generally energy-saving manner. Since cooking is mostly done collectively, consumption per capita is also lower. The sum of the measures thus results in significantly lower energy consumption.

The low CO_2 emissions result partly from the lower energy consumption and partly from the relatively low-emission energy sources. The natural gas used in Niederkaufungen is less emitting compared to other fossil fuels (see table I.1) and heating with wood from regional and sustainable forestry is very low in CO_2 emissions (0.05 kg CO_2/kg wood). Since Siebenlinden almost exclusively heats with wood and the rest is heated with solar energy, there are almost no emissions. Thus, the emissions in Siebenlinden are even lower than in Niederkaufungen. The supply of electricity in both ecovillages is almost exclusively from renewable energy sources, which emits no direct emissions and a small amount of indirect emissions with around 0.014 kg CO_2/kWh (UBA AT, 2022).

The ecovillage Tempelhof uses a district heating network which is mainly operated with pellets and partially with oil. The renewable electricity is produced almost a third by its own photovoltaic system and 2/3 are bought from the power exchange. Since the above reasons for energy savings are mentioned in Tempelhof, too and the heat energy is generated mainly from pellets, which emit about 0.13 kg CO_2/kg pellets (see table I.1), significant savings can also be assumed compared to the average German.

4.2 Transportation

The following is a depiction of the private mobility of the ecovillages Siebenlinden and Niederkaufungen. The data on person-kilometers for Siebenlinden were taken from Bocco et al. (2019). According to interviewee 1.1 (p.8), the mobility behavior has not fundamentally changed since then. For Niederkaufungen, data on the average driving distances of all cars for the year 2020 are available. The remaining data were taken from the Simon et al. study conducted in 2004. The mobility behavior has not really changed, for example, only one person flies to Brazil to visit family every few years (Interviewee 3.1, p. 71). The comparison values for the average German were obtained from BMVI (2020) and are for the year 2018.

Figure 8 shows the annual mobility behavior per person in person-kilometers by mode of transport, including all mobility without business purposes, but including the commute to work. The exclusion of business purposes is done as it is also excluded in the CO_2 calculator (UBA, 2022b, p. 18).

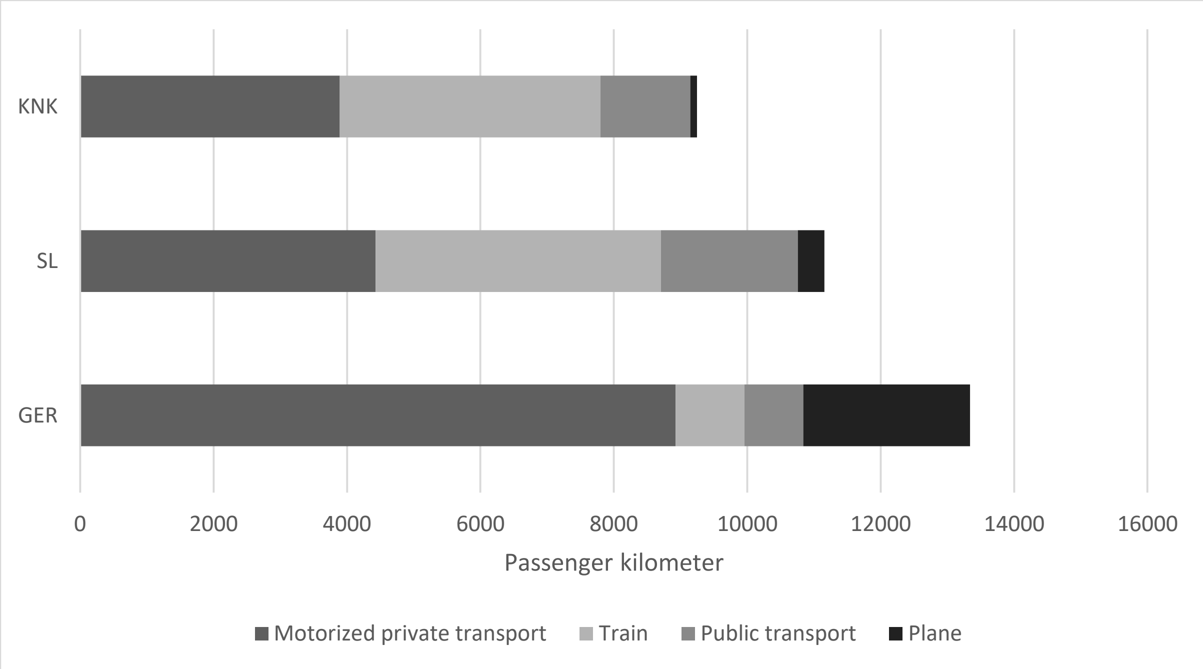

Figure 8: Yearly passenger kilometer by type of transportation in comparison

Source: Own representation, based on table II.2.

The aggregated mobility behavior of the two ecovillages is quite similar. Furthermore, the percentage shares of the various modes of transport in the total mobility of each ecovillage is relatively similar. The number of person kilometers in Niederkaufungen is almost 2,000 km less, which represents a reduction of about 20%. Both ecovillages have fewer person kilometers than the average German. In Siebenlinden, the person kilometers are just under 81%, and in Niederkaufungen, they are just under 68% of the reference value. There are significant differences in the type of transport. In the two ecovillages, the person kilometers for motorized individual transport are only about half as large as in Germany. In contrast, the person kilometers traveled by train are more than four times the average German. While motorized individual transport accounts for almost 78% of total mobility in Germany and is by far the most popular mode of transport, it is only about 40% in the two ecovillages. The train is the most common mode of transport in both villages in terms of person kilometers. For air travel, the traveled kilometers are lower. One reason for the lower mobility behavior in the ecovillages is the elimination of commuting, as the majority of residents work in the village. However, the mobility behavior for leisure activities in Niederkaufungen is higher than the German average (Fuhr & Klimer-Kirsch, 2003, p. 39). According to interviewee 2.1 (p.43), there is also a lot of work done within the village in Tempelhof, so the commuting is eliminated and only a handful of people have to commute. Nevertheless, probably every second person in the village still owns their own car. Additionally, some people in the ecovillages fly for vacations, although generally less vacation is taken than the average German. Estimating the person kilometers for Tempelhof is therefore difficult.

An exact statement regarding the material and energy throughputs of the ecovillages with respect to transportation is difficult to make. The total number of passenger kilometers is generally lower and the choice of transport mode is more resource and energy efficient. Additionally, in Niederkaufungen, there are on average more people in each car, resulting in even lower actual energy consumption than in Germany as a whole. Overall, it can be assumed that the material and energy throughputs in ecovillages are lower.

Figure 9 shows the resulting CO_2 emissions. Public transport here includes any public transportation. More detailed breakdowns and calculations can be found in Appendix II.

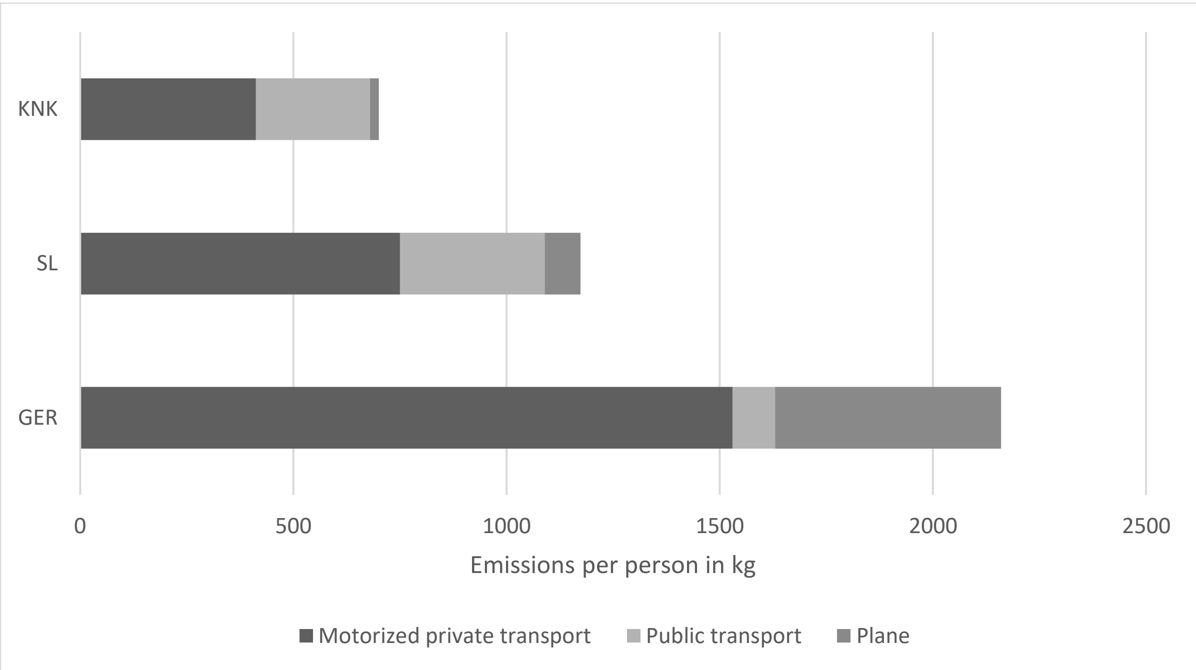

Figure 9: CO_2 emissions per person in transportation by comparison

Source: Own representation, based on table II.3.

The CO_2 emissions in the two ecovillages are significantly lower than the German average. In Siebenlinden, they are almost half as low, and in Niederkaufungen, they are only just under a third. While the differences in passenger kilometers were still comparatively low, the differences in emissions are larger. This is mainly due to the ecovillages' use of lower-emission modes of transport. Trains and buses have significantly lower emissions than, for example, cars or airplanes. In Niederkaufungen, the number of people per car trip is also higher than the

German average, which is 1.41, at 1.89, so the average driving distance of cars and thus emissions decrease. The number of people in the car does not have a decreasing influence on passenger kilometers per person but on the resulting emissions. For Tempelhof, GHG emissions from motorized individual transport are likely to be lower than the German average due to the elimination of the commute and the high focus on village life. However, the residents' flying behavior seems to be more pronounced than in the other two ecovillages, so the total emissions could be between the German average and the ecovillages.

4.3 Food

In the following, the quantities of food consumed in the ecovillages as well as the average German consumption will be listed. The quantities for the ecovillage Niederkaufungen are taken from Matovelle (2003), for Siebenlinden from Bocco et al. (2019), and for the average German from the (BMEL, 2022). Figure 10 shows the annual average consumption per person in kilograms, sorted by category.

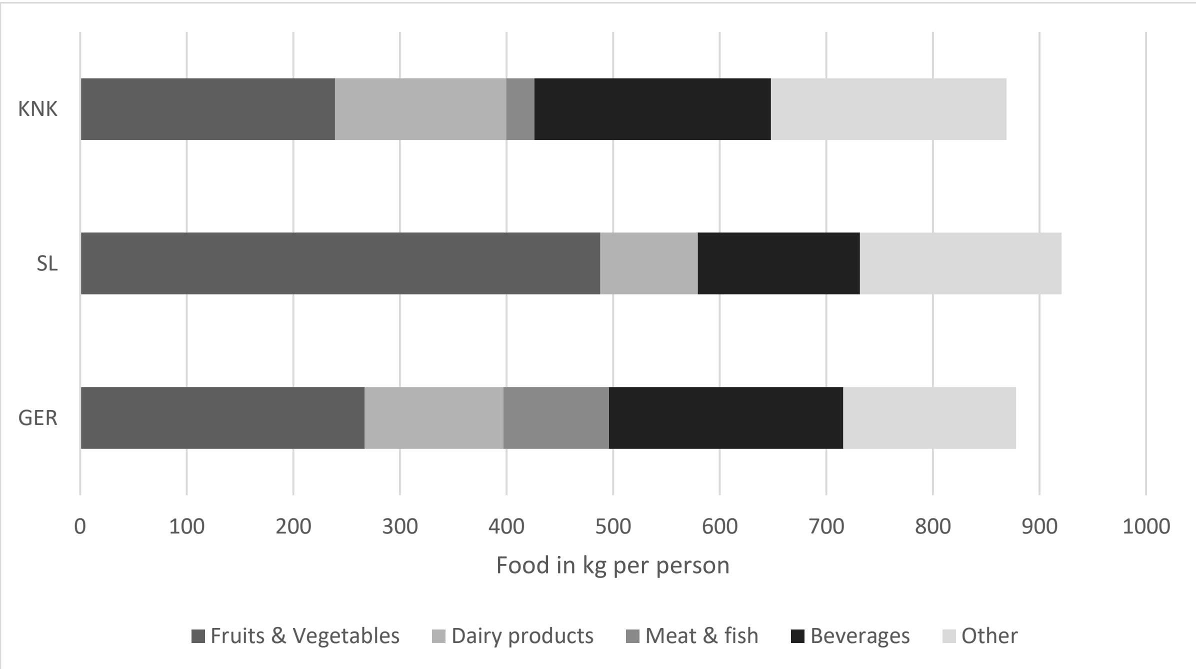

Figure 10 Yearly food consumption by food category in comparison

Source: Own representation, based table III.1.

The total amount of food consumed is hardly different between them, as all are in the range of around 900 kg per person per year, but the composition is different. For example, the consumption of fruits and vegetables in Siebenlinden is almost twice as high as in Niederkaufungen and Germany. In Niederkaufungen, dairy product consumption is almost twice as high as in Siebenlinden, at 161 kg per person, and almost a quarter higher than in Germany. In terms of meat and fish consumption, Niederkaufungen consumes almost 25% of the average, while virtually no meat and fish are consumed in Siebenlinden. The remaining categories are roughly the same. According to Interviewee 2.1 (p.44), since the communal canteen in Tempelhof cooks almost exclusively vegan and vegetarian food and is used by the majority of residents, the meat consumption is likely to be negligible. The other food categories are difficult to assess for Tempelhof.

The quantity of food in kilograms provides little information about material and energy throughput. However, ecovillages consume significantly fewer resource-intensive foods such as meat, with a large portion of their food being ecologically self-grown, and the purchase of food is predominantly regional and seasonal. Therefore, it can be assumed that there is a lower resource and material throughput. The lower CO2 emissions also indirectly suggest this. Figure 11 shows the annual per capita CO_2 consumption for the topic of nutrition, divided into the categories Meat & Fish, Dairy products and other. Other contains in this context vegetables & fruits, beverages and other from figure 10. As there are no exact figures for this classification from the CO2 calculator, a detailed presentation of the carbon footprint is not provided (UBA, 2022b).

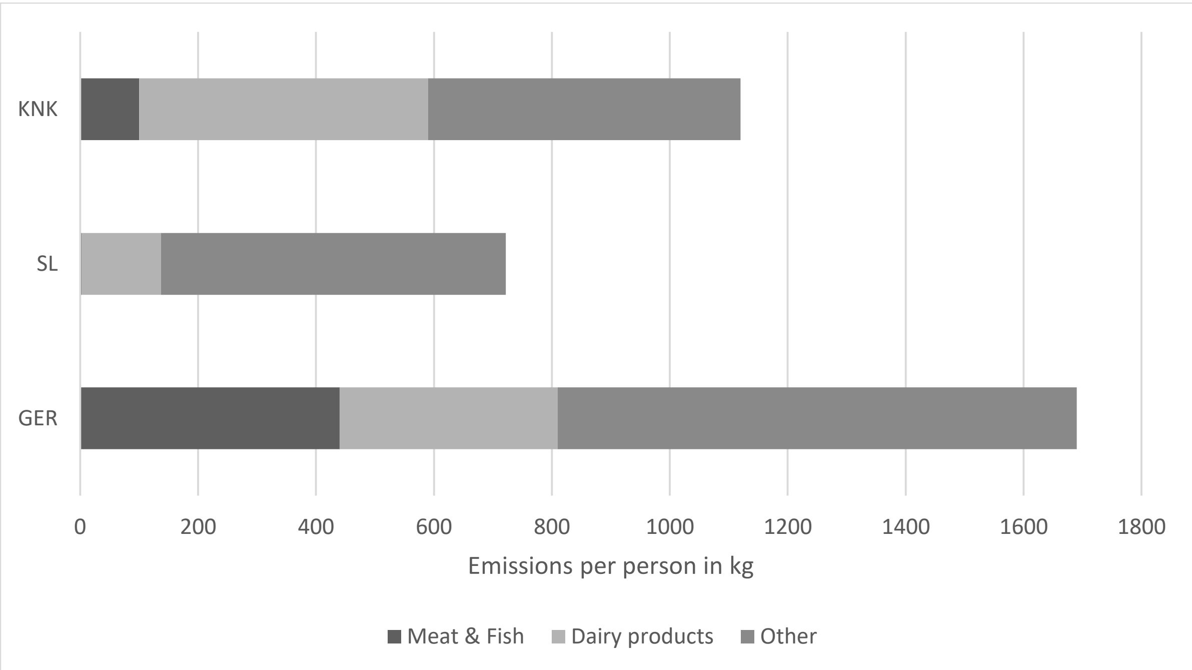

Figure 11: CO_2 emissions per person in food consumption by comparison

Source: Own representation, based on table III.2.

The examined ecovillages consume less CO_2 in the category of nutrition than the average German. In Niederkaufungen, it is almost a third less, and in Siebenlinden, less than half of the CO_2 consumption. This is due, on the one hand, to the consumption of meat and fish. Since the consumption of meat products in Siebenlinden is almost at 0 and in Niederkaufungen only a quarter of the German average, there is a significant CO_2 reduction in this category. As less dairy products are consumed in Siebenlinden, there is additionally a reduction in comparison to the German average. Niederkaufungen consumes considerably more dairy products, so the resulting carbon footprint exceeds that of Siebenlinden and even exceeds that of Germany. The remaining combined foods have lower emissions in both ecovillages than the German average because a variety of them are organically self-grown. The purchased foods are mostly organic and regional products, reducing the carbon footprint. Since the consumption of meat in Tempelhof is also very low, and there is a focus on regional, organic products, the carbon footprint is likely to be lower than the German average. A comparison with the other two ecovillages is difficult.

4.4 Miscellaneous consumption

The last category refers to the remaining consumption of a person, which, according to the CO_2 calculator, accounts for the largest share of annual CO_2 emissions for each citizen and includes all emissions that are not considered in other sectors (UBA, 2022b).

Table 6: Examples for miscellaneous consumption per person

	Niederkaufungen	**Siebenlinden**	**Tempelhof**	**Germany**
Living space in m²	36	35	35	47,7
Persons per household	6, 4	3-4[3]	-	2
Cars	0,1	0,23	-	0,58
Washing machines	0,0375	0,06	-	0,5

Source: Own representation, based on interviews and Destatis.

[3] This number represents all individuals living in communal housing. However, as approximately 40 people reside in trailers and therefore do not constitute a household, the actual number is even higher (Interviewee 1.1, p. 14)

This includes, among other things, clothing and shoes, household appliances, interior furnishings, and leisure activities (UBA, 2022b, p. 32). Since there is no detailed survey available from the ecovillages regarding this category, a graphical representation with values is omitted and only a table with some queried values is presented. Table 6 shows some numbers representing the miscellaneous consumption.

As previously noted in the housing and energy chapter, the living space of the ecovillage residents is smaller than the average German. This both affects energy consumption and how many things can fit in the apartment. The smaller the space, the fewer options there are for placing objects in the apartment. In addition, the number of people per household in ecovillages is significantly higher than the German average. According to Destatis (2022a), in 2021 there were 125 refrigerators, 75 dishwashers, and 99 washing machines per 100 households in Germany. In ecovillages, the number of households is lower, therefore the household appliances applied per person are lower, too. In addition, the average number of devices per household is lower. For example, in Niederkaufungen, there are only three washing machines that are used collectively. In Siebenlinden, there are a total of 9 washing machines for 150 people. The number of other items per person in Siebenlinden is considerably lower than the average German. If we look at the number of cars in ecovillages, it is also lower. In Niederkaufungen, the motorization rate is 0.1 and in Siebenlinden, it is 0.23. There is no precise data available for Tempelhof, but since there is a high focus on community use here, the findings from the other two ecovillages are likely to be transferable to Tempelhof. For example, in a current house construction, there are 15 people who will live in a household (Interviewee 2.1, p. 41). Additionally, there are numerous residents who live in yurts or construction wagons and use sanitary facilities collectively. In all ecovillages, a very high value is placed on exchanging with each other. For example, in Niederkaufungen, there is a clothes pantry where any clothes can be utilized collectively, and everyone can help themselves (Interviewee 3.1, p.70). In Siebenlinden and Tempelhof, there is a gift corner where everyone can help themselves. Before things are purchased, communication is made among the residents to see if someone already has the product and doesn't need it at the moment. In addition, a high value is placed on repairing objects in ecovillages. Tempelhof, for example, has a car workshop where minor repairs can be carried out on cars or a 3D printer can be employed to create spare parts, and there is expertise to repair electrical appliances (Interviewee 2.1, p. 39). In the other two ecovillages, too, the first option is to try to repair items before they are purchased.

It is difficult to estimate the exact material and energy consumption and the corresponding CO_2 emissions in each ecovillage, but due to the above reasons, it is likely to be much lower than the national average. A CO_2 footprint for durable and non-durable products was calculated for the Siebenlinden Ecovillage, which is 92.8 kg CO_2 per person (Bocco et al., 2019, p. 37). This is only a fraction of the German average, as it does not include all parts of the category miscellaneous consumption.

4.5 Overall assessment of throughput and emissions

The fundamental rationale behind degrowth is the reduction of material and energy throughput with the associated goal of reducing environmental degradation to a sustainable level. Table 7 provides a summary of the results of the various categories based on the hypotheses formulated in chapter 1.2. Only the results from the housing & electricity category support the two hypotheses. For the other categories, the data suggest a highly probable reduction in material and energy throughput, but the existing numbers are not sufficient to support this claim. Therefore, it is also not possible to confirm hypothesis H2 for these categories, although the significantly lower CO_2 emissions are an indication of H2.

Table 7: Overall assessment of formulated hypothesis

	H1	**H2**
Housing & electricity	☑	☑
Transportation	(☑)	-
Food	(☑)	-
Miscellaneous consumption	(☑)	-

Source: Own representation.

The emissions identified in the previous chapters for each category are summarized in Figure 12. The infrastructure category includes emissions that cannot be influenced by the ecovillages and thus is the same for all ecovillages. Since there were insufficient data available for the miscellaneous consumption category, it is not included in the figure.

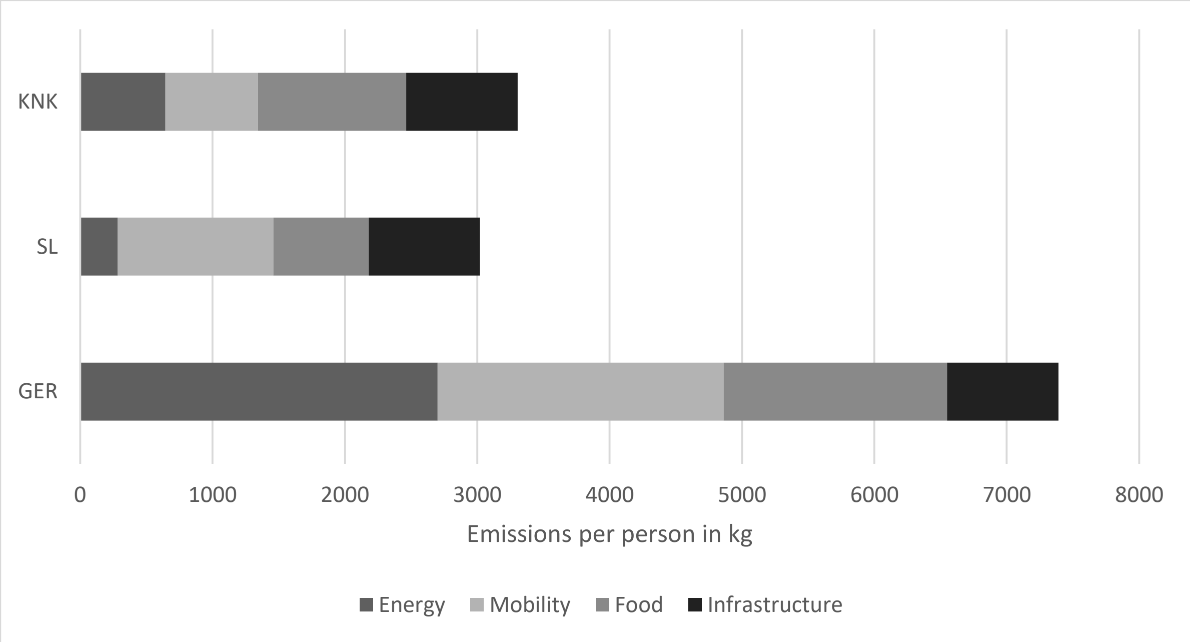

Figure 12: Aggregate carbon footprint by comparison

Source: own representation.

The carbon footprints of the two ecovillages, Siebenlinden and Niederkaufungen, are roughly equal and amount to less than half of the average German's. The biggest reduction can be observed in the housing & energy sector. While this sector accounts for the largest share on average in Germany, when excluding miscellaneous consumption, it is the smallest part in the two ecovillages. For mobility and food, the percentage and absolute difference to the German average is not quite as high, nevertheless these sectors lead to an overall lower carbon footprint. For Tempelhof, the carbon footprint would likely also be lower than the German average, but it may be higher than the other two ecovillages. If the miscellaneous consumption sector were to be integrated, the overall consumption of the ecovillages would likely be even lower, as emissions in this sector are probably lower than the average.

Overall, it can be concluded that the ecovillages have a lower environmental impact, expressed in CO_2 emissions, than the German average. This can be explained, among other things, by an overall lower consumption in material and energy throughput. In sum, the degrowth-goal of reducing the environmental impact is achieved. However, it is not clear to what extent this decline is due to reduced throughput.

4.6 Inequality

The degrowth concept aims to reduce financial inequalities using various instruments at the macroeconomic level. Ecovillages serve more as an example at the microeconomic level. From the interviews, it becomes clear that the three ecovillages differ in terms of their wealth structure and income, and handle redistributions differently. Looking at the material possessions of each individual in the village, the differences between individuals are very small. Land and housing belong to the respective community, and the maximum living space per person is limited. Some residents live alone in caravans and share sanitary facilities, while others live in shared apartments and share sanitary facilities and a kitchen. Thus, regarding the living spaces, there are hardly any differences in terms of equipment and living space within an ecovillage. Due to the limited living space, there is also limited storage space for belongings, so there may be few differences in this regard. In Tempelhof and Siebenlinden, some residents have their own car or motorhome, and there are additionally individual differences in electronics and clothing. In Niederkaufungen, almost all existing goods are used communally and belong to all members of the commune, which further minimizes individual differences.

Regarding financial wealth in Tempelhof expressed in monetary terms there are similar differences as in Germany according to Interviewee 2.1 (p. 46). So there are some who have very little wealth, as well as others who are millionaires. In Siebenlinden, the individual wealth of the residents is not known, but there are also financial differences among them. In Niederkaufungen, this is handled differently, as all wealth is deposited into the commune upon entry. Thus, each member of the commune has the same wealth and only differs in terms of private purchases. The money for purchases comes from the communal fund, which everyone can theoretically access without restrictions. It is up to each individual how much and how often they withdraw money, which could create differences. This principle has been applied since the beginning and has always worked without anyone exploiting it (Interviewee 3.1, p.74).

In addition there are income differences between the ecovillages. In Siebenlinden, there is a part that works outside the village and a larger part that works within the village. Those who work within the village earn a wage that is at most 1.5 times the minimum wage, depending on qualifications, responsibility, and the severity of the task (Interviewee 1.1, p. 11). Only a small part of the people work outside the village and earn more. A part-time senior doctor is highlighted as a high earner. However, the majority may earn below the national average. In Tempelhof, the range seems to be even greater, as there are people who are welfare recipients and others who earn around €15,000 per month from rent (Interviewee 2.1, p. 46). In Niederkaufungen, most people work within the commune. As all income, including that of people who work outside the commune, flows directly into the commune, there is ultimately no inequality.

When considering ideas and implementations regarding redistributions, the communities differ from each other as well. Niederkaufungen is by far the most distinct example, as it virtually communalizes income and wealth, resulting in maximum financial equality among its inhabitants. In the early days, Tempelhof experimented with a needs-based income structure, where income was not dependent on activity and qualifications, but on needs such as whether one lives as a single person or needs to support a family (Interviewee 2.1, p. 45). However, this was later abolished. Each resident pays the same absolute monthly community fee in the respective ecovillages of Tempelhof and Siebenlinden, with the fees varying in proportion to the financial situation of each individual. According to the Interviewee 2.1 (p. 46), this leads to inequality, as the absolute price of a packet of butter weighs more heavily on a retiree than on a millionaire. Equal prices can only exist if there are equal incomes and since the internal wage is lower than the wage level outside the community, this is not the case.

In Siebenlinden, there is a so-called solidarity fund, which allows individuals who cannot afford the one-time cooperative fee of €25,000, which must be paid upon joining the community, to access it (Interviewee 1.1, p. 11). The fund is voluntarily filled by the residents and is independent of the individual's financial situation. In Tempelhof, there is a so-called solidarity pot, which is filled with €20 by each resident every month (Interviewee 2.1, p. 46). Residents can freely opt-out if they feel there is a need for it. In addition, there is a transparent bidding round to finance the solidarity-based agriculture. The goal is for those who have more to contribute higher absolute amounts, while those who have less should pay lower amounts.

While, for example, in Siebenlinden, 80% of residents estimated themselves as having below-average income compared to their fellow inhabitants during an internal self-assessment (Interviewee 1.3, p. 28), the contribution made by residents of Tempelhof, as determined by Interviewee 2.1 (p. 46) in the bidding round for investment, does not reflect the financial capabilities of individuals. This indicates significant differences between the communities. While Niederkaufungen experiences nearly maximal redistribution, the redistributive measures in the other two ecovillages are relatively limited. The small internal wage disparities automatically lead to lower income inequality, but since internal wages are significantly lower than external wages, this creates inequality between those who work within the village and those who work outside of it. This is not offset by the existing redistribution measures. The goal of degrowth to reduce inequality is strongly evident in Niederkaufungen and emerging in the other two ecovillages.

4.7 Subjective well-being

Table 8 depicts the outcomes of the responses gathered from the well-being questions included in the questionnaire.

Table 8: Subjective well-being of ecovillages and reference values

	SL	TH	KNK	Mean	GER	ICs
SWB	8,83	7,33	8,75	8,25	7	7,7
SWB 5 y.	9,17	8	-	8,59	-	-
Increase	3/3	2/3	2/2	7/8	-	-

Source: Own representation, based on information described below.

Table 8 presents, among other things, the well-being values obtained through interviews conducted in the three ecovillages, their mean, as well as comparative values from Germany (GER) (Helliwell et al., 2022) and a study that examined the well-being values of participating intentional communities (IC) in the USA (Grinde et al., 2018). The rows display both the current subjective well-being (SWB) and the SWB expected in 5 years. Additionally, the table includes a question that asks whether respondents have noticed an increase in their life satisfaction since moving to the ecovillage, which is represented in the "Increase" row of the table.

It is notable that each ecovillage exhibits a higher SWB value than the average German. However, there are differences among the examined ecovillages, which, due to the small sample size, are not statistically significant. For example, Siebenlinden and Niederkaufungen have a value close to 9, while Tempelhof has a value of 7.33. Nevertheless, after categorization based on figure 5, all ecovillages are in the highest "Thriving" category. Additionally, the three communities together have a higher SWB value than the examined ICs in the USA. The value of the ICs is 10% higher than the average value in Germany and the USA (Helliwell et al., 2022). When asked about their anticipated SWB in 5 years, nearly every respondent expected their SWB to either remain at a high level or even increase further. In this regard, the communities fall under the "Thriving" category, which begins at a value of 8. When asked whether their SWB has increased since living in the ecovillage, all respondents except for one affirmed this.

Figure 13 depicts the reasons for the individual well-being, asked in the interviews and is expressed in their frequency. The maximum number of mentions for a specific reason was eight, due to the number of eight interviews in sum.

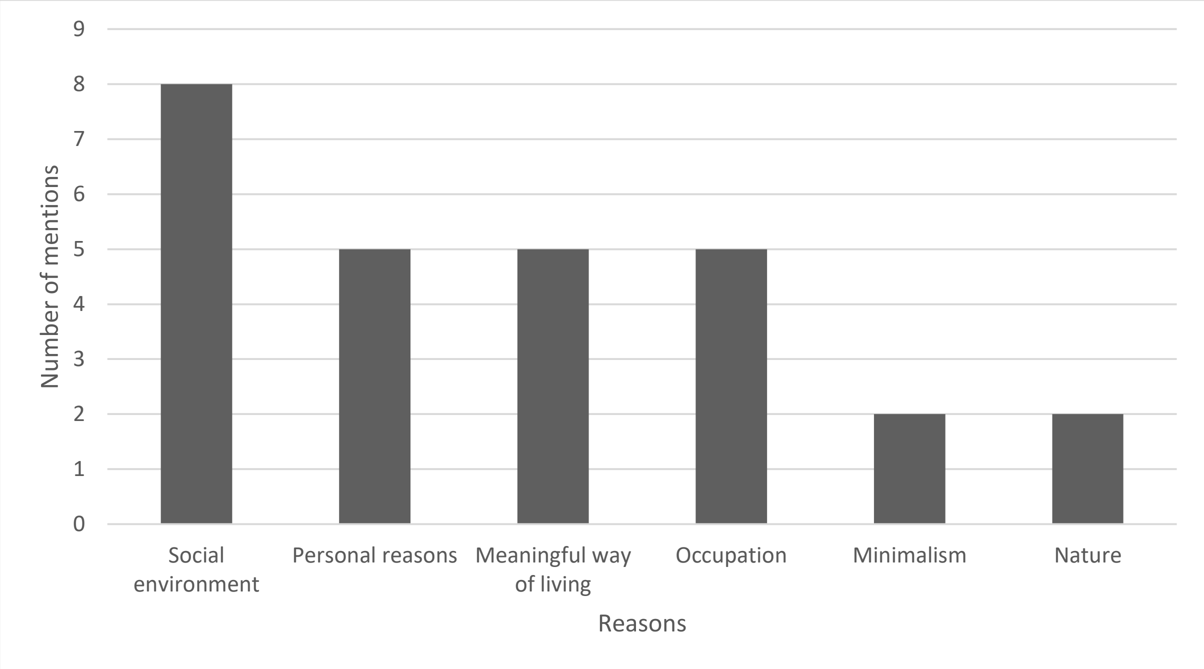

Figure 13: Reasons for individual SWB in the ecovillages

Source: Own representation, based on conducted interviews.

Each of the respondents cited the social environment as a reason for their reported life satisfaction. In particular, they mentioned that the close social interaction fosters a strong sense of belonging. They noted that the frequent conversations and interactions are inspiring and conducive to personal growth. Additionally, there is a high degree of mutual support, which makes residents feel never left alone.

Three other reasons were mentioned five times each. One of these is personal reasons, particularly referring to the individual's family situation. Examples include living with one's own children and grandchildren in the village, expecting a child, or living with a partner and children. Additionally, the concept of "meaningful way of living" was mentioned five times, which refers to the individual's own sense of purpose in life and the positive impact they have on the world. By living a more environmentally friendly lifestyle, not only can individuals reduce their negative impact on the environment, but they can also inspire others to do the same.

Lastly, "occupation" was mentioned five times, referring to the daily individual's tasks for profession or voluntary work. It is noteworthy that there were frequent mentions that a variety of tasks can be undertaken in the ecovillage, making the workday very diverse. Individuals can have more opportunities to self-actualize in their work and implement their own projects and ideas.

Two other reasons were mentioned twice. These are the minimalist lifestyle and direct closeness to nature. The latter was mentioned by two residents of Siebenlinden. Overall, the responses are very similar between the ecovillages, so the answers are presented in a joint graph. Except for the closeness to nature, there are no answers that exclusively relate to a certain village, or are not mentioned at all in one village.

4.8 Challenges

The ecovillages face a common challenge, despite their differences. In every interview, the issue of social interaction is mentioned as a problem. This problem is referred to as "social overload." Social overload takes various forms. On the one hand, social overwhelm is mentioned in every ecovillage. Because one knows everyone in the village, there is constant social exchange, whether one wants it or not. The numerous community spaces, shared projects, and friendships among residents lead to almost constant social interaction. This seems to be a burden for many residents. As a result, for example, many residents in Siebenlinden live alone in trailers (Interviewee 1.1, p.14), or a resident from Tempelhof walks around with a "silence button" when she doesn't want to be approached (Interviewee 2.3, p.58). The frequent confrontation with conflicts and participating in various decisions also leads some residents to feel overwhelmed. Another problem is the difference of opinions among people, which was mainly caused by the Covid-19 pandemic. Although there were already different opinions before the pandemic, the high focus on conflict-solving communication culture either eliminated them or at least defused them enough to make communal living possible. However, the Covid-19 pandemic has led to massive differences within the communities. The divergence of opinions and division into different camps (such as supporters and opponents of vaccination) played out similarly in the communities as in the rest of Germany. Due to the proximity of the village residents to each other, the conflicts could discharge more often, and spatial separation of the different factions was difficult. This has led some residents to leave the ecovillages of Siebenlinden and Tempelhof. Interviewee 1.2 (p.19 f.) and 1.3 (p.28) report that the social conflicts caused by Covid-19 are still simmering and need to be worked through and that this will take some time.

Another challenge that has been addressed in Siebenlinden and Niederkaufungen is the generational transition. As the number of residents has stagnated in recent years, but the average age has increased, it is essential for the survival of these communities that sufficient younger individuals join. This presents the challenge of finding young and suitable individuals for the community. The interviewees from Niederkaufungen are confident that this is achievable, while those from Siebenlinden are less optimistic due to persistently stagnant numbers despite efforts to attract new residents. Additionally, there is a challenge in reconciling the ideas and expectations of new members with those of the aging founding generation. This can potentially lead to conflicts, especially when it comes to the question of when the older generation should pass the torch to the younger one (Interviewee 3.2, p.79).

Another challenge, which became particularly clear from Interviewee 1.3, is the issue of finances. As previously mentioned, the income of those employed in Siebenlinden is quite low compared to the average German income. A large portion of Siebenlinden residents also work within the community. The majority of food and almost all other purchases must be made outside of the village. The community's commitment to particularly regional and ecological products, which are more expensive than conventional comparison products, coupled with inflation, has led to financial challenges. Additionally, rising construction costs have led to an increase in rent in the village, while simultaneously the internal wage in the village remains consistently low. Interviewee 1.3 (p.28) expressed concerns about her own solvency, particularly regarding possible poverty in retirement. Financial difficulties do not play a role in Niederkaufungen, according to the interviews, as the municipality has been operating in the black for many years and can finance itself. Tempelhof is also "in good shape," according to Interviewee 2.3's interview (p.61), but has to make significant investments due to further construction projects and a shift in energy supply. In particular, Interviewee 2.1 (p.47) expressed concerns about the rising prices and the lack of financial redistribution within the community. In the long run, those who earn little can only afford the rising prices if they are supported by those who own much. He sees financial inequality and the clearly inadequate efforts to redistribute wealth within the community as a problem.

5 DISCUSSION

5.1 Assessment of the environmental impact of ecovillages

As the calculated CO_2 emissions in the present chapter depend significantly on the assumptions made for each item, it is important to discuss them again. Due to the high degree of self-sufficiency in certain areas, it is also important to discuss the calculation in this regard.

In the chapter on housing and energy, one reason for the lower emissions in the ecovillages is the use of wood as an energy source. Strictly speaking, burning wood produces almost double the emissions of natural gas (Quaschning & Siegel, 2022). Using this calculation method would result in significantly higher emissions for the ecovillages. However, in Siebenlinden, the wood is exclusively harvested from their own sustainably managed forest. The forest grows back faster than it is harvested, so that more CO_2 is sequestered overall (Interviewee 1.1, p.4). Niederkaufungen uses wood from regional, sustainable forestry, and Tempelhof uses wood pellets. The numbers used reflect sustainable forestry and emissions that are close to zero (see table I.1). Johnston and van Cornelis Kooten (2015) view this critically, as it disregards the fact that climate change is an urgent matter, and that regrowing trees only neutralize the CO_2 from harvested and burned trees decades later. They emphasize the importance of reducing current emissions, and that the mere burning of wood generates comparatively high emissions. These are 367.6 g CO_2/kWh compared to 200 g CO_2/kWh for gas (see table I.1). If this value were applied for the ecovillages, the CO_2 balance would be significantly worse. In Siebenlinden, just under 3,200 kWh of heat were generated using firewood. This would equate to approximately 1,174 kg of carbon dioxide emissions, which would still represent a substantial reduction in emissions compared to the national average, albeit a decrease of 50% rather than the previous 90%. In the other two ecovillages, emissions would also increase significantly, as wood is an important source of heat here as well. Nevertheless, due to the lower energy requirements, the differences from the national average would still be high.

Moreover, each of the ecovillages produces its own renewable energy, some of which is fed into the public grid. While this does not capture CO_2, it does lead to a reduction in emissions because less electricity needs to be produced from fossil fuels. The average electricity mix in Germany caused 438 g CO_2/kWh in 2020, primarily due to fossil fuels (UBA, 2022a, p. 12). Therefore, the ecovillages are making a contribution to reducing CO_2 emissions from the average electricity mix. For instance, Niederkaufungen feeds all electricity from its photovoltaic system into the public grid. As this fact is not included in my calculations, it may result in an underestimation of the emissions savings from ecovillages.

Another point of consideration is the assessment of nutrition, particularly regarding self-sufficiency. For emission calculations, only consumed food items are taken into account. However, each of the ecovillages produces a significant portion of their food themselves and sells a large proportion of it. All of these food products are of organic quality. Calculations for emissions use average emission values for various food items, which suggests that regional, organic self-sufficiency could emit less CO_2 than what is reported in the studies. Another point to consider is the sale of these food products. Regional organic products may potentially replace conventional products for some consumers, indirectly leading to CO_2 reduction. The exact effects here are challenging to measure. It must also be noted that organic products are not necessarily more CO_2-efficient than conventional products. When emissions are considered per unit area, organic farming performs better, but there is no clear direction when emissions are considered per product. Mondelaers et al. (2009) meta-study indicates that there is no consensus on which method is more emission-efficient and that there are significant differences depending on the product.

5.2 Positive influence of ecovillages

The comparison of environmental pressure between the ecovillages and the national average was conducted solely on the basis of greenhouse gas emissions. Given that this is naturally highly limiting and that the range of environmental pressures is much more diverse, other pressures are briefly discussed.

One major problem exacerbated by climate change, as well as numerous other factors, is the decline of biodiversity. According to Steffen et al. (2015), planetary boundaries have already been exceeded with respect to biodiversity. The reasons for this are diverse, but the agricultural sector plays a crucial role (Dudley & Alexander, 2017). Factors within agriculture that contribute to the decline in biodiversity include the conversion of wilderness into cropland, the use of monocultures and limited diversity in seed varieties, and the use of pesticides (Geiger et al., 2010). The ecovillages under investigation are all engaged in agriculture and place a high emphasis on sustainable farming practices. For instance, Niederkaufungen is fully Bioland certified, meaning that the farming practices meet at least Bioland's requirements. In addition, regenerative agriculture plays a significant role, as part of the land is managed using agroforestry systems and a high focus is placed on building up soil humus. Besides, a variety of different vegetable varieties are grown, with a focus on old, resilient strains. Both Tempelhof and Siebenlinden place a strong emphasis on organic, regenerative farming practices. Both ecovillages experiment with permaculture in some of the used agricultural land to create self-sustaining, organic systems. Both ecovillages are experimenting with the so-called permaculture in parts of their agricultural land to create self-sustaining, organic cycles.

The effect of organic agriculture on biodiversity compared to conventional agriculture is generally considered positive. The extensive meta-analysis by Bengtsson et al. (2005) indicated that organic farming frequently has a positive impact on species richness and abundance. Specifically, out of the 63 studies analyzed, 53 demonstrated higher levels of species richness in organic agricultural systems. It is important to note, however, that the effects of organic farming on various organism groups and landscapes are diverse and can vary widely. Organic farming usually increases species richness, having on average 30% higher species richness than conventional farming systems. Moreove organic agriculture is expected to have lower nitrate leaching and phosphorus leaching, which both are denoted as negative externalities caused by agriculture (Mondelaers et al., 2009).

Furthermore, agroforestry systems are expected to have positive impacts on biodiversity. Switching to agroforestry can improve floral, faunal, and soil microbial diversity. Agroforestry systems differ from each other, but the older and larger they are, the greater the impact on biodiversity (Udawatta et al., 2021).

It is difficult to quantify the exact increase in biodiversity resulting from the agricultural practices of the ecovillages, but the combined efforts and measures taken by each ecovillage, as well as positive findings from literature, suggest a positive effect on biodiversity. This trend is likely to continue in the future as each village aims to expand and explore agroforestry systems.

In general, the positive external effects that arise from the ecovillages can be highlighted. These effects include the adoption of a more environmentally friendly lifestyle, which is associated with lower greenhouse gas emissions. Additionally, the ecovillages engage in agriculture that promotes biodiversity, while also providing the local community with organic produce and generating green energy. Besides, the ecovillages serve as a model for sustainable living. Each village has its own website that provides ample information about the unique lifestyle. The high level of transparency demonstrates a desire to share knowledge with society. Moreover, the ecovillages offer numerous seminars and workshops on a variety of sustainable topics. These serve not only as a source of revenue but also as a means of showcasing an alternative lifestyle to the wider community. For example, in Tempelhof, there are 10,000 annual guest stays, and seminar participants can be inspired to adopt a more sustainable and environmentally conscious lifestyle. Thus, the ecovillages' efforts can lead to further positive external effects.[4]

5.3 Rural values as reference scenario

The reference value applied in this study is always the German average, as it provides the most reliable data. However, since all ecovillages are located in rural areas, a comparison with the overall German average is only partially meaningful, as more than three quarters of the German population live in cities (Rudnicka, 2022). Therefore, it is reasonable to compare the carbon footprint of ecovillages with average values from rural areas.

Regarding housing and energy consumption, one factor contributing to increased energy use is a larger living space. According to Grade (2022), the average living space in rural areas is almost 10% higher than the national average, but there are significant differences between different regions. The typical community in rural areas with up to 1200 inhabitants has an average per capita living space of 65 m². As ecovillages like Tempelhof and Siebenlinden are located in sparsely populated communities, the living space in ecovillages is likely to be significantly lower than the average living space in the rural surroundings.

Furthermore, there are differences in mobility between urban and rural populations. The motorization rate in rural areas is significantly higher than in urban areas. While only 10% of people in small towns and rural areas do not own a car, it is 22% on average in Germany. Cars are also used much more frequently in rural areas. On a daily basis, 37 km per person are travelled in small towns and rural areas, whereas it is only 29 km on average in Germany (BMVI, 2019, p. 48). Therefore, it is likely that greenhouse gas emissions are higher in rural areas than the national average, which further reduces the carbon footprint of ecovillages compared to rural areas.

The two examples of mobility and housing illustrate that the emissions of rural residents are likely to be higher than the overall average. However, the differences are smaller than one might think. For instance, the differences in CO_2 emissions between villages and cities in Germany

[4] It must also be pointed out that a large number of the participants travel to the respective ecovillage by car, so that this results in increased greenhouse gas emissions. It is assumed, however, that the positive effect will outweigh this

are approximately 11%. While direct emissions differ by 35% due to varying mobility and larger living spaces in rural areas, urban residents have more disposable income and spend it on other activities that emit greenhouse gases, thus offsetting these effects to some extent. Nevertheless, rural emissions are higher than the overall average (Gill & Moeller, 2018).

Finally, it must be clarified whether the environmental impacts of ecovillages are low enough to achieve the climate goals of the Paris Agreement. It has been found that ecovillages have a significantly lower CO_2 footprint than the national average. Nevertheless, the average footprint in Germany is also significantly higher than the global average of about 5 t CO_2 per person per year (Crippa, 2022, p. 10). To limit global warming to a maximum of 1.5 °C, a remaining budget of 580 Gt CO_2 is existing (IPCC, 2021). Hypothetically assuming that the world is carbon neutral from 2050 and the global population reaches 9 billion people by that year, this would mean an annual per capita budget of 2.39 t CO_2. Ecovillages have higher emissions and, therefore, cannot achieve the current climate target. But ultimately, they have significantly more time, using the remaining budget per capita, to reduce their emissions to zero compared to the national average.

5.4 Suggestions on well-being

In addition to reducing environmental impacts, increasing well-being is an important component of the degrowth concept. In the well-being subchapter, it has been shown that the SWB of village residents is higher than the national average. However, caution should be exercised when interpreting this figure for several reasons. The sample size is too small to be representative of the respective villages. As participation in the interviews was voluntary and participants were not randomly selected, there may be a bias in favor of individuals with higher SWB. The high SWB values reflect a high level of current satisfaction, but this may have existed before participants moved to the ecovillage. To draw better conclusions about whether SWB has increased as a result of joining the ecovillage, SWB values prior to living in the ecovillage would be helpful. Nonetheless, almost all interviewees indicate that, according to their subjective perception, their personal happiness has increased as a result of living in the ecovillage. In addition, the interviews reveal that some residents have left the village. Therefore, individuals with higher SWB are more likely to remain in the village; otherwise, they may have left. This can also lead to an overestimation of well-being.

Ecovillages demonstrate that a life with less consumption and material possessions can lead to a high SWB. This is also an assessment used in degrowth literature (Sekulova, 2015). The decision of ecovillage residents to have a less consumption-oriented lifestyle is completely voluntary, and most of the interviewees had already considered moving to an ecovillage or had capitalist-critical and consumption-critical ideals. Degrowth aims to achieve a societal reduction in consumption, which would likely result in involuntary consumption reduction for some of the population. The theory of loss aversion, a concept in behavioral economics, suggests that people are more sensitive to losses than gains of equal value. Therefore, a reduction in consumption opportunities may decrease the SWB of many people (Büchs & Koch, 2019). Thus, observations from the investigated ecovillages cannot be easily extrapolated to the societal concept of degrowth.

5.5 Transforming challenges into dilemmas

The challenges highlighted in subchapter 4.8 differ partially between the ecovillages and partially they are very similar to each other. The chapter aims to identify any dilemmas arising from the challenges identified, which do not have a solution, always representing a trade-off. One problem that was mentioned by every interviewee relates to social interaction within the village. For many, the social overload and the multitude of social contacts are a challenge. At the same time, social interaction is also seen as a key reason for the high level of satisfaction in the village. The many friendships and opportunities to exchange ideas, engage in joint activities, and receive support from those living in the village are some positive aspects. This leads to many deep connections among people. However, since a large number of residents live and work in the village, they are always surrounded by the same people throughout the day. This lack of separation is a problem for some residents. Some residents in Siebenlinden, for example, live alone in trailers to be more isolated, nevertheless the sanitary facilities are still communal, so they are likely to encounter people. Since everyone knows everyone in the village, it is impossible to move around anonymously even if one wants to. For some, this is difficult to deal with, and they have trouble signaling to other residents that they do not want to be approached. For example, the daughter of one interviewee found the social interaction too much, so she had to move out (Interviewee 1.2, p.21). Interviewee 1.3 (p.27) discovered that a certain intimacy is lost with the friendships in the village. Due to seeing each other every day, there is sometimes a superficial and taken-for-granted level, so friendships are not actively maintained. She sees greater intimacy and quality in friendships outside the village. Thus, there is a need to maintain the high level of social interaction, which comes with both positive and negative aspects. Social interaction could be reduced by having people work more outside the village, spending less time in communal spaces, and changing the communal decision-making process. However, this could potentially both reduce the positive social aspects of interaction and also partially lose achievements in minimizing emissions. Additionally, the underlying concept of an ecovillage involves a high degree of social interaction. Thus, one can ultimately speak of a social dilemma in the villages, which manifests itself in different forms.

Another dilemma relates more to financial issues and externally given difficulties. The problem was only mentioned in Siebenlinden, but the core problem is transferable to other ecovillages. While it is said to be impossible to implement degrowth thinking in a capitalist world (Tokic, 2012), it is additionally challenging to build an ecovillage in a capitalist world (Baker, 2013). In the case of Siebenlinden, the problem arises from the low internal wage level and the high costs of a sustainable lifestyle. The high standards for sustainable building materials and food, which should have Demeter quality and be as regional as possible, lead to higher costs than comparable conventional products. Since a large part of the community works within the village, challenges arise in terms of financial feasibility. The community's own aspiration that life and work should take place within the village and that all products should meet high sustainability standards creates a dilemma. The current inflation exacerbates the situation in the village. While the dilemma is not explicitly mentioned in Tempelhof, Interviewee 2.1 (p.45) also sees challenges in affordability for people with low incomes, especially with the sharply increased prices of new apartments. The commune of Niederkaufungen does not have this dilemma since all income is shared among the residents. Thus, those who work outside the village partially finance the other residents. A high percentage of internal workers and high, costly sustainability standards can only function simultaneously if those who work outside the village must pay higher contributions. The higher the number of internal workers, the higher the contributions that external workers would have to pay. However, since this principle of radical redistribution is not sought in Tempelhof and Siebenlinden, the dilemma remains. Hypothetically, if the monthly cost of living were to increase so much that the internal wage is insufficient, maintaining internal work would only be possible through redistributions.

5.6 Feasibility on a large scale

Ecovillages appear to be a niche phenomenon within the nationwide context in Germany. In addition to the 22 projects listed by GEN, there are some other projects, but the number is unlikely to exceed 50 in Germany. Therefore, only a fraction of the population in Germany lives in an ecovillage. This subsection aims to outline whether these projects are scalable and whether scalability is even desirable. Interviews conducted in all ecovillages indicate a desire for an increase in residents, but the number of residents has been stagnant in Siebenlinden and Niederkaufungen for some time, suggesting insufficient demand for suitable candidates. Scalability of ecovillages may only be possible up to a certain number of people due to the high degree of social interaction. Nevertheless, ecovillages are dynamic and subject to constant change, and some level of scalability is always possible provided that the willingness for change is present, and sufficient time is given for integration (Interviewee 2.2, p.56)). Outside of Germany, there are examples of ecovillages that house significantly more people. The ecovillage Findhorn, mentioned in chapter 2.3, houses 700 residents and was established in 1962 (East, 2018). The ecovillage Auroville in India, founded in 1968, accommodates nearly 3,000 residents (Koduvayur Venkitaraman & Joshi, 2022). However, beyond a certain number of people, the question arises as to whether we can still refer to it as a small-scale habitat. Nonetheless, these examples demonstrate that ecovillages can function with far more than 100 people. In Germany, interest in living in an ecovillage appears to be relatively low. Possible reasons include the high degree of social interaction, personal restrictions regarding consumption, and the lack of proximity to cities. Over the last 30 years, the living space per person and the number of single-person households have steadily increased in Germany, while urbanization has been continuously on the rise between 2000 and 2012, with a recent plateau (Destatis, 2020).

Besides, it is important to consider whether it would be sustainable to encourage more people to move into ecovillages. It may be more sensible to integrate sustainable lifestyles from ecovillages into city life. For example, transportation in cities is typically more sustainable than in rural areas. In general, the communal mindset of ecovillages could be incorporated into urban life through more communal living arrangements, leading to less energy and resource consumption. The focus could shift to using used goods instead of buying new ones, which could be realized through neighborhood associations. The trend of claiming larger living spaces would also need to be reversed in the city to lead a more energy- and resource-efficient life. City dwellers could look to ecovillages as a model and integrate the opportunities to save energy and resources into their city life.

Ecovillages do not see themselves as a mass movement, but rather as part of the solution (Interviewee 1.1, p.13). Tempelhof, for example, is referred to as a workshop of the future to experiment with more sustainable lifestyles (Interviewee 2.1, p.36). Similarly, Interviewee 3.1

(p.75) sees Niederkaufungen as an ongoing experiment in exploring alternative ways of living, which may not necessarily be the best path for everyone.

6 CONCLUSION

This master thesis aims to contribute to the research on degrowth, a concept that seeks to address urgent environmental issues through reduced consumption and production. The primary focus of current research is on the top-down approach, which involves the implementation of macroeconomic instruments by the government or other high-level entities. However, this master's thesis examines the bottom-up approach, which involves the implementation of degrowth at the individual level, with a focus on three ecovillages in Germany as case studies. This study investigates the extent to which the degrowth concept is implemented in ecovillages and identifies the major challenges faced by ecovillages in this regard. The research approach employed in this study is both quantitative and qualitative, involving interviews and the use of data from previous studies. The environmental impact of ecovillages is evaluated in terms of CO_2 emissions.

All three ecovillages have a significantly lower CO_2 footprint compared to the national average. This difference is highest in percentage and absolute terms in the areas of energy and housing. While pure energy consumption is just under half of the national average, CO_2 emissions in Siebenlinden are 10% and in Niederkaufungen 24%. In addition the ecovillages have a lower CO_2 footprint in the area of mobility. Residents in Niederkaufungen emit just under a third of the national average, while Siebenlinden emits slightly over half. A similar picture emerges in the area of nutrition, where predominantly vegetarian, regional, and organic diets result in 33% lower emissions in Niederkaufungen and a 60% reduction in Siebenlinden. Due to insufficient data on miscellaneous consumption, no quantitative CO_2 savings can be reported, but insights from interviews suggest significant savings in this area as well. The overall environmental impact in the ecovillages is less than half of the national average. This is likely to also be the case in the ecovillage of Tempelhof, given its similarities to the other two villages. Regarding inequality there are differences between the ecovillages. The communal use of available financial resources in Niederkaufungen results in no financial inequality, whereas inequality exists in Siebenlinden and Tempelhof, and is partially addressed through redistribution mechanisms. Regarding well-being, all ecovillages score above average and show very high values, mainly due to their social interactions. Overall, the first research question can be answered by stating that the ecovillages implement degrowth to a high degree and have a lower environmental footprint due to reduced consumption and sustainable living practices, while also exhibiting a very high level of well-being. However, it is not clear to what extent the reduction in environmental degradation is due to a reduced material and energy throughput. Furthermore there is still room for improvement in terms of inequality, particularly in Tempelhof and Siebenlinden.

Regarding the second research question, three particular challenges have emerged. Social overload has been identified as a core challenge and manifests itself in the forms of overwhelmed contacts and decision-making, as well as disagreements. The upcoming generational change with restructuring and the necessary influx of new young residents is also seen as a major challenge. Additionally, financial challenges are mentioned, which are demonstrated by the lower internal wages coupled with high external cost factors. Especially in the case of social overload and financial challenges, dilemmas arise that are difficult to resolve with the given concepts and priorities, revealing the need for further developments.

6.1 Limitations

The master thesis has some limitations. One of the difficulties was to simplify the concept of degrowth to be able to test it in the ecovillages, which may not fully represent the complexity of the concept. Although the chosen focus areas of environmental impact, inequality, and well-being capture the core elements of degrowth, they do not cover the entire concept. Additionally, there are limitations within the selected focus areas. For instance, the environmental impact is only quantitatively represented in terms of CO_2 emissions, and a more comprehensive approach would require additional indicators. Furthermore, some of the data used in the study is almost 20 years old, which may limit its transferability to the present time. When it comes to inequality, the study relies on subjective perceptions of the interviewees. A more objective assessment would require quantitative data on the income and assets of all residents. The small number of interview participants reduces the generalizability of the results on SWB values to the entire ecovillages. Despite the numerous similarities among ecovillages, there were also significant differences that could complicate any generalizations or simplifications when additional ecovillages are considered. As a result, the inclusion of more ecovillages may lead to even greater diversity of outcomes, making universal generalizations more difficult.

6.2 Implications and further research

The ecovillages demonstrate a more climate-friendly way of life. Therefore, this approach could be of interest to the German government in achieving its self-imposed climate goals, and ecovillage concepts could be implemented in other small villages in Germany. Moreover, incentives could be created to finance such projects and support their implementation. The results of the master's thesis show that a high level of SWB can be achieved without high levels of consumption. The insights into what makes people happy could be integrated into governmental considerations. Besides, the findings could be useful for other existing ecovillages, as well as for individuals who are considering founding an ecovillage.

The master's thesis provides room for further research opportunities. To obtain more meaningful results regarding SWB, more ecovillage residents should be surveyed. It would additionally be helpful to question individuals who have left the ecovillage and what their reasons were. This could provide insights into what needs to be improved in ecovillages to attract more people to such projects. As ecovillages are still niche projects, it would be advisable to survey the willingness of the general population to live in such projects and what prevents them from doing so. Since ecovillages are not the only examples of bottom-up approaches to degrowth, it is also necessary to investigate further similar projects and compare contrast them if comparable, such as comparing the environmental impact of such projects.

The overall impact of ecovillages is limited due to their small number, and they cannot solve urgent climate problems alone. However, they contribute to a more sustainable way of life with their own behavior and can be one small part of many solutions for a transformation towards a more sustainable and future-oriented world. While the concept of living in an ecovillage or degrowth in general may seem too radical for many people, the urgency revealed by IPCC (2014) suggests that quick and drastically rethinking and especially action to ensure a livable earth for future generations is unavoidable.

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APPENDIX I

Table I.1: Energy sources and their properties

Energy source	Caloric value in kWh/kg	Density	Direct CO_2 emissions in gram/kWh	Indirect CO_2 emissions in gram/kWh	Total CO_2 emissions in gram/kWh
Natural gas	13,89	0,73 kg/m³	200	68	268
Liquid gas	12,8	0,54 kg/l	231	81	312
Wood pellets	5	650 kg/m³	6	20	26
Wood	4	-	6	6	12

Source: Own representation, based on values from umweltbundesamt.at.

Table I.2: Energy use and sources in Niederkaufungen (2011-2021)

Natural gas CHP	Natural gas Cooking	Heating CHP	Heating freezing plant	Heating wood
24,890 m³	1,338 m³	141,094 kWh	7,280 kWh	178,626 kWh

Source: Own representation, based on values provided by Niederkaufungen.

Table I.3: Electricity use and sources in Niederkaufungen (2011-2021)

Electricity use purchase	Electricity use CHP	Electricity sell CHP	Electricity sell PV
32,754 kWh	48,517 kWh	14,686 kWh	56,443 kWh

Source: Own representation, based on values provided by Niederkaufungen.

Table I.4: Energy consumption and carbon footprint in Siebenlinden

	Use (kWh/person)	CF ($kgCO_2$/person)
Electricity use purchase	256.03	0.00
Electricity use PV	294.10	0.00
Heating firewood	3,209.51	192.57
Heating Solar panels	600	24.13
Total	4,771.20	283.75

Source: Own representation, based on Bocco et al. (2019, p. 32).

Table I.5: Energy consumption and footprint of ecovillages and Germany per person

	Niederkaufungen	Siebenlinden	Germany
Heating in kWh	2,861.25 (1)	3,809 (5)	7,395 (6)
Electricity in kWh	711 (2)	650.13 (5)	818 (6)
Cooking in kWh	118.71 (3)	311.57 (5)	489 (6)
Total in kWh	3,691	4,770	8,704
CO_2 emissions in gram	624 (4)	283.75 (5)	2,700 (7)

Source: Own representation, calculations and sources below.

Calculations on the values of Table I.5:

(1): $\frac{(141{,}094 + 7{,}280 + 178{,}626)*0.7}{80}$ = 2,861.25 kWh pp

(2): $\frac{(32754+48517)*0.7}{80}$ = 711 kWh pp

(3): $\frac{(1{,}338m^3*13.89kWh/kg*0.73kg/m^3)*0.7}{80}$ =118.71 kWh pp

(4): $\frac{(26{,}228m^3*13.89kWh/kg*0.73kg/m^3*0{,}268gCo2/kWh)*0.7}{80}$ = 624 CO_2 pp

(5): Values are obtained from Table I.4.

(6): Values are from Destatis (2020, p. 9).

(7): Value is obtained from CO_2 Calculator.

Notes on the calculations:

The factor 0.7, used in (1) – (4), reflects the fact that nearly 30% of the energy was employed for public facilities (Dangelmeyer, 2003, p. 9).

As 80 persons are living in Niederkaufungen, the values are divided by 80.

APPENDIX II

Table II.1: Emissions of transport in Germany per passenger kilometer in 2019

Plane	Car	Public Bus	Train	Tram	Train
214 g	164 g	84 g	51 g	49 g	27 g

Source: Own representation, values obtained from UBA (2023), TREMOD 6.42 (12/2022).

Table II.2: Passenger kilometer by transport in the ecovillages and Germany

	Niederkaufungen	Siebenlinden	Germany
Car	3,891 (1)	4,228 (3)	8,950 (4)
Train	3,908 (2)	4,275 (3)	1,031 (4)
Public transport	1,347 (2)	2,054 (3)	881 (4)
Plane	100 (2)	400 (3)	2,500 (5)
Total	9,246	10,957	11,412

Source: Own representation, calculation and sources below.

Calculations on the values of Table II.2:

(1): $\frac{(20{,}000*7+43{,}000)*0.9*1.89}{80}$ = 3,891 km pp

(2): Values obtained from Fuhr and Klimer-Kirsch (2003, p. 19).

(3): Values obtained from Bocco et al. (2019, p. 37).

(4): $\frac{Passenger\ kilometres\ by\ type\ of\ transport - passenger\ kilometres\ for\ work}{Population\ in\ Germany}$

Values obtained from BMVI (2020, pp. 222–224).

(5): Value obtained from CO_2 Calculator.

Notes on the calculations:

For (1), the annual mileage of cars in Niederkaufungen was provided by email. The factor of 0.9 is derived from the fact that 10% of the trips were used for business purposes. The factor of 1.89 is derived from the average number of persons, which is 1.89 per car.

Table II.3: Carbon footprint in kg per person by transport

	Niederkaufungen	Siebenlinden	Germany
Car	472.68 (1)	750.09 (4)	1,530 (7)
Public transport	265.56 (2)	339.27 (5)	100 (7)
Plane	21.4 (3)	84 (6)	530 (7)
Total	759	1,173	2,160

Source: Own representation, calculation and sources below.

Calculations on the values of Table II.3:

(1): $\frac{3{,}891 km * 0.164 kgCO2/km * 1.4}{1.89}$ = 472.68 CO_2

(2): $\frac{3{,}908 km * (0.051+0.027) kgCO2/km}{2}$ + 1347km * 0.084kgCO_2/km = 265.56 CO_2

(3): 100km*0,214kgCO_2/km = 21.4 kg CO_2

(4): Value obtained from Bocco et al. (2019, p. 37).

(5): Procedure as in (2).

(6): Procedure as in (3).

(7): Values obtained from CO_2 Calculator.

Notes on the calculations:

The average greenhouse gas emissions of individual means of transportation were obtained from table I.1.

In (1), a factor of 1.4 is applied as the emissions are per passenger-kilometer and on average, 1.4 passengers travel in a car.

Since precise data on the distribution between local and long-distance rail travel is unavailable for (2), both are considered to contribute equally, i.e., 50%.

APPENDIX III

Table III.1: Food consumption in the ecovillages and Germany per person in kg

	Niederkaufungen (1)	Siebenlinden (2)	Germany (3)
Fruit & vegetables	239.06	488.96	267
Dairy products	160.88	91.66	130.5
Meat & Fish	26.25	0.6	99
Beverages	222.74	152.20	162
Other	221	152	220
Total	870	923	879

Source: Own representation, calculation and sources below

Calculations on the values of Table III.1:

(1): Values obtained from Matovelle (2003, p. 35)

(2): Values obtained from Bocco et al. (2019, p. 38)

(3): Values obtained from BMEL (2022, pp. 150–153), representing food consumption in year 2020

Table III.2: Carbon footprint per person in kg of the food consumption

	Niederkaufungen	Siebenlinden	Germany
Dairy products	495 (1)	135.54 (3)	362.7 (4)
Meat & Fish	89.6 (2)	2 (3)	440 (5)
Other	463.08 (2)	586.05 (3)	887.3 (5)
Total	1,048	724	1,690

Source: Own representation, calculation and sources below

Calculations on the values of Table III.2:

(1): Values of different dairy products from Matovelle (2003, p. 42) combined with CO_2 values per dairy product from Reinhardt et al. (2020, pp. 11–12)

(2): Values obtained from Matovelle (2003, p. 35)

(3): Values obtained from Bocco et al. (2019, p. 38)

(4): Values of different dairy products from BMEL (2022, p. 151) combined with CO_2 values per dairy product from Reinhardt et al. (2020, pp. 11-12)

(5): Values obtained from CO_2 Calculator

APPENDIX IV: PERSONAL DECLARATION

Personal Declaration

I hereby affirm that I have prepared the present master thesis self-dependently, and without the use of any other tools, than the ones indicated. All parts of the text, having been taken over verbatim or analogously from published or not published scripts, are indicated as such. The master thesis hasn’t yet been submitted in the same or similar form, or in extracts within the context of another examination.

Bonn, 29.03.2023

Student’s signature